Extension of Tormin Mine, West Coast, South Africa

Environmental Impact Assessment Report and Environmental Management Programme

Report Prepared for

Mineral Sands Resources (Pty) Ltd

Report Number 507228/3A

DMR Reference Number: WC 30/5/1/2/2/162 & 163 MR

Report Prepared by

srk consulting

September 2018

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SRK Project Number 507228

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EXECUTIVE SUMMARY: ENVIRONMENTAL IMPACT ASSESSMENT REPORT EXTENSION OF TORMIN MINE, WEST COAST, SOUTH AFRICA

DMR Reference Number: WC 30/5/1/2/2/162 & 163 MR

1 INTRODUCTION

Mineral Sand Resources (Pty) Ltd (MSR) owns and operates the Tormin Mineral Sands Mine (Tormin Mine) on the West Coast of South Africa, near Lutzville. The mine holds two Mining Rights (MR162 and MR163), covering an area of 119.9 ha, and an approved Environmental Management Programme (EMPr) to mine Valuable Heavy Minerals (VHM) on beaches below the high-water mark adjacent to Farm Geelwal Karoo 262.

MSR proposes to extend mining operations at Tormin Mine in terms of Section 102 of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA), into the following areas (the "project") (Figure 2, Figure 3 and Figure 4):

- Ten beaches adjacent to Remainder of Graauw Duinen 152, and Portions of Farm Klipvley Karoo Kop 153, along a stretch of coastline north of Tormin Mine comprising 43.7 ha mining and ~6 ha for haul road widening;
- Inland "strand line" mining area on the Farm Geelwal Karoo 262, inland of the existing processing plant comprising 75 ha for mining; and
- An infrastructure / plant expansion area of 64 ha adjacent to the existing processing plant to accommodate additional processing plants, stockpile areas, industrial yards, parking and laydown areas.

SRK Consulting (South Africa) (Pty) Ltd (SRK) was appointed by MSR to undertake the Scoping and Environmental Impact Reporting (S&EIR, also referred to as EIA) process in terms of the National Environmental Management Act 107 of 1998 (NEMA). The EIA process was undertaken in accordance with Section 23 of the EIA Regulations, 2014 (GN R982, as amended by GN R326).

See page 18 for details on how you can participate in the process.

2 GOVERNANCE FRAMEWORK

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an EA issued by the competent authority, in this case, the DMR. The EIA Regulations, 2014 (Government Notice (GN) R982)[1], promulgated in terms of NEMA, govern the process, methodologies and requirements for the undertaking of EIAs in support of EA applications. The EIA Regulations are accompanied by Listing Notices (LN) 1-3 that list activities that require EA.

The EIA Regulations, 2014, lays out two alternative authorisation processes. Depending on the type of activity that is proposed, either a Basic Assessment (BA) process or an S&EIR process is required to obtain EA. LN 1 lists activities that require a BA process, while LN 2 lists activities that require S&EIR. LN 3 lists activities in certain sensitive geographic areas that require a BA.

SRK has determined that the proposed project triggers activities listed in terms of LN 1, LN 2 and LN 3 of the EIA Regulations, 2014, requiring an EIA. The equivalent activities in terms of the EIA Regulations, 2014, are included in Table 1.

Table 1: Listed activities triggered by the project

No	Description
LN1 (requiring BA)	
9	Development of infrastructure exceeding 1 000 m in length for bulk transportation of water
10	Development of infrastructure exceeding 1 000 m in length for bulk transportation of effluent, process water or slimes
12	The development of dams, infrastructure or structures with a physical footprint of more than 100 square metres within 32 metres of a watercourse
17	Development in the sea or littoral active zone in respect of embankments, rock revetments or stabilising structures
19	Depositing or excavating of material from a watercourse
19A	Depositing or excavating of material from the seashore or the littoral active zone
24	Development of a road wider than 8 m.
25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput of more than 2000 but less than 15 000 cubic metres

[1] As amended by GN R327, GN R325 and GN R324 on 7 April 2017.

No	Description
28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or game farming on or after 01 April 1998 and where such development will occur outside an urban area and the land to be developed is bigger than 1 hectare
LN2 (requiring S&EIR)	
14	Development of a structure on or along the sea bed
15	Clearance of more than 20 ha of indigenous vegetation
17	Any activity that requires a mining right
19	The removal and disposal of minerals contemplated in terms of section 20 of the MPRDA
26	Development in the sea or littoral active zone
LN3 (requiring BA in the sensitive areas)	
4	Development of a road wider than 4 m in areas containing indigenous vegetation.
12	Clearance of more than 300 m² of indigenous vegetation in sensitive areas

Consequently, the proponent is obliged to apply for EA for the project. Since activities listed under Regulation GN R984 apply to the project, an S&EIR process is required.

In addition to EA, various other key authorisations, permits or licences might be required before the project may proceed (see Table 2).

Table 2: Key authorisations, permits and licences

Application	Authority
Waste Management Licence	DMR
Heritage Application	Heritage Western Cape
Water Use Authorisation	Department of Water and Sanitation (DWS)[2]

3 ENVIRONMENTAL PROCESS

The EIA Regulations, 2014 define the detailed approach to the S&EIR process, which consists of two phases: the Scoping Phase (completed in June 2018) and the Impact Assessment Phase (the current phase) (see Figure 1).

The Scoping Phase was completed in June 2018 and the Final Scoping Report was accepted by the DMR on 28 June 2018. The Impact Assessment Phase is being undertaken in accordance with the Plan of Study for EIA, included in the Scoping Report accepted by the DMR.

The key objectives of the Impact Assessment Phase are to:

- Inform Interested and Affected Parties (IAPs) about the proposed project and the EIA process followed;
- Obtain comments from IAPs (including the relevant authorities and the public) and ensure that all issues, concerns and queries raised are fully documented and addressed in the EIA Report;
- Identify and assess potential significant impacts associated with the proposed development;
- Formulate mitigation measures to avoid and/or minimise impacts and enhance benefits of the project; and
- Produce a Final EIA Report which will provide all the necessary information for the DMR to decide whether (and under what conditions) to authorise the proposed project.

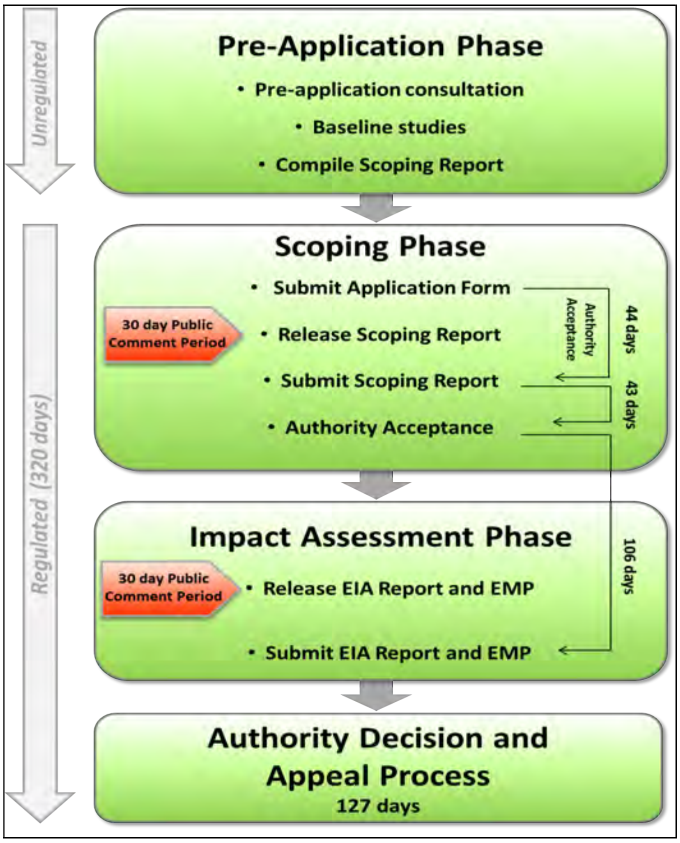

Figure 1: S&EIR Process

***Note:** EMP = Environmental Management Programme

[2] The proposed widening of the northern haul road and the access road to Beach 1 triggers water use activities in terms of section 21 (c) and (i) of the National Water Act 36 of 1998. MSR will apply for Water Use Authorisation from the DWS prior to the widening of these roads.

Figure 2: Locality Map

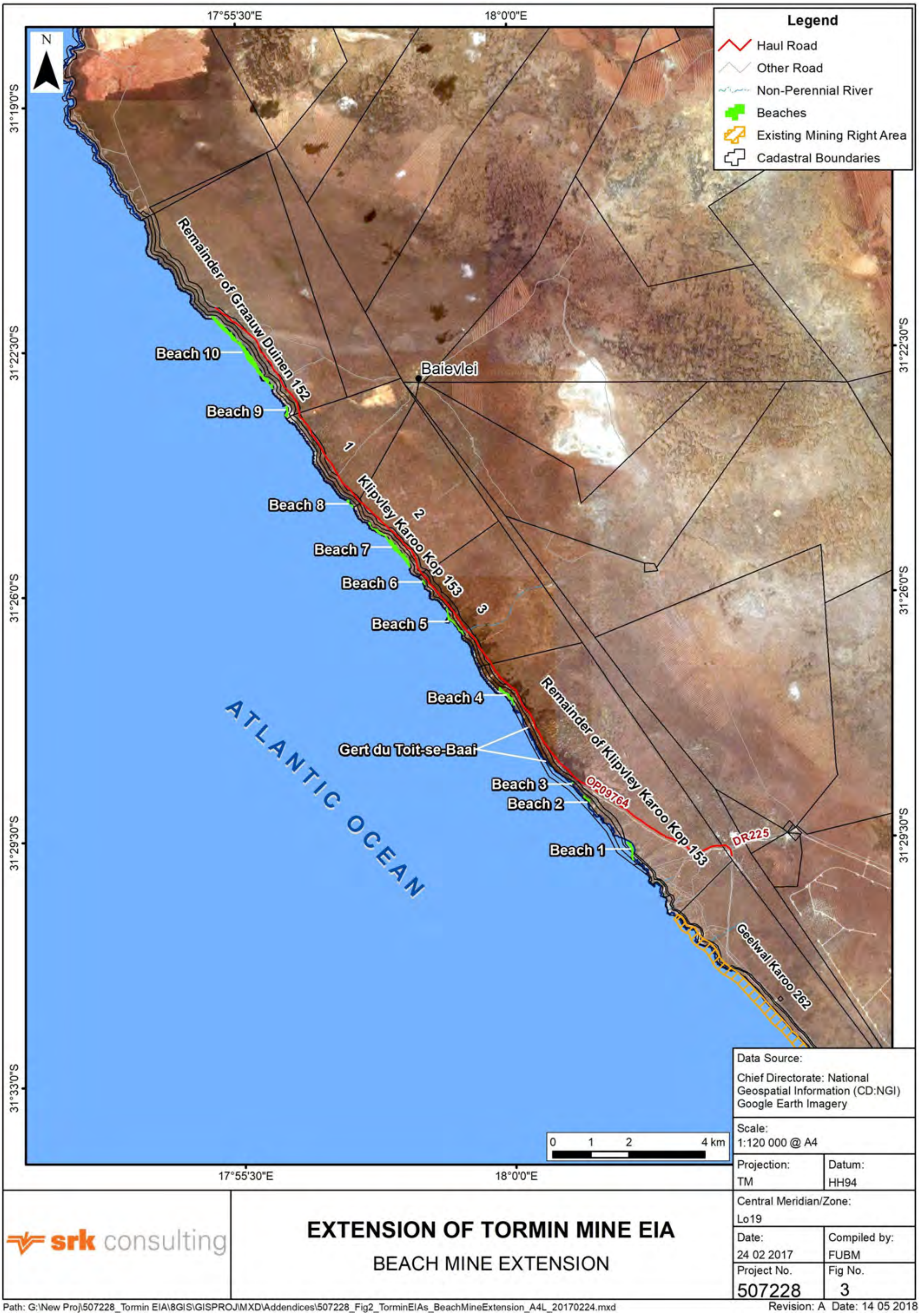

Figure 3: Beach mine extension

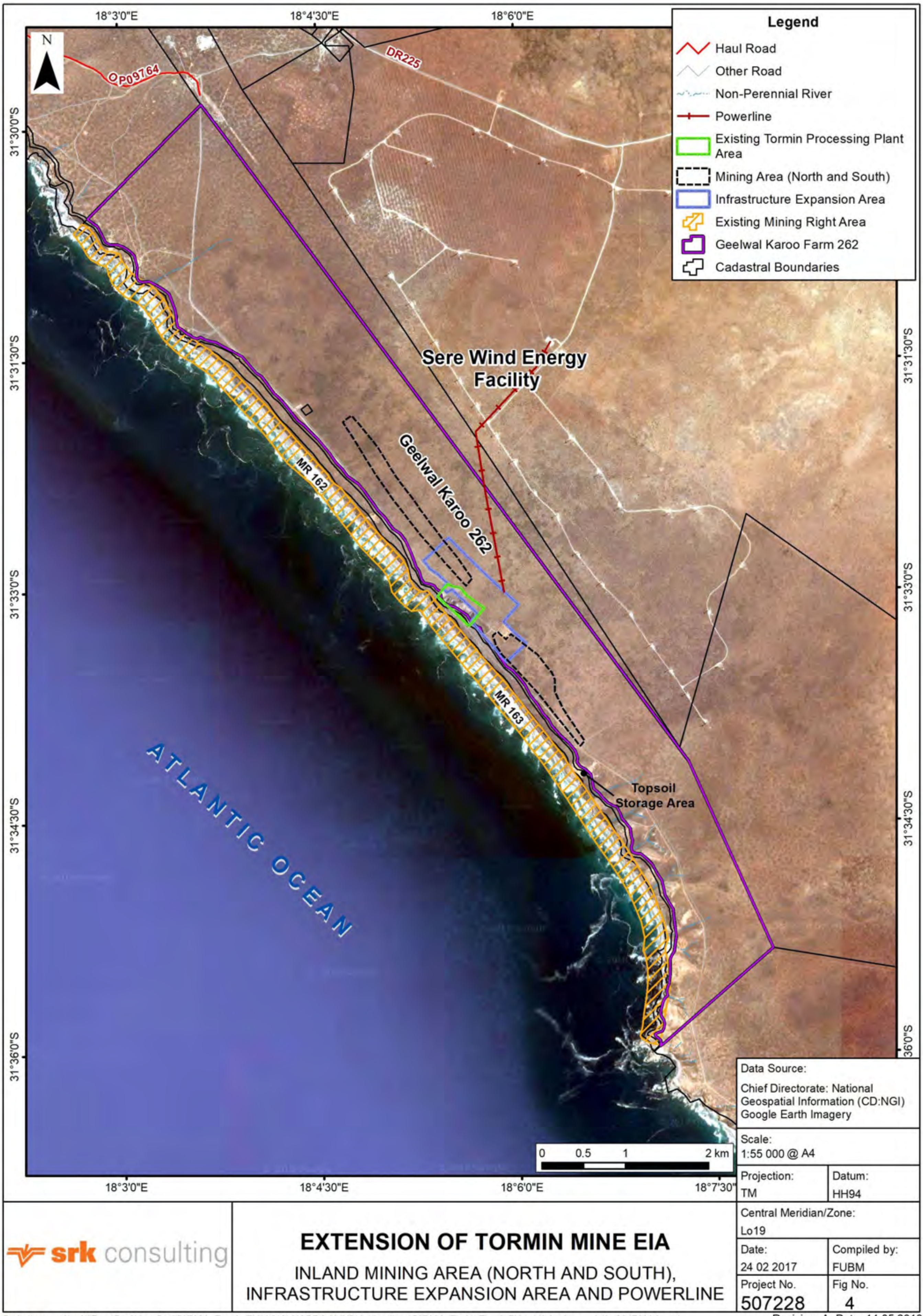

Figure 4: Inland mining and infrastructure / plant expansion area

4 DESCRIPTION OF THE SITE AND ENVIRONMENT

Tormin Mine is located on Farm Geelwal Karoo 262 on the West Coast of South Africa, north of the Olifants River Estuary and approximately 25 km west of Lutzville. Eskom's Sere wind energy facility is located on the ridgeline inland of Tormin Mine.

Access to the Mine is from Koekenaap via Robeiland and De Punt, or from Koekenaap via Kommandokraal and Schaapvlei (DR225). The gravel road extending the length of Farm Geelwal Karoo 262 is maintained by the Mine and provides access to the processing plant. The public (gravel) road OP09764 (see Figure 2) provides access to the coastline north of Tormin Mine. This road is used by farmers and visitors to the coastline. The coastline is used by campers and other recreational users.

The coastline of Farm Geelwal Karoo 262 consists of wide beaches separated by rugged rocky promontories. Steep dunes and rocky cliffs (between 30 and 50 m above mean sea level) are a feature of the area. The coastal platform is almost flat before rising to a ridgeline along the western boundary of Farm Geelwal Karoo 262.

The coastline to the north of Tormin Mine is characterised by a rocky shoreline with isolated beaches in small bays. The character of the coastline changes further north, as longer beaches and primary dune systems become more prominent. The vertical change from the high-water mark to the inland zone is less abrupt: the topography rises gently to a ridgeline ~ 5 km inland.

Areas along the coast have been disturbed from historical and current mining and/or prospecting activities, as well as by people accessing the coastline on a network of informal beach access roads.

The predominant vegetation type of the region is Namaqualand Strandveld (Figure 5). Plant diversity of this vegetation type is relatively low but has a rich component of annual and perennial flora. Namaqualand Seashore vegetation occurs along the coast on slightly sloping beaches and coastal rocky formations (Figure 6). The vegetation of the area consists of low coastal shrub up to 1 m high, typical of much of the West Coast.

Figure 5: Namaqualand Strandveld vegetation on the coastal platform

Figure 6: Namaqualand Seashore vegetation along the coast

The majority of the area under application falls within Critical Biodiversity Areas (CBAs). These areas have been designated as CBAs to promote coastal resource protection and to maintain ecological processes associated with the coastal strip, especially the ability of fauna to move along the coast. Although CBAs confer no rights and have no official conservation status in law, they provide an indication of ecological status (biodiversity).

The beaches are used by shoreline birds for foraging, rest or breeding as well as by mammals such as seals, the Cape Clawless Otter and Black-Backed Jackal. The dunes and rocky formations / cliffs are important reptile habitats and several relatively rare species - restricted to the West Coast - occur within this habitat. The coastal plain is an important habitat for a wide range of faunal species.

The study area lies in the Olifants-Doorn Water Management Area. With the exception of the Olifants River, ~19 km south-east of Tormin Mine and beyond the study area, all of the rivers and wetlands in the area are minor ephemeral systems. Wetlands in the area comprise mainly pans or "depressions".

The bulk of archaeological sites (mainly Later Stone Age middens) lie within 500 m of the coast. Inland of the coast, archaeological sites are quite scarce, limited to scatters in deflation hollows. Evidence of historic occupation is prolific in areas of rocky outcrops with shelters or overhangs or any place with potential for providing a water source.

5 PROJECT AND PROCESS DESCRIPTION

MSR proposes to extend mining operations to ensure the ongoing operation of Tormin Mine. The proposed project consists of the following key activities (see Figures 2 to 4):

- **Mine VHM deposits on ten discrete beaches** (Figure 3 and Figure 7) along a stretch of coastline north of Tormin Mine:
  - Mining will be undertaken using hydraulic excavators, slurry pumps and other ancillary equipment to position and load the ore into a mobile Primary Beach Concentrator for

processing. Dump trucks will haul the processed ore up the beach access roads to the haul road and then onward to the secondary (current) processing plant;

- Beach mining will be conducted along the beaches between the low-water mark of the sea and the toe of the dunes / cliffs with a 10 m buffer. Mining will progress along each beach depending on tidal movements and mine schedule grade requirements;
- Mining will be to an average depth of 6 m. Where the VHM deposit is shallow or poorly developed, mining will take place where tides allow. Where thick VHM deposits are found near the low water mark, a sand berm, wave breaker (ditch in the sand), or similar will be constructed on the seaward side of the deposit, providing temporary safety protection from the incoming tide whilst ensuring the mining process is efficient and minimising the need to return to the same area following tide retreat. Once the deposit has been mined, wave action will quickly return the beach to its former condition in a short period of time (and partly replenish VHM deposits). In some instances, a bulldozer will reshape the beach to the original profile where mining occurs above the high-water mark;

Figure 7: Target Beach 6

- MSR proposes to utilise existing gravel roads from the Tormin Mine entrance (off the DR2225) to the beaches to serve as haul roads for dump trucks. This includes public road OP9764 adjacent to the coast and informal beach access roads. MSR will **widen and grade the haul roads** as required;
- **Mine a 75 ha inland VHM deposit** in an area 100 – 300 m wide and ~4.8 km long inland (east) of the existing processing plant, but seaward of the Sere wind energy facility (Figure 4 and Figure 8). Strip mining of the inland strand line will be undertaken progressively:
  - Vegetation and topsoil (to a depth of approximately 30 cm) will be stripped by bulldozers and stored in stockpiles in designated areas or - where mine sequencing allows - placed directly over tailings backfilled to the preceding mine void. Topsoil from the initial box cut will be stored in the existing topsoil storage area;
  - Overburden will be removed to a depth of 2-25 m (depending on resource depth) and will immediately be backfilled into an adjacent previously mined-out area or temporarily stored in the designated infrastructure buffer areas;
  - A 15 m wide haul road on the western side of the proposed mining areas, and ramps, will provide access into the pit for mining vehicles and plant / equipment. The haul roads between the mining areas and the infrastructure / plant expansion area will be located within the proposed mining areas or infrastructure / plant expansion area footprints;
  - Excavators will mine the mineralised sand layer (ore) up to a maximum depth of 30 m (average of 10 m). The ore will be loaded into dump trucks and transported to the new ROM stockpile area in the infrastructure / plant expansion area;
  - The ROM ore will be processed in an upgraded Primary Concentrator located in the infrastructure / plant expansion area;
  - Tailings will be returned (pumped) to the mine void as backfill and then covered with stockpiled overburden and topsoil material; and
  - Rehabilitation will be undertaken as soon as the mining path allows. Once an area has been mined and backfilled, the backfilled material will be re-profiled to create the desired landform. The backfill material will be reseeded (if required) and the final rehabilitated area demarcated as a No-Go area;
- **Construct additional processing plants** in the infrastructure / plant expansion area:
  - A **Mineral Separation Plant (MSP)** to further beneficiate the concentrates produced and increase overall mineral recovery; and
  - A **Tailings Disposal Plant (TSP)**; and
- **Install a 22 kV powerline** from the Sere wind energy facility to an electrical substation in the infrastructure / plant expansion area.

Figure 8: View across the inland strand line

6 ALTERNATIVES

Appendix 3 Section 3 (h)(i) of the EIA Regulations, 2014, requires that all S&EIR processes must identify and describe feasible and reasonable alternatives. Numerous alternatives were identified and considered during the early feasibility and design phases of the project, including:

Location Alternatives for Mine Areas: MSR owns Farm Geelwal Karoo 262, the property on which the Tormin Mine and the inland strand line is located. The locations of the VHM beach deposits and inland deposits are fixed, which dictates possible mining locations. MSR is applying for extension into areas in immediate proximity to existing operations, infrastructure and facilities at Tormin Mine to take advantage of such infrastructure and facilities and maximise operational efficiency. Location / site alternatives for the mine sites have thus not been considered for assessment. However, specialists considered the location of new mining and infrastructure footprints within the extension areas, considering environmental constraints identified during their site visits. The specialists did not identify any specific areas of high sensitivity within the proposed mining and infrastructure footprints that should be designated as “exclusion zones”.

Location Alternatives for the MSP: Based on capital costs, operating costs and hauling costs, MSR identified Tormin Mine as the most feasible location for the MSP and no location alternatives are considered for the MSP.

Location Alternatives for Access Road to Beach 1: MSR proposes to utilise existing informal gravel roads to access the target beaches. After discussions with the freshwater ecologist, MSR identified an alternative beach access road to Beach 1 to reduce the potential impact on a drainage line.

Activity Alternatives: The purpose of the project is to expand existing mining operations north along the coastline and inland of the processing plant to ensure the ongoing operation of Tormin Mine. No other activity alternatives (other than the No-Go alternative) are considered acceptable or viable by the proponent, and activity alternatives (other than the No-Go alternative) are not considered further in the EIA process.

Layout Alternatives for the Infrastructure / Plant Expansion Area: MSR proposed a layout design for the infrastructure / plant expansion area that extended close to the eastern (fenced) boundary of Farm Geelwal Karoo 262. On advice of the terrestrial ecology specialist, MSR revised the layout of the infrastructure / plant expansion area to increase the ecological corridor between the infrastructure / plant expansion area and the eastern fenceline. The revised layout will also reduce the overall disturbance footprint as the Infrastructure Buffer Area North and South will now be located partly over areas to be mined. This layout design has been selected for assessment and no other design alternatives were assessed.

Alternatives for Transporting Ore to the Processing Plant: MSR does not consider conveyors and pipelines to be feasible, as these alternatives will require significant capital outlay and the infrastructure will significantly increase the disturbance footprint. The use of dump trucks is considered to be the only feasible alternative.

Technology Alternatives Enabling Beach Mining: MSR considered the use of dredging techniques and machinery; or geofabric socks to enable beach mining. The high energy environment during most high tides does not allow for safe mining. Mining will therefore focus on the use of mobile excavators during lower tides.

Power Supply Alternatives: MSR considered installing additional generator sets or photovoltaic panels to generate the required electricity on site. However, a connection to the Eskom network is MSR's preferred alternative.

Fresh Water Supply Alternatives: MSR initially considered seawater desalination as the only viable option for freshwater supply as trucking of water was not considered to be feasible due to cost, the Lower Olifants River Water User Association canal has insufficient unallocated water available for Tormin Mine and no aquifers were identified. However, with changes to the MSP (wash circuit not required), limited additional freshwater will be required (for domestic purposes) and MSR will continue to truck water from Lutzville.

The No-Go alternative is considered in the EIA in accordance with the requirements of the EIA Regulations, 2014. The No-Go alternative implies no change in the sites' status quo. The No-Go alternative will have major implications for the sustainability of Tormin Mine and will probably entail the closure of the Mine.

7 STAKEHOLDER ENGAGEMENT

Stakeholder engagement is a key component of the S&EIR process and is being undertaken in accordance with Chapter 6 of the EIA Regulations, 2014. The key stakeholder engagement activities during the Impact Assessment Phase are summarised in Table 3 below.

Relevant local, provincial and national authorities, conservation bodies, local forums and surrounding landowners and occupants have been directly notified of the S&EIR process and the release of the Scoping Report for comment.

Table 3: Stakeholder Engagement during Scoping

Activity	Date
Release EIA Report to registered IAPs	14 - 17 September 2018
Public Comment Period	18 September – 18 October 2018
Public Open Day	3 October 2018
Compile Issues and Responses Summary and finalise EIA Report	18 – 25 October 2018
Submit Final EIA Report to DMR	30 October 2018

Key comments and concerns raised by stakeholders to date, based on the information provided in the prior EIA process and the Scoping Report released for the current EIA process are as follows:

- A Section 102 application process is the incorrect procedure to apply for an extension of Tormin Mine, and may potentially not be submitted while the Prospecting application is still under review;
- Authorisation should not be granted to MSR as they are not in compliance with their existing authorisations / approvals (relating to inter alia mining area, process and transportation) and must undertake a Section 24G rectification process;
- Road transport has a significant impact on other road users and the existing road network; rail must be investigated;
- It is not clear how MSR obtained the required prospecting data to determine the resource and financial viability of the proposed mine extension;
- Insufficient information has been provided for the proposed beach access roads and beach mining areas;
- Impacts related to seawater in tailings and cliff stability must be investigated;
- The removal of beach sand may result in beach, cliff and dune erosion, and setback lines should be stipulated;
- The extension of Tormin Mine will restrict public access to the coast, affecting the tourism value of this stretch of coastline; and
- The project may compromise the ecological functioning and integrity of the CBA and rehabilitation is very difficult; a biodiversity offset may be required.

8 ASSESSMENT OF POTENTIAL IMPACTS

Specialist studies were undertaken to investigate key potential direct, indirect and cumulative impacts, as follows:

- Soil and Land Capability Impact Assessment;
- Air Quality Impact Assessment;
- Groundwater Impact Assessment;
- Marine Ecology Impact Assessment;
- Freshwater Ecology Impact Assessment;
- Terrestrial Ecology Impact Assessment;
- Heritage Impact Assessment;
- Traffic Impact Assessment; and
- Geotechnical Impact Assessment.

Specialist input, rather than a full specialist study, was provided for noise, visual and socio-economic aspects.

For all potentially significant impacts, the significance of the anticipated impact was rated without and with recommended mitigation measures. These impacts are presented in Table 4.

The significance of potential impacts of the proposed project was determined in order to assist decision-makers. Relevant observations with regard to the overall impact ratings, assuming mitigation measures are effectively implemented, are:

- The predicted impacts on *soil and land capability* are rated as *insignificant* to *medium* during construction, *very low* to *low* during operations, and *insignificant* during closure. Land capability impacts are low because of the affected areas' very low grazing capacity and the change in land use will not cause any loss to agricultural production in the area.
- The predicted *air quality* impacts, mainly associated with the generation of Particulate Matter (dust) emissions and the resulting health and nuisance effects, are rated as *insignificant* to *very low* during construction, *very low* to *medium* during operations and *insignificant* to *very low* during closure. Residents along DR2225 are likely to be most affected from increased transport of product.
- The predicted *noise* impacts are rated as *insignificant* during construction, *low* during operations and *insignificant* during closure. Beach mining is likely to increase noise and vibration levels to visitors to the coast and increased product hauling is likely to increase noise and vibration levels to residents along the DR2225.
- The predicted impacts on *groundwater* are rated as *insignificant* during construction, *insignificant* to *low* during operations, and *insignificant* during closure. Impacts on groundwater are low because the likelihood of groundwater occurring in the area is low and there are no downgradient water users in the area.
- The predicted impacts on *marine ecology* are rated as *insignificant* to *medium* during construction and closure as beach access road construction and closure could have a medium-rated impact on marine life but increased turbidity in the water column is likely to be insignificant. The predicted impacts on *marine ecology* are rated as *insignificant* to *medium* during operations because, although beach mining will severely alter the beaches, beach faunal communities are able to recover relatively rapidly and these communities are not considered to be unique to the region. The most significant impacts from beach mining (medium rating) are changes to macrofaunal community structure and disturbance / mortality of marine life.
- The predicted impacts on *freshwater ecology* are rated as *very low* during construction, *low* during operations, and *insignificant* during closure as neither of the two watercourses (drainage lines) that may be affected by the Tormin Mine extension are of significant conservation importance.
- The predicted impacts on *terrestrial ecology* are rated as *medium* during construction, *very low* to *medium* during operations, and *insignificant* during closure. CBAs and ESAs will be affected by the Tormin Mine extension, but vegetation diversity in the study area is moderate with a relatively low abundance of species of conservation concern. There is relatively high faunal diversity, with the confirmed presence of numerous West-Coast endemics and species of conservation concern.
- The predicted *socio-economic* benefits are rated as *low* to *medium* during construction, *medium* to *high* during operations and *very low* during closure. Adverse socio-economic impacts are rated as *insignificant* during construction, *very low* during

operations and *insignificant* during closure.

- The predicted *archaeological* impacts are rated as *low* during construction and *very low* to *low* during operations, but only if the mitigation measures are implemented and if archaeological resources are identified and preserved. The predicted *palaeontological benefits* are rated as *very low* to *high* during construction and operations, but only if the mitigation measures are implemented and if exposed fossils are identified and preserved. There are no predicted heritage impacts during closure.
- The predicted *visual* impact is rated as *very low* during construction, *very low* to *low* during operations and *very low* during closure. Visual impacts are low because the proposed activities will be visible to a limited number of receptors.
- The predicted *traffic* impact is rated as *very low* during construction, *insignificant* to *low* during operations and *insignificant* during closure.
- The predicted *geotechnical* impact is rated as *very low* during operations as the cliff stability analysis indicates that the infrastructure / plant expansion area, inland mining and beach mining are unlikely to adversely affect the dunes / cliffs.

Table 4 below summarises:

- The impacts assessed in the EIA;
- Their significance before and following the implementation of essential mitigation measures, on which the significance rating is based; and
- The key (non-standard essential) mitigation measures.

Impact Significance Ratings Legend:

Rating	+ve	-ve
Insignificant	I	I
Very Low	VL	VL
Low	L	L
Medium	M	M
High	H	H
Very High	VH	VH

Table 4: Summary of Impacts

ID #	Impact	Significance rating Without	Significance rating With	Key selected non-standard mitigation/optimisation measures
CONSTRUCTION PHASE IMPACTS				
LC	**Impacts on Soil and Land Capability**			
LC 1	Soil compaction caused by construction traffic	Medium	Medium	• Restrict construction activities to the project footprint areas. • Restrict vehicle movements to haul roads and construction areas and prohibit vehicle parking or storage of construction materials outside these areas.
LC 2	Loss of fertile topsoil	Medium	Low	• Strip the topsoil layer of the infrastructure / plant expansion area prior to construction and stockpile the topsoil in a demarcated area. • Locate all topsoil stockpiles in areas where they will not have to be relocated prior to replacement for final rehabilitation.
LC 3	Soil chemical pollution from construction activities	Very Low	Insignificant	• Use appropriately sized drip trays for all refuelling, repairs or when vehicles are parked. • Ensure hazardous materials are stored in suitable hazardous material storage facilities constructed from impermeable materials.
LC 4	Loss of land capability	Low	Low	• Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.
LC 5	Loss of soil ecosystem services	Medium	Low	• Use conserved topsoil as soon as possible to maintain soil nutrient cycles. • Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.
A	**Impacts on Air Quality**			
A 1	Impaired human health from increased pollutant concentrations associated with construction activities	Low	Very Low	• Reduce airborne dust through e.g.: ○ Dampening dust-generating areas, roads and stockpiles with seawater; and ○ Utilise screens in high dust-generating areas. • Use high quality diesel for construction vehicles / equipment. • Maintain all generators, vehicles, and other equipment in good working order to minimise exhaust fumes.
A 2	Increased dustfall from construction activities	Very Low	Insignificant	
N	**Noise Impacts**			
N 1	Increased noise and vibration levels during construction	Very Low	Insignificant	• Maintain all generators, vehicles and equipment in good working order. • Respond rapidly to complaints and take appropriate corrective action.
G	**Impacts on Groundwater**			
G 1	Groundwater contamination during construction of the infrastructure / plant expansion area	Very Low	Insignificant	• Store hazardous liquids in above ground containers in bunded. • Clean up hydrocarbon spills immediately. • Collect and dispose of polluted soil at a licensed waste disposal facility.

ID #	Impact	Significance rating Without	With	Key selected non-standard mitigation/optimisation measures
ME	**Impacts on Marine Ecology**			
ME1	Disturbance and/or mortality of marine life during construction of beach access roads	Low	Very Low	• Ensure that a 10 m buffer zone from the toe of the dune/cliffs remains undisturbed outside of the construction footprint. • Prohibit vehicle maintenance and refuelling on the beach. • Park vehicles / plant / machinery on beach access roads rather than on the beach when not in use.
ME2	Mortality of marine fauna caused by construction waste	High	Medium	• Inform all staff about sensitive marine species and the responsible disposal of construction waste. • Do not dispose of any waste in the marine environment.
ME3	Increased turbidity in the water column during construction of beach access roads	Insignificant	Insignificant	• No mitigation is required.
FE	**Impacts on Freshwater Ecology**			
FE1	Destabilisation of watercourses caused by road widening and increased vehicle movements during construction	Low	Very Low	• Utilise the alternative access road to Beach 1. • Plan for the management of water runoff during infrequent but potentially destructive storms. • Allow for the dissipation of runoff into the surrounding veld from multiple side drains, rather than for the concentration of flows along or off the road in major channels. • Install pipe culverts or similar at the road crossing points to allow for the uninterrupted flow of water under / across the road.
TE	**Impacts on Terrestrial Ecology**			
TE1	Loss of vegetation and plant species of conservation concern (SCC) during construction	Medium	Medium	• Appoint a suitably qualified specialist to undertake a preconstruction walk-through to identify SCC and protected species and oversee the rescue and relocation of these species. • Obtain a permit from CapeNature for the removal / destruction of SCC. • Erect wind screens along beach access roads in areas of mobile sands to limit and contain wind-blown sand.
TE2	Disturbance to terrestrial fauna and loss of habitat during construction	Medium	Medium	• Appoint a suitably qualified specialist to undertake a preconstruction walk-through to demarcate and clear burrows. • Prohibit trapping, collecting and hunting of fauna. • Flush any faunal species within the construction footprint towards more suitable habitat within the surrounding areas. • Do not leave trenches open for extended periods.
TE3	Disturbance to avifauna and loss of habitat during construction	Medium	Medium	• Check for nests during the preconstruction walk-through. • Keep the construction site clear of litter and especially plastic, twine and string.
S	**Socio-Economic Impacts**			
S1	Investment in and contribution to the economy	Medium	Medium	• Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers.
S2	Increased employment, income and skills development	Low	Low	• Maximise use of local skills and resources through preferential employment of locals where practicable. • Provide ancillary training to workers on maximising the use of income and training to further future economic prospects, potentially through projects initiated as part of a social upliftment programme.
S3	Reduced access to the coast	Insignificant	Insignificant	• Install appropriate signage and information regarding coastal access. • Restrict construction activities to the development footprint.
S4	Possible decline of tourism	Insignificant	Insignificant	• Install appropriate screening of construction sites in line with the scenic nature of the area.
H1	**Heritage Impacts**			
H1	Loss of archaeological resources during road widening	Low	Low	• Limit clearance and the footprint of construction activities to what is essential. • Alert personnel to possibility of finding archaeological resources and follow "Finds Procedure". • Appoint an archaeologist to monitor construction activities and sample affected archaeological resources as required.
H2	Loss of archaeological resources during construction of infrastructure / plant expansion area	Low	Low	
H3	Loss of fossil bones during road widening	Low	Medium	• Alert personnel to possibility of finding rare fossil bones / shells and follow "Fossil Finds Procedure". • Cease construction on (chance) discovery of fossil bones / shells and protect fossils from further damage. • Send information and photographs to a palaeontologist for assessment and to determine preservation, collection and record keeping procedures.
H4	Loss of fossil shells during road widening	Very Low	Very Low	
H5	Loss of fossil bones during construction of infrastructure / plant expansion area	High	High	

ID #	Impact	Significance rating Without	With	Key selected non-standard mitigation/optimisation measures
V	**Visual Impacts**			
V 1	Altered sense of place and visual intrusion caused by construction activities	Very Low	Very Low	• Avoid excavation, handling and transport of materials which may generate dust under high wind conditions. • Keep construction sites tidy and all activities, material and machinery contained within an area that is as small as possible. • Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase. • Minimise the use of night-lighting. No high mast or spot-light security lighting or up-lighting allowed.
V 2	Altered sense of place from increased traffic during construction	Very Low	Very Low	• Restrict construction deliveries to Mondays to Saturdays between the hours of 08h00 and 17h00. • Maintain all vehicles in good working order.
T	**Traffic Impacts**			
T 1	Increased nuisance on existing road users and surrounding residents from construction traffic and road widening	Very Low	Very Low	• Restrict construction deliveries to Mondays to Saturdays between the hours of 08h00 and 17h00. • Use appropriate road signage, in accordance with the South African Traffic Safety Manual, providing flagmen, barriers etc. at the various access points where necessary to inform other road users of construction activities. • Maintain and repair roads damaged by construction vehicles, in consultation with relevant road authorities. • Schedule road widening of OP9764 during "off season" (low visitor) periods.
GT	**Geotechnical Impact**			
No impacts identified.				
OPERATIONAL PHASE IMPACTS				
LC	**Impacts on Soil and Land Capability**			
LC 6	Soil erosion caused by operational activities	High	Very Low	• Implement drainage control measures and culverts to manage the natural flow of surface runoff around the infrastructure / plant expansion area. • Use conserved topsoil as soon as possible or vegetate topsoil stockpiles if the topsoil cannot be used immediately.
LC 7	Soil compaction caused by hauling and stockpiles	Medium	Low	• Restrict hauling to designated haul roads. • Do not stockpile topsoil higher than 4 m.
LC 8	Soil chemical pollution from operational activities	Medium	Low	• Ensure hazardous materials are stored in suitable hazardous material storage facilities constructed from impermeable materials. • Design processing areas to effectively manage and dispose of contaminated storm water and process water.
LC 9	Loss of land capability	Medium	Low	• Undertake concurrent rehabilitation to prevent stockpiled topsoil from losing its inherent fertility.
A	**Air Quality Impacts**			
A 3	Impaired human health from increased pollutant concentrations associated with mining and processing activities	Low	Very Low	• Reduce airborne dust through dampening roads with water (control efficiency of minimum 75%). • Partially enclose MSP product stockpiles (control efficiency of minimum 70%). • Use high quality diesel for construction vehicles. • Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.
A 4	Increased dustfall associated with mining and processing activities	Very Low	Very Low	
A 5	Impaired human health from increased pollutant concentrations associated with increased product truck movements	High	Medium	
A 6	Increased dustfall associated with increased product truck movements	Low	Low	
N	**Noise Impacts**			
N 2	Increased noise and vibration levels during operations	Medium	Low	• Avoid beach mining near "tourist" beaches (e.g. Gert du Toit-se-Baai), during peak holiday season (Easter and Christmas holidays). • Limit hauling operations from the northern beaches to Mondays to Fridays during Easter and Christmas holidays. • Limit product transport from Tormin Mine along DR2225 to Mondays to Saturdays between the hours of 07h00 and 17h00.

ID #	Impact	Significance rating Without	Significance rating With	Key selected non-standard mitigation/optimisation measures
G	**Impacts on Groundwater**			
G 2	Groundwater contamination during inland mining	Medium	Low	• Discontinue (inland) mining if groundwater is intersected. • Undertake a geophysical survey south-east of the infrastructure / plant area to determine groundwater flow and install four boreholes in this zone for aquifer characteristic testing. • Install monitoring boreholes up and down gradient of the mining area and analyse data regularly, taking corrective action as and if required. • Produce a numerical groundwater model prior to mining and update the model biannually based on groundwater monitoring results.
G 3	Groundwater contamination from the infrastructure / expansion area	Medium	Very Low	• Inspect vehicles and equipment for oil/fuel leaks. • Store hazardous liquids in above ground containers in bunded areas or on drip trays.
G 4	Groundwater contamination from pipeline spills	Medium	Insignificant	• Ensure pipelines are accessible along the entire length. • Implement measures to detect, contain and fix pipeline leaks within 48 hours.
ME	**Impacts on Marine Ecology**			
ME 4	Shoreline erosion and altered beach profiles caused by beach mining	High	Low	• Enforce a 10 m buffer zone from the toe of the sand dunes and cliffs towards the sea in which no mining or disturbance may take place. • Take weekly photographs of beach mining areas (dunes and cliffs) and cease work if deviations are recorded (until mitigation measures are implemented). • Undertake primary processing on the beach and distribute tailings evenly above the mid-line of the beach from where it was mined. • Actively backfill mined beaches and profile the mining area to resemble the natural beach profile.
ME 5	Changes in macrofaunal community structure caused by beach mining	High	Medium	
ME 6	Disturbance and/or mortality of marine life caused by beach mining	High	Medium	• Enforce a 10 m buffer zone from the toe of sand dunes and cliffs towards the sea in which no mining may take place. • Actively backfill mined beaches and profile the mining area to resemble the natural beach profile. • Prohibit vehicle maintenance and refuelling on the beach. • Park vehicles / plant / machinery on beach access roads rather than on the beach when not in use.
ME 7	Smothering of reefs and macrofauna caused by increased sedimentation from beach mining	Low	Very Low	• Prohibit mining closer than 10 m to rocky shore habitats. • Actively backfill mined beaches and profile the mining area to resemble the natural beach profile.
ME 8	Increased turbidity in the water column caused by beach mining	Insignificant	Insignificant	• No mitigation is required.
FE	**Impacts on Freshwater Ecology**			
FE 2	Destabilisation of watercourses caused by increased vehicle movements during operations	Medium	Low	• Utilise the alternative access road to Beach 1. • Allow for the dissipation of runoff into the surrounding veld from multiple side drains. • Install multiple culverts or other appropriate structures at Watercourse 2 to convey water runoff under / across the road. • Implement measures (adjusting the routing of flows, dissipating runoff and/or establishing vegetation) to address erosion nick-points. • Undertake monthly auditing of access roads to assess erosion with a photographic record. • Compile a stormwater management plan.
TE	**Impacts on Terrestrial Ecology**			
TE 4	Loss of vegetation, plant SCC and ecological connectivity during inland mining	High	Medium	• Appoint a suitably qualified specialist to undertake a pre-mining walk-through to identify SCC and protected species within the mining footprint and oversee the rescue and relocation of these species. • Obtain a permit from CapeNature for the removal / destruction of SCC. • Only clear vegetation when a new area is to be mined. Remove the vegetation and soil simultaneously and, where possible, immediately place this material in an area prepared for rehabilitation to reduce the duration of topsoil storage.
TE 5	Disturbance to the coastal environment and loss of ecological connectivity during beach mining	Medium	Low	• Enforce a 10 m buffer zone from the toe of the sand dunes and cliffs towards the sea in which no mining or disturbance may take place. • Take weekly photographs of beach mining areas (dunes and cliffs) and cease work if deviations are recorded (until mitigation measures are implemented).
TE 6	Disturbance to fauna and loss of habitat during mining	High	Medium	• Rehabilitate disturbed areas incrementally as new mining blocks are opened and previous blocks are closed. • Prohibit unnecessary driving at night. • Prohibit trapping, collecting and hunting of fauna.

ID #	Impact	Significance rating Without	With	Key selected non-standard mitigation/optimisation measures
				• Flush any faunal species within the mining footprint towards more suitable habitat within the surrounding areas. • Do not leave trenches open for extended periods.
TE7	Disturbance to avifauna and loss of habitat during mining	Medium	Low	• Undertake avifaunal monitoring of the powerline route. • Install bird flight diverters along the length of the powerline. • Insulate the pylons and other exposed infrastructure. • Prohibit trapping and hunting of avifauna and egg collecting. • Undertake counts at regular roosting sites.
TE8	Increased erosion during mining	Medium	Low	• Enforce a 10 m buffer zone from the toe of the sand dunes and cliffs towards the sea in which no mining or disturbance may take place. • Take weekly photographs of beach mining areas (dunes and cliffs) and cease work if deviations are recorded (until mitigation measures are implemented). • Only clear vegetation in the inland mining areas when a new block is to be mined. Remove the vegetation and soil simultaneously and, where possible, immediately place this material in an area prepared for rehabilitation to reduce the duration of topsoil storage. • Erect wind screens along beach access roads in areas of mobile sands to limit and contain wind-blown sand.
TE9	Proliferation of alien and invasive species during mining	Low	Very Low	• Compile an Alien Plant Management Plan. • Undertake regular monitoring for alien plants. • Conduct regular alien clearing using the best-practice methods for the species concerned. Avoid using herbicides as far as possible.
S	**Socio-Economic Impacts**			
S5	Investment in and contribution to the economy	Medium	High	• Establish and support Corporate Social Investment projects and / or networks that provide training and support for small and medium enterprises in the local municipality. • Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers. • Procure ancillary services for goods purchased overseas from South African companies as far as possible.
S6	Increased employment, income and skills development	Medium	Medium	• Maximise use of local skills and resources where practicable. • Provide ancillary training to workers on maximising the use of income and training to further future economic prospects.
S7	Reduced access to the coast	Very Low	Very Low	• Implement management measures (e.g. road signs, speed limits, etc.) to ensure that the public is still able to safely use OP9764. • Avoid beach mining near "tourist" beaches (e.g. Gert du Toit-se-Baai), during peak holiday season (Easter and Christmas holidays).
S8	Possible decline of tourism	Very Low	Very Low	
H	**Heritage Impacts**			
H6	Loss of maritime archaeological resources during beach mining	Low	Very Low	• Alert machine operators to possibility of finding shipwreck material. • Establish protocol if any shipwreck material is found, including reporting the find/s to SAHRA. • Maritime archaeologist to assess the material (if any identified). • Collect / excavate any exposed maritime archaeological resources using appropriate methods to record provenance.
H7	Loss of archaeological resources during strand line mining	Medium	Low	• Monitor mining for archaeological resources. Initially this will need to be semi-permanent until it can be established if any resources are present or not. • Alert personnel to possibility of finding archaeological resources. • Collect any archaeological resources that are exposed using appropriate methods to record provenance.
H8	Loss of fossil bones during beach mining	High	High	• Identify and appoint a stand-by palaeontologist. • Alert personnel to possibility of finding rare fossil bones / marine shelly beds. • Cease mining on (chance) discovery of fossil bones / large exposure of shell beds. • Palaeontologist to assess information and establish suitable response. • Record and sample exposed fossiliferous sections in earthworks.
H9	Loss of fossil shells during beach mining	Very Low	Very Low	
H10	Loss of fossil bones during strand line mining	High	High	
H11	Loss of fossil shells during strand line mining	Medium	Medium	
V	**Visual Impacts**			
V3	Altered sense of place and visual intrusion caused by mining activities and associated infrastructure	Low	Very Low	• Progressively and continually rehabilitate mined out areas and project components. • Avoid beach mining near "tourist" beaches (e.g. Gert du Toit-se-Baai), during peak holiday season (Easter and Christmas holidays). • Restrict infrastructure along the coast to the north of Tormin Mine as far as possible.
V4	Altered sense of place from increased traffic during	Medium	Low	• Limit hauling operations from the northern beaches to Mondays to Fridays during Easter and Christmas holidays.

ID #	Impact	Significance rating Without	Significance rating With	Key selected non-standard mitigation/optimisation measures
	operations			• Limit product transport from Tormin Mine along DR2225 to Mondays to Saturdays between the hours of 07h00 and 17h00.
V 5	Altered sense of place and visual quality caused by light pollution at night	Low	Very Low	• Limit lighting only to essential activities and facilities. • Direct lighting inwards and downwards towards activities and facilities to avoid light spillage and trespass.
T	**Traffic Impacts**			
T 2	Reduced traffic capacity on haul roads	Low	Very Low	• Use appropriate road signage, in accordance with the South African Traffic Safety Manual, providing flagmen, barriers etc. at the various access points where necessary to inform other road users of hauling activities. • Investigate and respond to complaints about traffic.
T 3	Reduced traffic capacity on the regional road network	Insignificant	Insignificant	• No mitigation is required.
T 4	Compromised road surface integrity of the haul roads	Low	Very Low	• Maintain and repair roads damaged by trucks, in consultation with relevant road authorities.
T 5	Compromised road surface integrity of the regional road network	Medium	Low	• Seal DR2225, in consultation with relevant road authorities. • Maintain and repair damage caused by trucks on DR2225, in consultation with relevant road authorities.
GT	**Geotechnical Impacts**			
GT 1	Cliff failure caused by the construction of the infrastructure / expansion area	Very Low	Very Low	• Set and maintain a minimum buffer zone of 143 m between the infrastructure / plant expansion area and the cliff. • Monitor cliff geometry changes and adapt the expansion plan, if required, accordingly to maintain the buffer zone. • Monitor additional loading within the infrastructure / plant expansion area.
GT 2	Cliff / dune failure caused by beach mining	Very Low	Very Low	• Set and maintain beach mining limits according to the mine bench toe, assuming that the bench will form a 35° natural repose angle slope. • Delineate the mining limits (buffer zones) on mine plans and on the beaches.
GT 3	Cliff failure caused by inland mining	Very Low	Very Low	• Set and maintain a minimum buffer zone of 220 m between inland mining and the cliff. • Restrict the mining depth to 30 m and the mining extent to within the planned inland mine boundaries. • Monitor cliff geometry changes and adapt the mining plan, if required, accordingly to maintain the buffer zone.
CLOSURE PHASE IMPACTS				
LC	**Soil and Land Capability Impacts**			
LC 10	Soil compaction caused by closure activities	Very Low	Insignificant	• Restrict closure activities to the project footprint areas.
LC 11	Soil chemical pollution from closure activities	Very Low	Insignificant	• Use appropriately sized drip trays for all refuelling, repairs done on vehicles / machinery or when vehicles are parked. • Ensure hazardous materials are stored in suitable hazardous material storage facilities.
A	**Air Quality Impacts**			
A 7	Impaired human health from increased pollutant concentrations associated with closure activities	Low	Very Low	• Reduce airborne dust through e.g.: ○ Dampening dust-generating areas, roads and stockpiles with water; and ○ Utilise screens in high dust-generating areas. • Use high quality diesel for vehicles / equipment. • Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.
A 8	Increased dustfall associated with closure activities	Very Low	Insignificant	
N	**Noise Impacts**			
N 3	Increased noise and vibration levels during closure	Very Low	Insignificant	• Maintain all generators, vehicles, vessels and other equipment in good working order to minimise excess noise. • Respond rapidly to complaints and take appropriate corrective action.
G	**Impacts on Groundwater**			
G 5	Groundwater contamination during closure of the infrastructure / plant expansion area	Insignificant	Insignificant	• Remove all hazardous materials from site and dispose at a licensed waste disposal facility. • Do not bury any materials on site. • Collect and dispose of polluted soil at a licensed waste disposal facility.
ME	**Impacts on Marine Ecology**			
ME 9	Disturbance and/or mortality of marine life during closure of beach access roads	Low	Very Low	• Ensure that a 10 m buffer zone from the toe of the dune/cliffs remains undisturbed outside of the closure footprint. • Prohibit vehicle maintenance and refuelling on the beach. • Park vehicles / plant / machinery on beach access roads rather than on the beach when not in use.
M	Mortality of marine fauna	High	Medium	• Inform all staff about sensitive marine species and the responsible

ID #	Impact	Significance rating Without	With	Key selected non-standard mitigation/optimisation measures
E10	caused by waste			disposal of waste. • Do not dispose of any waste in the marine environment.
ME11	Increased turbidity in the water column during rehabilitation of beach access roads	Insignificant	Insignificant	• No mitigation is required.
FE	**Impacts on Freshwater Ecology**			
FE3	Destabilisation of watercourses caused by increased vehicle movements during closure	Very Low	Insignificant	• Rehabilitate eroded areas (e.g. eroded channels, dongas). • Plan for the management of water runoff during infrequent but potentially destructive storms. • Remove or shape graded vegetation and soils along the road edges.
TE	**Impacts on Terrestrial Ecology**			
TE10	Disturbance to terrestrial fauna during closure	Very Low	Insignificant	• Prohibit the indiscriminate movement of vehicles and staff through vegetation outside of the affected footprint. • Prohibit trapping, collecting and hunting of fauna. • Do not leave trenches open for extended periods. • Keep the site clear of litter and especially plastic, twine and string.
TE11	Disturbance to avifauna during closure	Very Low	Insignificant	
S	**Socio-Economic Impacts**			
S9	Investment in and contribution to the economy	Very Low	Very Low	• Procure goods and services from local, provincial or South African suppliers as far as possible, with an emphasis on BEE suppliers.
S10	Increased employment, income and skills development	Very Low	Very Low	• Maximise use of local skills and resources through preferential employment of locals where practicable. • Provide ancillary training to workers on maximising the use of income and training to further future economic prospects.
S11	Reduced access to the coast	Insignificant	Insignificant	• Restrict closure / closure activities to the affected footprint. • Install appropriate signage and information regarding coastal access.
S12	Possible decline of tourism	Insignificant	Insignificant	
H	**Heritage Impacts**			
No impacts identified.				
V	**Visual Impacts**			
V6	Altered sense of place and visual intrusion caused by closure and rehabilitation activities	Very Low	Very Low	• Use dark green or black (non-glossy) wind screens. • Remove rehabilitation wind screens as soon as vegetation is viable.
T	**Traffic Impacts**			
T6	Increased nuisance on existing road users and surrounding residents from closure traffic	Insignificant	Insignificant	• Restrict traffic along DR2225 to Mondays to Saturdays between the hours of 07h00 and 17h00. • Use appropriate road signage, in accordance with the South African Traffic Safety Manual, providing flagmen, barriers etc. at the various access points where necessary to inform other road users of closure activities. • Maintain and repair roads damaged by large vehicles, in consultation with relevant road authorities. • Investigate and respond to complaints about traffic.
GT	**Geotechnical Impacts**			
No impacts identified.				

9 CONCLUSIONS AND WAY FORWARD

This Draft EIA Report has identified and assessed the potential biophysical and socio-economic impacts associated with the proposed extension of Tormin Mine.

SRK believes that sufficient information is available for DMR to take a decision regarding authorisation of the project.

The Tormin Mine extension project will result in unavoidable adverse environmental impacts. None of these adverse impacts are considered unacceptably significant and all can be managed to tolerable levels through the effective implementation of the recommended mitigation measures.

In addition, the project will directly and indirectly benefit the local and regional economy.

Working on the assumption that MSR is committed to ensuring that beach mining, inland mining and the associated processing activities are undertaken to high standards, achieved through implementation of the recommended mitigation measures and ongoing monitoring of performance, SRK believes and the EIA Report demonstrates that through effective implementation of the stipulated mitigation measures, the adverse impacts of this project can be reduced to levels compliant with national (and international) standards or guidelines.

The fundamental decision is whether to allow the development, which brings economic benefits and is generally consistent with development policies for the area, but which may have limited biophysical impacts.

SRK believes that the specialist studies have shown that the Tormin Mine extension project is generally acceptable. The EIA has also assisted in the identification of essential mitigation measures that will mitigate the impacts associated with these components to within tolerable limits.

In conclusion SRK is of the opinion that on purely 'environmental' grounds (i.e. the project's potential socio-economic and biophysical implications) the application as it is currently articulated should be approved, provided the essential mitigation measures are implemented. Ultimately, however, the DMR will need to consider whether the project benefits outweigh the potential impacts.

HOW YOU CAN YOU PARTICIPATE IN THE EIA PROCESS

The Draft EIA Report is not a final report and can be amended based on comments received from stakeholders. Stakeholders' comments on the EIA Report will assist the DMR in making a decision regarding the application. The public is therefore urged to submit comment. Once stakeholders have commented on the information presented in the EIA Report, the Final EIA Report will be prepared and submitted to the DMR for approval. Once a decision is taken by authorities, this decision will be communicated to all registered IAPs.

REVIEW THE REPORT

Copies of the complete report are available for public review at the following locations:

- Lutzville Public Library;
- Vredendal Public Library;
- SRK's Cape Town office; and
- SRK's website: www.srk.co.za – click on the 'Library' and 'Public Documents' links.

ATTEND A MEETING

A **Public Open Day** will be held where the project will be discussed:

- Venue: Lutzville Hotel
- Date: 3 October 2018
- Time: 15h00 – 18h00

IAPs are invited to attend the Open Day **anytime** between the above times, and are requested to **confirm their intention to attend** the Open Day with the SRK contact person.

IAPs are invited to comment, and/or to register on the project database. IAPs should refer to the DMR reference number, and must provide their comments together with their name, contact details (preferred method of notification, e.g. email), and an indication of any direct business, financial, personal or other interest which they have in the application, to the contact person below, by **18 October 2018**.

REGISTER OR PROVIDE YOUR COMMENT

Register or send written comment to:

Jessica du Toit

SRK Consulting

Postnet Suite #206, Private Bag X18, Rondebosch, 7701

Email: jedutoit@srk.co.za

Tel: + 27 21 659 3060

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Profile and Expertise of EAPs

SRK Consulting (South Africa) Pty Ltd (SRK) has been appointed by Mineral Sands Resources (Pty) Ltd (MSR) to undertake the Environmental Impact Assessment (EIA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA).

SRK Consulting comprises over 1 300 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Cape Town environmental department has a distinguished track record of managing large environmental and engineering projects, extending back to 1979. SRK has rigorous quality assurance standards and is ISO 9001 accredited.

As required by NEMA, the qualifications and experience of the key independent Environmental Assessment Practitioners (EAPs) undertaking the EIA are detailed below and Curriculum Vitae provided in Appendix 1 and Appendix 2.

Project Director: Christopher Dalgliesh, BBusSc (Hons), MPhil (EnvSci)
Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)
Chris Dalgliesh is a Partner and Principal Environmental Consultant with over 25 years' experience, primarily in South Africa, Southern Africa, West Africa and South America (Suriname). Chris has worked on a wide range of projects, notably in the natural resources, Oil & Gas, waste, infrastructure (including rail and ports) and industrial sectors. He has directed and managed numerous Environmental and Social Impact Assessments (ESIAs) and associated management plans, in accordance with international standards. He regularly provides high level review of ESIAs, frequently directs Environmental and Social Due Diligence studies for lenders, and also has a depth of experience in Strategic Environmental Assessment (SEA), State of Environment Reporting and Resource Economics. He holds a BBusSci (Hons) and M Phil (Env) and is a Certified Environmental Practitioner of South Africa (CEAPSA).

Project Manager: Sue Reuther, BSc (Hons) (Econ); MPhil (Enviro. Man)
CEAPSA
Sue Reuther has more than 15 years of experience researching and working on issues in the environmental assessment sector. She has been involved in a variety of ESIAs as well as strategic State of Environment Reporting, the development of Environmental Management Frameworks (EMF) and the compilation of Environmental Management Programmes (EMP). Her experience also includes due diligence reviews and gap analysis studies against IFC and World Bank Standards. Sue also undertakes socio-economic and resource economic specialist assessments.
She holds a BSc (Hons) in Economics and MPhil in Environmental Management and is a Certified Environmental Practitioner of South Africa (CEAPSA).

Project Manager: Scott Masson, BSc (Hons) (EnvMan); MLA (L.Arch.)
CEAPSA
Scott Masson is a Senior Environmental Consultant and has been involved in the environmental and landscape architectural field for the past 9 years. His expertise includes Visual Impact Assessment, ESIAs, EMPs, Integrated Water and Waste Management Plans, and environmental planning and sensitivity studies. Scott holds a BSc (Hons) in Environmental Management, a MLA in Landscape Architecture and is a Certified Environmental Practitioner of South Africa.

Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK has no beneficial interest in the outcome of the assessment which is capable of affecting its independence.

Disclaimer

The opinions expressed in this report have been based on the information supplied to SRK by MSR. SRK's report is reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

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Tormin Mine Extension: EAP Affirmation

Section 16 (1) (b) (iv), Appendix 1 Section 3 (1) (r), Appendix 2 Sections 2 (j) and (k) and Appendix 3 Section 3 (s) of the EIA Regulations, 2014 (promulgated in terms of NEMA), require an undertaking under oath or affirmation by the EAPs in relation to:

- The correctness of the information provided in the report;
- The inclusion of comments and inputs from stakeholders and interested and affected parties;
- Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties; and
- The level of agreement between the EAP and interested and affected parties on the Plan of Study for undertaking the environmental impact assessment.

SRK and the EAPs managing this project hereby affirm that:

- To the best of our knowledge the information provided in the report is correct, and no attempt has been made to manipulate information to achieve a particular outcome. Some information, especially pertaining to the project description, was provided by the applicant and/or their sub-contractors. In this respect, SRK's standard disclaimer (inserted in this report) pertaining to information provided by third parties applies.
- To the best of our knowledge all comments and inputs from stakeholders and interested and affected parties have been captured in the report and no attempt has been made to manipulate such comment or input to achieve a particular outcome. Written submissions are appended to the report while other comments are recorded within the report. For the sake of brevity, not all comments are recorded verbatim and are mostly captured as issues, and in instances where many stakeholders have similar issues, they are grouped together, with a clear listing of who raised which issue(s).
- Information and responses provided by the EAP to interested and affected parties are clearly presented in the report. Where responses are provided by the applicant (not the EAP), these are clearly indicated.
- SRK has taken account of interested and affected parties' comments on the Plan of Study and, insofar as comments are relevant and practicable, has considered these during the Impact Assessment Phase of the EIA process.

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Acronyms and Abbreviations

AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
amsl	Above mean sea level
BA	Basic Assessment
BPEO	Best Practicable Environmental Option
Ca	Calcium
$CaCO_3$	Calcium Carbonate
CBA	Critical Biodiversity Area
CIA	Cumulative Impact Assessment
Cl	Chlorine
CO_2	Carbon Dioxide
CWDP	Coastal Waters Discharge Permit
DEA	National Department of Environmental Affairs
DEA&DP	(Western Cape) Department of Environmental Affairs and Development Planning
DEA: O&C	Department of Environmental Affairs: Oceans and Coasts
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
ESA	Ecological Support Area
EStA	Early Stone Age
GDP	Gross Domestic Product
GDPR	Regional Gross Domestic Product
GGP	Gross Geographic Product
GN	Government Notice
GSP	Garnet Stripping Plant
GVA-R	Regional Gross Value Added
H_2SO_4	Sulphuric Acid
ha	Hectares
HCl	Hydrochloric Acid
HDPE	High Density Polyethylene
HIA	Heritage Impact Assessment
HWC	Heritage Western Cape
IAPs	Interested and Affected Parties
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IUCN	International Union for Conservation of Nature and Natural Resources
km	Kilometres

km^2	Square kilometres
kVA	Kilo Volt-Amperes
LED	Local Economic Development
LM	Local Municipality
LoM	Life of Mine
LN	Listing Notice
L/s	Litres per second
LSA	Late Stone Age
m^3/h	Cubic metres per hour
mamsl	Meters above mean sea level
mbgl	Meters below ground level
mg/L	Milligrams per litre
Ml/d	Million litres per day
mm/a	Millimetres per annum
mS/m	Millisiemens per meter
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MSA	Middle Stone Age
MSDS	Material Safety Data Sheet
MSR	Mineral Sands Resources (Pty) Ltd
Mt	Million tonnes
MWP	Mining Work Programme
NEMA	National Environmental Management Act 107 of 1998 as amended
NEM:AQA	National Environmental Management: Air Quality Act 39 of 2004
NEM:BA	National Environmental Management: Biodiversity Act 10 of 2004
NEM:ICMA	National Environmental Management: Integrated Coastal Management Act 24 of 2008
NEM:WA	National Environmental Management: Waste Act 59 of 1998
NFEPA	National Freshwater Ecosystem Priority Area
NH_3	Ammonium Hydroxide
NHRA	National Heritage Resources Act 25 of 1999
NID	Heritage Notification of Intent to Develop
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NWA	National Water Act 36 of 1998
O_3	Ozone
PES	Present Ecological State
PM	Particulate matter
PM_{10}	Particulate matter with diameter of less than 10 µm
$PM_{2.5}$	Particulate matter with diameter of less than 2.5 µm
RDL	Red Data List
RO	Reverse Osmosis
ROM	Run of Mine

S&EIR	Scoping and Environmental Impact Reporting
SAHRA	South African National Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SCC	Species of Conservation Concern
SCP	Secondary Concentration Plant
SDF	Spatial Development Framework
SLP	Social and Labour Plan
SO_2	Sulfur dioxide
SoW	Scope of Work
SRK	SRK Consulting (South Africa) (Pty) Ltd
StatsSA	Statistics South Africa
TDS	Total Dissolved Solids
THG	Trans Hex Group
tpa	Tonnes per annum
tph	Tonnes per hour
TSP	Tailings Scavenger Plant
ToR	Terms of Reference
VAC	Visual Absorption Capacity
WMA	Water Management Area
WML	Waste Management Licence
WUL	Water Use Licence
WWTW	Waste Water Treatment Works
µ	micro

Glossary

Acidic	A condition where pH is below 7
Aquifer	An underground body of permeable rock or unconsolidated materials (gravel, sand or silt) which can contain or transmit groundwater.
Avifauna	The collective birds of a given region.
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.
Benguela Current	The broad, northward flowing ocean current that forms the eastern portion of the South Atlantic Ocean.
Biodiversity	The diversity, or variety, of plants, animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity
Borehole	Includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer
Community	Those people who may be impacted upon by the construction and operation of the project. This includes neighbouring landowners, local communities and other occasional users of the area
Construction Phase	The stage of project development comprising site preparation as well as all construction activities associated with the development.
Consultation	A process for the exchange of views, concerns and proposals about a project through meaningful discussions and the open sharing of information.
Critical Biodiversity Area	Areas of the landscape that must be conserved in a natural or near-natural state in order for the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.
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.
Electrical Conductivity (in water)	Reflects the capacity of water to conduct electrical current, and is directly related to the concentration of salts dissolved in water.
Ecology	The study of the interrelationships of organisms with and within their physical surroundings
Ecosystem	The interconnected assemblage of all living organisms that occupy a given area and the physical environment with which they interact.
Endemic / Endemism	Species unique (native or restricted) to a defined geographic location, i.e. ecological state of a species being unique to a defined geographic location.
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.
Environmental Authorisation	Permission granted by the competent authority for the applicant to undertake listed activities in terms of the NEMA EIA Regulations, 2014.

Environmental Impact Assessment	A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.
Environmental Impact Assessment Report	The report produced to relay the information gathered and assessments undertaken during the Environmental Impact Assessment.
Environmental Management Programme	A description of the means (the environmental specification) to achieve environmental objectives and targets during all stages of a specific proposed activity.
Ephemeral	A water body that does not flow or contain water year-round, in response to seasonal rainfall and run-off.
Fauna	The collective animals of a particular region, habitat or geological period.
Feasibility study	The determination of the technical and financial viability of a proposed project.
Fine Tailings	Tailings below the average grain size found in the resource.
Fossil	Rare objects that are preserved due to unusual circumstances.
Flora	The collective plants of a particular region, habitat or geological period.
Geohydrology	The study of the character, source and mode of occurrence of groundwater.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Heritage Resources	Refers to something tangible or intangible, e.g. a building, an area, a ritual, etc. that forms part of a community's cultural legacy or tradition and is passed down from preceding generations and has cultural significance.
Heuweltjies	Slightly raised, rounded termite mounds up to 10 m in diameter.
High shore	The section of the intertidal zone reaching from the extreme high water spring tide to the mean high water neap tide.
High-water mark	The highest line reached by coastal waters, but excluding any line reached as a result of exceptional or abnormal weather or sea conditions.
Hydrology	(The study of) surface water flow.
Hydraulic Conductivity	Measure of the ease with which water will pass through earth material; defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow.
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.
Independent EAP	An independent person with the appropriate qualifications and experience appointed by the Applicant to manage the Environmental Impact Assessment process on behalf of the Applicant.
Integrated Environmental Management	The practice of incorporating environmental management into all stages of a project's life cycle, namely planning, design, implementation, management and review.

Intertidal zone	The section of the marine environment that lies exposed at low tide and submerged at high tide.
Littoral active zone	Any land forming part of, or adjacent to, the seashore that is unstable and dynamic as a result of natural processes and characterised by dunes, beaches, sand bars and other landforms composed of unconsolidated sand, pebbles or other such material which is either unvegetated or only partially vegetated.
Low shore	The section of the intertidal zone reaching from the mean low water neap tide to the extreme low water spring tide.
Low-water mark	The lowest line to which coastal waters recede during spring tides.
Midden	A mound or deposit containing shells, animal bones, and other refuse that indicates the site of a human settlement.
Mineral Resource	The concentration or occurrence of material of intrinsic economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction.
Mining Right	A right to enter upon and occupy a specific piece of ground (in South Africa) for the purpose of working it for the extraction or collection of minerals.
Mitigation measures	Design or management measures that are intended to avoid and / or minimise or enhance an impact, depending on the desired effect. These measures are ideally incorporated into a design at an early stage.
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.
Ore	The economically mineable part of a measured and/or indicated mineral resource, including diluting materials, allowances for losses that may occur when the material is mined, and the consideration of modifying factors.
Palaeo	Older or ancient, especially relating to the geological past.
Peneplain	A more or less level land surface produced by erosion over a long period.
Perennial river	A river that flows year-round.
Red Data List	Species of plants and animals that because of their rarity and/or level of endemism are included on a Red Data List (usually compiled by the IUCN) which provides an indication of their threat of extinction and recommendations for their protection.
Seashore	The area between the low-water mark and the high-water mark.
Scoping	A procedure to consult with stakeholders to determine issues and concerns and for determining the extent of and approach to an EIA (one of the phases in an EIA). This process results in the development of a scope of work for the EIA and specialist studies.
Sense of Place	The unique quality or character of a place, whether natural, rural or urban. Relates to uniqueness, distinctiveness or strong identity. Sometimes referred to as genius loci meaning 'spirit of the place' (Oberholzer, 2005).

Slimes	Waste material containing clay and other fine minerals not able to be economically extracted.
Specialist study	A study into a particular aspect of the environment, undertaken by an expert in that discipline.
Stakeholders	All parties affected by and/or able to influence a project, often those in a position of authority and/or representing others.
Strand line	An ancient beach line located inland of the current seashore.
Subtidal	The marine habitat that lies below the level of mean low water for spring tides.
Supratidal	The area above the spring high tide mark that is not submerged by seawater. Seawater penetrates these elevated areas only at high tide during storms.
Sustainable development	Sustainable development is generally defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. NEMA defines sustainable development as the integration of social, economic and environmental factors into planning, implementation and decision-making to ensure that development serves present and future generations.
Tailings	Tailings are the materials left over after the process of separating the valuable fraction from the uneconomic fraction of an ore. Tailings are distinct from overburden, which is the waste rock or materials overlying an ore or mineral body that are displaced during mining without being processed.
Tidal level	The level of the coastal waters.
Visibility	The area from which the project components would be visible and depends upon topography, vegetation cover, built structures and distance.
Visual Character	The elements that make up the landscape including geology, vegetation and land-use of the area.
Visual Quality	The experience of the environment with its particular natural and cultural attributes.
Visual Receptors	Potential viewers (individuals or communities) who are subject to the visual influence of a particular project.

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

ENVIRONMENTAL IMPACT ASSESSMENT REPORT
And
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

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

NAME OF APPLICANT: Mineral Sand Resources (Pty) Ltd
TEL NO: +27 87 150 4010
FAX NO: +27 21 525 1902
POSTAL ADDRESS: PO Box 139, Lutzville, 8165
PHYSICAL ADDRESS: Tormin Mine, Schaapvlei Road, Lutzville
FILE REFERENCE NUMBER SAMRAD: WC 30/5/1/2/2 MR

1. IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

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

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

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

2. OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

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

(a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;

(b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;

(c) identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;

(d) determine the—-

(i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and

(ii) degree to which these impacts—

(aa)can be reversed;

(bb)may cause irreplaceable loss of resources, and (cc)can be avoided, managed or mitigated;

(e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;

(f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;

(g) identify suitable measures to manage, avoid or mitigate identified impacts; and

(a) identify residual risks that need to be managed and monitored.

PART A

SCOPE OF ASSSSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

1. Contact Person and correspondence address

a) Details of

i) Details of the EAP

Name of The Practitioner: Sue Reuther and Scott Masson

Tel No: +27 21 659 3060

Fax No: 086 530 7003 or +27 21 685 7105

e-mail address: sreuther@srk.co.za; smasson@srk.co.za

ii) Expertise of the EAP

(1) The qualifications of the EAP

(with evidence attached as Appendix 1).

Sue Reuther	
Profession:	Principal Environmental Consultant
Education:	MPhil (Environmental Management), University of Cape Town, 2004 BSc (Hons), (Economics), University College London, 2001
Registrations / Affiliations:	Certified Environmental Assessment Practitioner of South Africa (CEAPSA) Member, IAIAsa
Scott Masson	
Profession:	Senior Environmental Consultant
Education:	MLA (Landscape Architecture), University of Cape Town, 2008 BSc (Hons), (Environmental Management), University of Cape Town, 2004
Registrations / Affiliations:	CEAPSA Member of National Association for Clean Air

(2) Summary of the EAP's past experience.

(with evidence attached as Appendix 2).

Sue Reuther, BSc (Hons) (Econ); MPhil (Enviro. Man)

CEAPSA

Sue Reuther has more than 15 years of experience researching and working on issues in the environmental assessment sector. She has been involved in a variety of Environmental Impact Assessments (EIAs) as well as strategic State of Environment Reporting, the development of Environmental Management Frameworks (EMF) and the compilation of Environmental Management Programmes (EMPr's). Her experience also includes due diligence reviews and gap analysis studies against IFC and World Bank Standards. Sue also undertakes socio-economic and resource economic specialist assessments.

She holds a BSc (Hons) in Economics and an MPhil in Environmental Management and is a CEAPSA.

Scott Masson, BSc (Hons) (EnvMan); MLA (L.Arch.)

CEAPSA

Scott Masson is a Senior Environmental Consultant and has been involved in the environmental and landscape architectural field for the past 9 years. His expertise includes Visual Impact Assessment, EIAs, EMPr's, Integrated Water and Waste Management Plans, and environmental planning and sensitivity studies. Scott holds a BSc (Hons) in Environmental Management, a MLA in Landscape Architecture and is a CEAPSA.

b) Description of the property.

Table 1: Description of properties

Farm Name:	Geelwal Karoo 262/RE	C07800000000026200000
	Geelwal Karoo 262/2	C07800000000026200002
	Klipvley Karoo 153/RE	C07800000000015300000
	Klipvley Karoo 153/4	C07800000000015300004
	Klipvley Karoo 153/5	C07800000000015300005
	Klipvley Karoo 153/6	C07800000000015300006
	Klipvley Karoo 153/7	C07800000000015300007
	Perseel Weskus 191	C07800000000019100000
	Perseel Weskus 192	C07800000000019200000
	Perseel Weskus 193	C07800000000019200003
	Perseel Weskus 194	C07800000000019200004
	Perseel Weskus 196	C07800000000019600000
	Perseel Weskus 197	C07800000000019700000
	Perseel Weskus 198	C07800000000019800000
	Perseel Weskus 199	C07800000000019900000
	Perseel Weskus 200	C07800000000020000000
	Perseel Weskus 201	C07800000000020100000
	Perseel Weskus 202	C07800000000020200000
	Perseel Weskus 203	C07800000000020300000
	Perseel Weskus 204	C07800000000020400000
	Perseel Weskus 205	C07800000000020500000
	Perseel Weskus 206	C07800000000020600000
	Graauwduinen 152/3	C07800000000015200003
Application area (Ha)	• Ten beaches adjacent to Remainder of Graauw Duinen 152 and Portions of Farm Klipvley Karoo Kop 153, along a stretch of coastline north of Tormin Mine comprising 43.7 ha intended for mining and ~6 ha for haul road widening; • Inland "strand line" mining area on the Farm Geelwal Karoo 262, inland of the existing processing plant comprising 75 ha for mining; and • An infrastructure / plant expansion area of 64 ha adjacent to the existing processing plant to accommodate additional processing plants, stockpile areas, industrial yards, parking and laydown areas.	

	Current mining activities at Tormin Mine are not assessed in this EIA.
Magisterial district:	West Coast District Municipality
Distance and direction from nearest town	Koekenaap is located ~ 19 km east of Tormin Mine.
21 digit Surveyor General Code for each farm portion	See above

c) Locality map

(show nearest town, scale not smaller than 1:250000).

See Appendix 3.

d) Description of the scope of the proposed overall activity.

Provide a plan drawn to a scale acceptable to the competent authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site.

See Appendix 5.

(i) Listed and specified activities

Table 2: Listed activities

NAME OF ACTIVITY (All activities including activities not listed) (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.)	**Aerial extent of the Activity Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** **(GNR 983, GNR 984 or GNR 985)/ NOT LISTED[1]**	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**
Beach Mining	43.7 ha			
Mine Valuable Heavy Mineral (VHM) deposit on beaches		X	GN R983 (17), (19A) GN R984 (19), (26)	
Primary processing in Mobile Primary Beach Concentrator			Not listed	
Load concentrate into dump trucks			Not listed	
Haul concentrate to Run-of-Mine (ROM) stockpile at existing Processing Plant			Not listed	
Widening of Northern Haul Road and Beach Access Roads	6 ha	X	GN R983 (12), (19), (19A) GN R984 (15) GN R985 (12)	
Inland Mining	75 ha			
Remove topsoil and stockpile		X	GN R984 (15) GN R985 (12)	

[1] As amended by GN R327, GN R325 and GN R324 on 7 April 2017.

NAME OF ACTIVITY (All activities including activities not listed) (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.)	**Aerial extent of the Activity Ha or m²**	**LISTED ACTIVITY** (Mark with an **X** where applicable or affected).	**APPLICABLE LISTING NOTICE** **(GNR 983, GNR 984 or GNR 985)/ NOT LISTED[1]**	**WASTE MANAGEMENT AUTHORISATION** (Indicate whether an authorisation is required in terms of the Waste Management Act). **(Mark with an X)**
Mine VHM deposit		X	GN R984 (17), (19)	
Load ore into dump trucks			Not listed	
Haul ore along haul road to ROM stockpile		X	GN R983 (24) GN R985 (4)	
Return tailings to mine void and decant excess water and return water to Processing Plant		X	GN R983 (10), (25)	GN R921, Category B (7), (10), (11)
Rehabilitate inland mining area			Not listed	
Infrastructure Expansion Area	64 ha			
Stockpile Areas			GN R983 (28) GN R984 (15) GN R985 (12)	
Strand Line Haul Roads		X	GN R984 (15) GN R985 (4), (12)	
Mineral Separation Plant		X	GN R983 (28) GN R984 (15) GN R985 (12)	
Tailings Disposal Plant		X	GN R983 (28) GN R984 (15) GN R985 (12)	
Primary Concentration Circuit Improvements		X	GN R983 (28) GN R984 (15) GN R985 (12)	
22 kV powerline		X	GN R984 (15)	

(ii) Description of the activities to be undertaken

(Describe Methodology or technology to be employed, including the type of commodity to be mined and for a linear activity, a description of the route of the activity)

1 Introduction: Project Description

1.1 Heavy Mineral Sands

This section provides a general overview of heavy mineral sands and the sector.

The term "mineral sands" normally refers to concentrations of heavy minerals in an alluvial (old beach or river system) environment. Most mineral sands deposits (sometimes also referred to as ore in this report) are found in unconsolidated fossil shorelines several hundreds of metres to tens of kilometres and occasionally hundreds of kilometres inland from the present coastline. Repeated storm erosion and reworking over centuries or millennia may progressively enrich a mineral sand deposit. This can be observed within individual deposits being mined today and can result in enrichment of heavy mineral within a deposit (Jones, 2009).

Deposit preservation occurs over geologically longer periods through subsidence of coastal sediments, changing sea levels caused by ice ages or isostatic adjustment of continental margins. This may cause shorelines to migrate inland (marine transgression), potentially resulting in reworking older heavy mineral accumulations into larger deposits. Alternatively, migration seaward (marine regression) can occur leaving reworked deposits preserved inland (Jones, 2009).

The principal valuable minerals include ilmenite, leucoxene, rutile, zircon and monazite. Smaller volumes of garnet and staurolite are sold as niche products for specialised use.

The mineral sands sector generates two principal product streams (Jones, 2009):

- Titanium dioxide minerals – in the form of rutile, ilmenite and leucoxene. Titanium dioxide minerals are used mainly as feedstock for the world's titanium dioxide (TiO2) pigment industry commonly used in architectural and automotive paints, plastics, paper, textiles and inks. Rutile, synthetic rutile and titanium slag can be used to produce titanium metal; and
- Zircon - The most important application for zircon is in the ceramics industry in the production of opacifiers used in surface glazes and pigments. Due to its high melting point (2 200°C), zircon is used as a foundry sand in moulds, and as a milled "flour", particularly in higher temperature applications where maintaining the quality of the surface of the casting is important (Jones, 2009). Zircon is also used to produce zirconia, zirconium metal and zirconium chemicals. These are high value and growing applications resulting in increased demand for zircon (Jones, 2009).

The US Geological Survey (2018) estimated global titanium minerals (ilmenite and rutile) production in 2017 of 7.2 Million tonnes (Mt), of which South Africa accounted for 19%. Zircon production was estimated at 1.6 Mt, with South Africa accounting for 25%.

Garnet production was estimated at 1.1 Mt, with South Africa producing 300 kt – 27% of global production (US Geological Survey, 2018). Garnet is mainly used for abrasive blasting (sandblasting) where it has less environmental impacts than coal or metalliferous slags and does not have the health and safety risks associated with sand blasting using silica sands.

South Africa is the leading producer of titanium minerals and the second largest producer of zircon and garnet.

1.2 Existing Tormin Mine and Current Mining Method Overview

Mineral Sand Resources (Pty) Ltd (MSR) owns and operates the Tormin Mineral Sands Mine (Tormin Mine) on the West Coast of South Africa (Appendix 3). Tormin Mine is located on and adjacent to Farm Geelwal Karoo 262, approximately 18 km north of the Olifants River Estuary and 25 km west of Lutzville. Eskom's Sere wind energy facility is located on the ridgeline inland of Tormin Mine.

The Mine holds two Mining Rights (MR162 and MR163), covering an area of 119.9 ha, with an approved Environmental Management Programme (EMPr) to mine VHM below the high-water mark adjacent to Farm

Geelwal Karoo 262 (Appendix 3). Tormin Mine is a 24 hour a day, 7 days a week operation and has been in operation since late 2013. The Mine employs more than 200 people.

The Tormin Mine operation includes:

- Mining on the beach;
- Access roads;
- Processing plant and associated infrastructure area;
- Water supply; and
- Power supply.

These are described further below.

1.2.1 Beach Mining

MSR currently uses hydraulic excavators to mine VHM beach deposits: beach sand is excavated to an average depth of 6 m, along a ~75 m wide[2] and ~12 km long stretch of beach, with a 10 m setback from the toe of the cliff.

The excavated sand (ore) is loaded into dump trucks. The dump trucks haul the ore to the Run-of-Mine (ROM) stockpile located at the processing plant on the elevated coastal plain (Appendix 5, Figure 1).

MSR coordinates beach mining activities with the Trans Hex Group (THG), who mine the diamondiferous gravel below the VHM deposit (refer to Section 1.4) to ensure efficient, often concurrent mining of the VHM deposit and the diamondiferous gravel.

1.2.2 Access and Haul Roads

Access to Tormin Mine is from Koekenaap via Robeiland and De Punt, or from Koekenaap via Kommandokraal and Schaapvlei. The gravel road extending the length of Farm Geelwal Karoo 262 is maintained by the Mine and provides access to the processing plant.

Five existing gravel tracks down to the beach were upgraded by MSR. These roads are used as haul roads / ramps to transport ore from the beach to the processing plant, where it is delivered to the ROM stockpile.

1.2.3 Processing

The processing plant and associated infrastructure are located on the elevated coastal plain on Farm Geelwal Karoo 262, occupying an area of approximately 10 ha (Appendix 5, Figure 1).

A front-end loader feeds the ore from the ROM stockpile into a feed hopper and conveyor system, which conveys the material to a trommel (mechanical screening machine) where seawater is introduced to form a slurry. The slurry from the slurry tank is pumped to the Primary Beach Concentrators (PBCs) (Figure 1) where the heavy and light particles are separated by means of gravity separation.

The light particles (quartz and silica [beach sand]) are retreated in the Tailings Scavenger Plant (TSP) modules to increase recovery of valuable minerals. The residual light particles (tailings) are combined with the tailings from the Secondary Concentration Plant (SCP) at the Tailings Disposal Plant. The tailings then report to the Tailings Disposal Hoppers for disposal onto the beach below the processing plant as a slurry by pipeline (Appendix 5, Figure 1) or via dump truck where the natural wave action levels the beach.

The heavy particles are stockpiled as a heavy mineral concentrate prior to processing at the SCP (Figure 1) at a throughput of ~110 tons per hour (tph). The SCP includes trash screen, spirals, magnetic separators and screens to produce a:

[2] The centreline of the mining area along the beach moves with tidal fluctuations and is midway between the high-water mark and low-water mark of the sea at the time of mining.

- Non-magnetic concentrate rich in zircon and rutile;
- Garnet concentrate; and
- Magnetic concentrate containing ilmenite.

A Garnet Stripping Plant (GSP) was installed and commissioned in 2016 to improve production efficiency. The GSP removes garnet and low density silicates from the feed to the SCP using gravity and magnetic separation, thereby increasing the non-magnetic / ilmenite feed grade to the SCP.

Annual production of concentrates at Tormin Mine was ~674 720 tonnes gross in 2017 inclusive of refeeding garnet and ilmenite concentrate to improve concentrate grades. Net production in 2017 was 372 418 tonnes. The finished ilmenite and garnet concentrate is transported to the Port of Saldanha via Vredendal, Leipoldtville, Elandsbaai, Velddrif and Vredenburg for bulk export. The non-magnetic zircon / rutile concentrate is bagged and transported to Cape Town for export in containers. At present (2017) there are ~ 36 truck trips per day from Tormin Mine to the Port of Saldanha (1 210 monthly in one direction; 2 420 trips in both directions). Currently, ~ 200 000 tonnes per annum (tpa) of garnet concentrate is exported in bulk under an off-take agreement with an international company. Excess production is stockpiled on-site for later transport as required.

There are two process (sea) water dams at the SCP (Figure 1). The process water dams are lined and have a combined storage capacity of ~49 000 m^3.

Prefabricated containers provide offices, workshops and stores in the processing plant area.


Figure 1: The PBCs (left) and the SCP and process water dams (right)

1.2.4 Water Supply

MSR utilises water from two sources, namely seawater for processing activities from the seawater intake located on the coast and fresh water for domestic purposes, the latter transported by truck to site from Lutzville. The current daily seawater intake rate is approximately 7.2 Ml/d. Seawater is pumped to two process water dams at the SCP (Appendix 5, Figure 1). Process water from the SCP and GSP is discharged into the secondary process water dam for settling. The water is then recirculated back to the main process water storage dam for further use in processing. Excess process water is returned to the beach with the tailings as a slurry.

1.2.5 Power Supply

Diesel powered generator sets (gensets) are currently used at Tormin Mine to provide power to the Mine. Power is generated by 4 x 1250 kVA gensets with an installed power capacity of 3.8 kVA. The gensets are containerised and located adjacent to the SCP and GSP processing plant.

1.3 Geology of the Deposits

The VHM deposit in the Tormin area occurs in a present-day beach environment and in an older palaeo-beach strand line found 300 – 500 m inland.

The coastal zone adjacent to Tormin Mine consists of alternating coastal dunes and cliffs. Cliffs have formed from the more resistant basement rocks creating small outcrops and headlands whilst dunes have developed over the softer shales and schists (basement rock). The coastline is in a natural regressive state eroding and undercutting cliffs and palaeo-beach deposits which, together with the northerly current transporting mineralised marine sediments, function as a replenishment source for heavy minerals along the coast.

The dune coast north of Tormin Mine is characterised by alternating poorly developed bays and headlands. On headlands the coastal plain often extends seawards onto the headland, and a foredune is absent. A broader dune structure is associated with embayments, comprising poorly developed hummock dune zones which blend into constantly rising foreland dune slopes, with a well-defined transition into the coastal plain approximately 20 m above mean sea level (amsl). Lower angled slopes (at approximately 45º) covered in uniform brown sandy loam, occur above the cliff face and extend upwards to an elevation of approximately 50 m amsl.

The area under application has been investigated and mined for VHM deposits as far back as the 1930s (Haughton, 1931). Subsequent geological surveys and exploration programmes investigated the distribution, mineralogy and economic potential of the VHM deposits along the coastline of Geelwal Karoo (Toerien & Groeneveld 1957, Abele 1989, Swart 1990, Barnes 1998).

The accumulation of heavy minerals in the beach sands of the coastal zone in this region is not related to the inland geology of the area, but more to ongoing erosion of elevated historic beach terraces, and subsequent marine transport of released minerals.

Heavy minerals concentrated in the coastal bays have formed enriched zones of ilmenite, garnet, rutile and zircon. This material has been deposited unconformably over the basement rock - micaceous schist. The beach sand is up to 6 m thick in places and consists of a basal conglomerate pebble unit which fills in the unconformities in the bedrock and is overlain by marine sands that contain the VHM deposit. The conglomerate pebble material contains the diamondiferous material which the THG and numerous other groups and contractors (e.g. De Beers and Namakwa Diamond Company) have been mining since the 1950s.

The beach environment on the West Coast is extremely dynamic with large volumes of sand displaced between tides and across seasons (Figure 2). However, broad trends in the heavy mineral distribution are evident as described:

- A low tide lower grade zone consisting of high grade garnet, low grade ilmenite and zircon. The material is not well sorted because of a constant mixing action in this zone. This zone contains a higher percentage of lighter minerals such as quartz;
- The intertidal mixed zone consisting of lower grade garnet and zircon with a moderate grade ilmenite. This zone reflects better sorting and has local high grade garnet lenses; and
- The high tide zone consisting of high grade zircon, garnet and ilmenite. This area represents sediments that have been extensively reworked and preferentially sorted. Lighter minerals have been washed away leaving only the heavy minerals.

Heavy mineral enriched mega-ripples and longshore bars in the sub-tidal area indicate the existence of a reserve in the offshore zone, which acts as a replenishment source for the VHM beach deposits. The heavy minerals are constantly replenished by the transport of new sediment from deeper waters, much of which have been derived from erosion of deposits accumulated in the elevated historic beach terraces onto the present beach.

The inland palaeo strand line, known as the 35 m strand line and the subject of this application, is one of three strand lines on Farm Geelwal Karoo 262 that form part of an inland VHM deposit (Figure 3). The 50 m strand line is located east of the 35 m strand line and the 25 m strand line is currently being eroded on the cliffs.

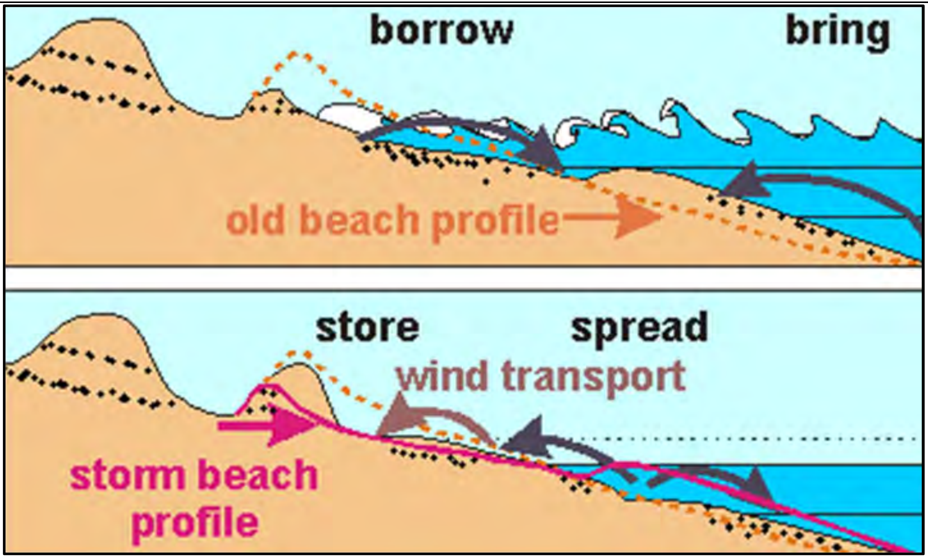


Figure 2: The heavy mineral sand beach depositional cycle

Source: MSR, 2017

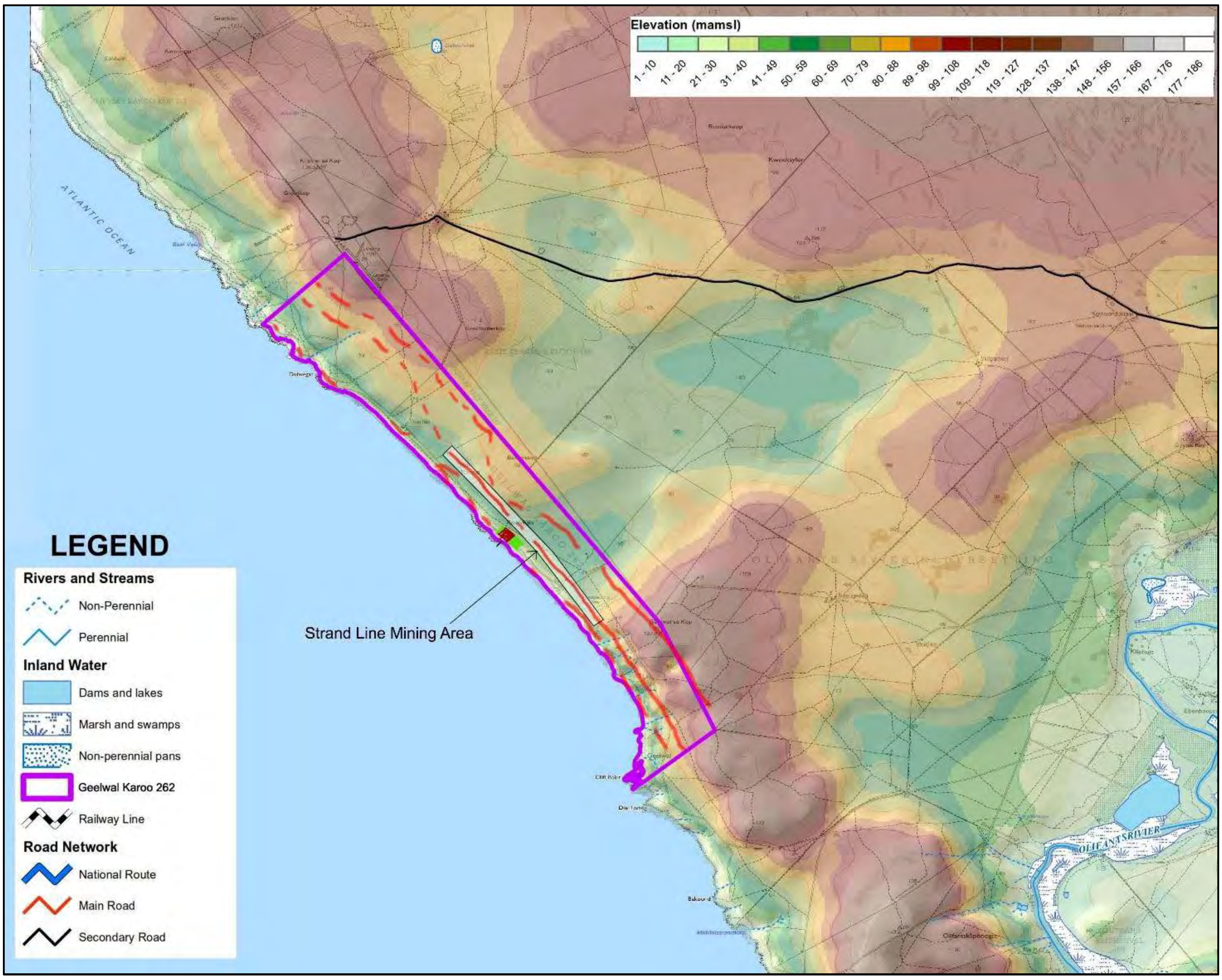


Figure 3: Inland strand lines (dashed red lines) on Farm Geelwal Karoo 262

Source: MSR, 2017

1.4 Prior / Current Mining Activities

Areas along the coast adjacent to and north of Tormin Mine have been disturbed from prior and current mining and/or prospecting activities. Mining companies have been operating in the area since the 1950s. The THG has the right to mine the beaches north and south of Tormin Mine for diamondiferous gravel below the VHM deposit, down to the bedrock. The Namakwa Diamond Company mined the adjacent inland areas between 2004 and 2006.

Appendix 6 indicates the extent of THG's approved Mining Right areas - concessions 11(a), 12(a) and 13(a) occupy a coastal strip from 31.49 m seaward of the low-water mark to approximately 1000 m seawards of the high-water mark north of the Olifants River mouth. The associated surf-zone and admiralty strip concessions Weskus, Bethel, Strykloof, De Punt, Papendorp and Hollebakstrandfontein occupy a narrow coastal strip ~70 m to ~300 m wide from 31.49 m seaward of the low-water mark to the edge of the adjacent farm boundaries. THG conducts the following mining methods on the above-mentioned concessions below the high-water mark to extract the diamondiferous gravels:

- Beach mining – removal of beach sand to reach the bed rock;
- Shore-based mining – use of diver-assisted suction pumps to extract gravels from subtidal gullies and potholes to ~10 m; and
- Vessel-based mining – diver-assisted suction pumps to ~25m.

In earlier years, the coastline north of Tormin Mine was mined by De Beers Consolidated Mines. According to the THG EMPr (2002) and THG EMPr Update (2005), the extensive terrestrial diamond mining and prospecting which has occurred along the coastline inland of concessions 11(a), 12(a) and 13(a) resulted in widespread damage and disturbance to the coast (Figure 4).

Mining damage along the coast adjacent to concessions 11(a), 12(a) and 13(a) is comprehensively described in the THG EMPr. Past damaged sites are indicated on annotated orthophoto maps in Appendix 6.

Figure 4: Mining damage along the coast

1.5 Exploration Results

THG completed a resource assessment of the VHM deposits of the northern beaches as part of an overall economic assessment to mine the diamondiferous gravels. Exploration consisted of:

- Hand held auger drilling in 1989;
- Reverse Circulation drilling in 1990 and 1991; and
- One metre diameter bulk sample drilling in 1991.

A total of 572 holes were drilled and analysed by THG. The feasibility study compiled by THG in 1992 included a defined mineral resource.

During 1999, THG conducted inland drilling and identified the raised beach deposits. The inland strand lines were defined based on bulk sample information, drilling logs and geophysical surveys undertaken by MSR (airborne magnetics and radiometric survey).

Addition resource information was obtained from historical exploration and mining work by Namakwa Diamond Company in 2003 and 2004, Goliath Gold in 2012 and 2013 and numerous published research and sampling work by Philander, Rozendaal and Elferink.

MSR conducted regional aeromagnetic and radiometric surveys (Xcalibur) in 2014 to confirm the above results and HMS trends.

A total base resource of 15.4 million tonnes (beach and inland strand line) has been identified by MSR, excluding potential beach replenishment.

2 Proponent's Project Motivation

MSR has been mining the VHM beach deposits at Tormin Mine since 2013, with an (anticipated) continual decline in grade. This decline in grade is not surprising because, although the resource is partly replenished by erosion and marine transport, ultimately the resource at a given location will be depleted if mining continues at the current intensity. A period of reduced mining will allow the beaches in the current Mining Right area to replenish, thereby ensuring the long-term operation of the Mine.

It is likely that mining operations will need to be scaled down or closed for Care and Maintenance should resource grades remain low. If mining operations are scaled down, MSR anticipates that approximately 116 full term employees will be retrenched. If Tormin Mine is closed without a prospect of mining additional resources (as described in this report), approximately 216 full term employees (11% of the local workforce) and more than 80 contractors and suppliers are likely to be retrenched. The closure of Tormin Mine will terminate the ~ R 500 million annualised average contribution to the South African economy.

The extension of Tormin Mine will extend the Life of Mine (LoM) thereby securing long-term employment at the Mine and contribution to the local and regional economy. Approximately 80 additional employment opportunities will be created by the proposed Mine extension, predominantly at the proposed MSP. The project will require initial capital investment in excess of R 52 million and will generate some R1.5 billion per annum in taxable revenue. Through local procurement of ~R500 million, the project is expected to contribute significantly to the local economy.

MSR proposes to construct an MSP at Tormin Mine to beneficiate the ore and increase overall mineral recovery. It is expected that the establishment of the MSP will result in the following benefits to MSR:

- Increase revenue by increasing mineral recovery to saleable products and production of higher value products;
- Reduce shipping costs as waste minerals will be rejected prior to export;
- Reduce processing costs as processing will occur on site and not at alternative locations (e.g. USA, Australia);
- Reduce sale agreement risk between MSR and off-take customers as MSR will control mineral recovery and product quality via the MSP; and
- Upgrade the low grade ilmenite concentrate making it more marketable.

3 Proposed Mine Operations Expansion

MSR proposes to extend mining operations to ensure the ongoing operation of Tormin Mine. The proposed project consists of the following key activities which are described in further detail in the sections below (refer to Appendix 5, Figure 1 to Figure 12):

- Ten beaches adjacent to Remainder of Graauw Duinen 152 and Portions of Farm Klipvley Karoo Kop 153, along a stretch of coastline north of Tormin Mine comprising 43.7 ha mining and ~ 6 ha haul road widening;
- Inland "Strand line" mining area on the Farm Geelwal Karoo 262, inland of the existing processing plant comprising 75 ha mining; and
- An infrastructure / plant expansion area of 64 ha adjacent to the existing processing plant to accommodate additional processing infrastructure, processing plants, stockpile areas, industrial yards, parking and laydown areas.

3.1 Beach Mining

MSR proposes to mine VHM deposits on ten isolated beaches (identified as Beach 1 to Beach 10 in Appendix 5, Figure 2) along a stretch of coastline north of Tormin Mine (Figure 5, and refer to photographs of northern beaches, Appendix 12). The proposed beach mining area is 43.7 ha while ~6 ha will be disturbed for the widening and upgrade of the public road OP9764 and the beach access roads (Appendix 5, Figure 2 to Figure 10).

The VHM deposits in the beach extension area contain garnet, ilmenite, zircon and rutile. The mineral composition of the beach VHM deposits is presented in Table 3.

Table 3: Heavy mineral composition – beach VHM resource excluding replenishment

Mining Area	Total Resource (Mt)	Total HM %	Zircon % of resource	Ilmenite % of resource	Rutile % of resource	Garnets % of resource
Beach 1 - 10	2.03	22.65	0.68	3.62	0.47	16.71

Source: MSR, 2017

Beach mining will be conducted along the beaches between the low-water mark of the sea and the toe of the dunes / cliffs with a 10 m buffer zone between the cliffs and the proposed beach mining area (refer to Appendix 5, Figure 3 to Figure 10). Mining will proceed along each beach depending on tides and mine schedule grade requirements. Beach mining will focus predominately on the larger resource beaches (i.e. Beach 5, 7 and 10).

VHM deposits will be mined to an average depth of 6 m. Where the VHM deposit is shallow or poorly developed, mining will take place where tides allow. Where thick VHM deposits are found near the low-water mark, a sand berm, wave breaker (ditch in the sand), or similar will be constructed on the seaward side of the deposit, providing temporary[3] safety protection from the incoming tide whilst ensuring the mining process is efficient and minimising the need to return to the same area following tide retreat.

Mining will be undertaken using hydraulic excavators, slurry pumps and other ancillary equipment (e.g. graders, watercart, dozer) to feed the ore into a mobile PBC. Considering the number of trucks required to transport material to the processing plant at Tormin Mine, it would be more efficient and have less impact to concentrate the material on the beaches and transport the concentrate to the processing plant. This will also reduce the number of truck trips along OP9764 between the beaches and the processing plant.

The ore will be processed (primary processing) on the beaches using a mobile PBC at ~150 tph to extract the heavy mineral concentrate (about 20-40% of the ore will report to the concentrate). The concentrate will be loaded into ~36 ton dump trucks and hauled up the beach access road to the haul road and then onward to the ROM stockpiles at the processing plant for further processing.

Tailings (mainly quartz [beach sand]) from the mobile PBC will be discharged onto the beach (above the tide level) and, because of the low solids content of the slurry and the energy of the waves, will disperse quickly on the beach (see Section 3.5, “Tailings Management”).

Once the deposit has been mined, wave action will naturally return the beach to its former condition in a short period of time (and partly replenish VHM deposits). In some instances, bulldozers will reshape the beach to the original profile where mining occurs above the high-water mark.

MSR will coordinate beach mining activities with THG, which has the right to mine diamondiferous gravel on the beaches, to ensure efficient mining of the VHM deposit and the diamondiferous gravel.

Figure 5: Beach 5 (left) and Beach 6 (right)

3.2 Inland Strand Line Mining

MSR is proposing to mine a 75 ha inland VHM deposit in an area 100 - 300 m wide and ~4.8 km long, inland (east) of the existing processing plant, but seaward of the Sere wind energy facility (Figure 6). The inland mining area will consist of a north inland mining area and a south inland mining area on either side of the proposed infrastructure / plant expansion area (Appendix 5, Figure 11).

Figure 6: View across the inland strand line with the existing processing plant right of photograph

A total of ~ 13.5 Mt of material will be mined at the inland strand line. The mineral composition of the inland VHM deposit is presented in Table 4.

[3] Based on MSR’s experience with current beach mining operations, this is normally a few hours to about 1 to 3 days depending on the tide cycle.

Table 4: Heavy mineral composition – inland VHM deposit

Mining Area	% of Mining Area	Total VHM		Zircon		Ilmenite		Rutile		Garnet	
		%	tons	%	tons	%	tons	%	tons	%	tons
Upper Ore	68	15.9	1,451,990	1.5	136,980	8.9	812,749	0.6	54,792	2.6	237,432
Lower Ore	32	30.4	1,327,716	3.0	131,025	17.63	755,575	0.7	30,572	4.8	209,639

Source: Synergy Mining, 2017

Strip mining of the inland strand line will be undertaken progressively as discussed below (refer to the typical mine layout, Figure 7):

- Vegetation and topsoil (to a depth of approximately 30 cm) will be stripped by bulldozers and scrapers just before mining activities occur and stored in stockpiles in designated areas or - where mine sequencing allows - placed directly over tailings backfilled to the preceding mine void. This has the advantage of ensuring that vegetative material (including the seedbank) is returned to or very close to the area from which it was removed. Topsoil from the initial box cut will be stored in the existing topsoil storage area (Appendix 5, Figure 11) because an area readied for rehabilitation will not be immediately available;
- Overburden will be removed to a depth of 2-25 m (depending on resource depth) and will immediately be backfilled into an adjacent, previously mined-out area or temporarily stored in the designated overflow areas (Infrastructure Buffer Area North and South) located in the infrastructure / plant expansion area (Appendix 5, Figure 12). Long-term storage of overburden will only be required when mining in a new discrete area commences, i.e. when overburden is removed for the first time and no proximate mined-out area is available for backfilling;
- A 15 m wide haul road on the western side of the proposed mining areas, and ramps, will provide access into the pit for mining vehicles and plant / equipment. The haul roads between the mining areas and the infrastructure / plant expansion area will be located within the proposed mining areas or infrastructure / plant expansion area footprints;
- Excavators will mine the mineralised sand layer up to a maximum depth of 30 m (average of 10 m) in 5 m benches to the depth of the strand line. The sand and ore will be loaded into dump trucks and transported to the existing ROM stockpiles at the processing plant or the new ROM stockpile area in the infrastructure / plant expansion area (Appendix 5, Figure 12). The ore extraction process is entirely mechanical, and no chemical compounds will be used other than fuel and lubricants to power equipment and machinery;
- The ROM ore will be processed in an upgraded Primary Concentrator located in the infrastructure / plant expansion area (Appendix 5, Figure 12);
- Tailings will be returned (pumped) to the mine void as backfill (see Section 3.5, “Tailings Management”) and then covered with stockpiled overburden and topsoil material; and
- Rehabilitation will be undertaken as soon as the mining path allows. Once an area has been mined and backfilled, the backfilled material will be re-profiled to create the desired landform. Re-profiling will aim to mimic the pre-mining topography as far as possible, but the final land surface will be lower than the original landform due to the removal of the ore. The backfill material will be reseeded (if required) and the final rehabilitated area demarcated as a No-Go area.

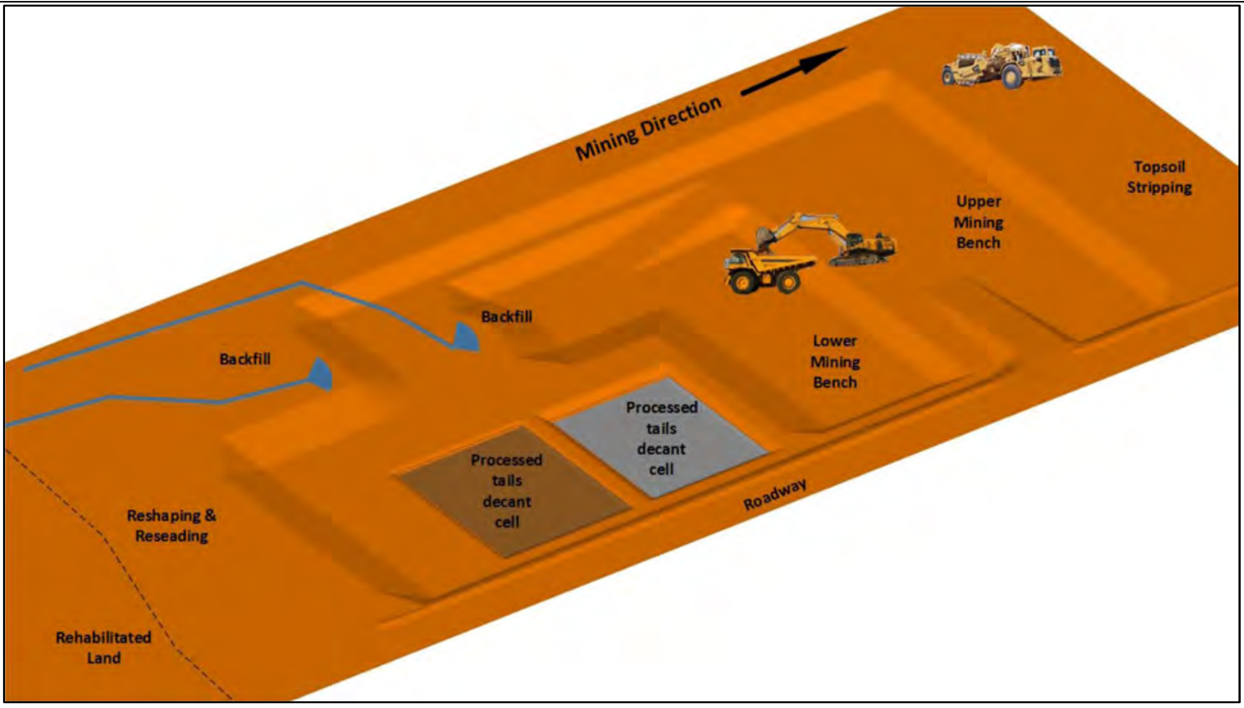


Figure 7: Typical mine layout

Source: Synergy Mining, 2017

3.3 Ore Transport and Storage Areas

3.3.1 Beach Mining

MSR proposes to utilise existing gravel roads from the Tormin Mine entrance (off the DR2225) to the beaches to serve as haul roads for dump trucks (Figure 9). This includes public road OP9764 adjacent to the coast (Appendix 5, Figure 2) and informal beach access roads currently used by THG and, previously, by Namakwa Diamond Company and De Beers (Appendix 5, Figure 3 to Figure 10) for their mining operations in the same area.

Figure 8: Existing beach access roads to be utilised by MSR

Beach 1 and Beach 10 are located approximately 2.5 km and 19 km from the Tormin Mine entrance, respectively. The access roads from OP9764 to the beaches will be via existing gravel roads which range between 150 m and 2.2 km in length with an average length of about 500 m.

Existing beach access roads will be widened by a maximum of 4 m to achieve a road width of 7 – 8.75 m. An area of ~ 2.1 ha will be disturbed by beach road widening (Table 5). The cross-fall of the beach access roads will be between 3-6% to ensure adequate drainage and reduce erosion potential. Where stormwater run-off is expected, cut-off berms will be constructed on the road edge[4].

MSR has identified an alternative (existing) beach access road to Beach 1 to reduce the potential impact on a drainage line identified by the freshwater ecologist (Appendix 5, Figure 3).

Table 5: Beach access road widening

Beach	~ Length (m)	~ Average width (m)	Proposed widening (m)	Proposed width (m)	Disturbed area (m^2)
Beach 1	2 240	5	3.75	8.75	8 400
Beach 1 Alternative	*1 750*	*4*	*4*	*8*	*7 000*
Beach 2	550	4	4	8	2 200
Beach 3	250	4	4	8	1 000
Beach 4	350	3	4	7	1 400
Beach 5	220	4	4	8	880
Beach 6	150	3.5	4	7.5	600
Beach 7	340	7	1.75	8.75	595
Beach 8	450	3.5	4	7.5	1 800
Beach 9	280	4	4	8	1 120
Beach 10a	290	3	4	7	1 160
Beach 10b	400	4	4	8	1 600
Total disturbed area (m^2)					20 755
Total disturbed area (ha)					**2.0755**

Dump trucks, with a payload of ~ 36t (Figure 9) will transport approximately 800 tonnes of concentrate per day from the beaches to the processing plant in every second year when the northern beaches are mined (see Section 3.15, “Mine Schedule”). Approximately 20 truck return trips per day are planned between the beaches and the processing plant. The haul roads will also be used by light vehicles to transport staff, fuel, water and equipment to the beaches.

MSR will widen public road OP9764 (Figure 9) to 8 m between Farm Geelwal Karoo 262 and the northern beaches to safely accommodate two-way traffic, to ensure compliance with the Department of Transport’s Structural Design, Construction and Maintenance Guidelines for Unpaved Roads (TRH20, 1990). In consultation with the relevant roads authority, MSR will implement management measures (e.g. road signs, speed limits, etc.) to ensure that the public is still able to safely use OP9764 to access this stretch of coast.

MSR will grade the roads as required. A suitable road surface material will be used which may need to be replenished (due to gravel loss). The thickness and type of the wearing course layer will depend upon in-situ testing to assess if the material is suitable for compaction, or whether additional structural layers are required. The quality of material is expected to be at least a G7 subbase material[5].

[4] Any stormwater protection measures will be installed within the maximum road widening width of 4 m.
[5] Generally, a G5 or G6 material is classified as natural gravel and a G7 to G10 material is classified as a gravel-soil (www.asaqs.co.za).

Figure 9: Public road OP9764 (left) and an example of a dump truck MSR intends using to haul ore from the beaches to the plant (right)

Source: MSR, 2018

Excavators and a mobile / semi-mobile PBC (Figure 10) will be walked slowly to the beach or transported on a low-loader, depending on access road conditions and distance. The PBC may be moved onto the beach access ramps during high tide. No other infrastructure or laydown areas are proposed for beach mining activities.

No additional ore storage areas are required for beach mining activities.

Figure 10: Example of a mobile PBC potentially to be used by MSR on the beaches

Source: MSR, 2017

3.3.2 Inland Mining

A 15 m wide haul road on the western side of the proposed mining areas, and temporary access ramps (at ~8 degrees), will provide access into the pit for mining vehicles and plant / equipment. The haul roads between the mining areas and the infrastructure / plant expansion area will be located within the proposed mining areas or infrastructure / plant expansion area footprints (i.e. alignments have not yet been identified, but the roads will be located within the disturbed footprint).

Table 6: Location of inland mining haul roads

	Start	Middle	End
North Inland Mine Area	31°32'57.61"S; 18°5'37.25"E	31°32'29.00"S; 18°5'8.37"E	31°31'53.88"S; 18°4'41.72"E
South Inland Mine Area	31°33'17.21"S; 18° 5'49.20"E	31°33'39.33"S; 18° 6'9.05"E	31°34'0.04"S; 18° 6'28.80"E

MSR will either utilise existing ROM stockpile areas at the processing plant or new ROM stockpile areas (north and south) in the infrastructure / plant expansion area (Appendix 5, Figure 12).

Overburden and topsoil will either be stockpiled in the previous mining area or in the designated overflow areas (Infrastructure Buffer Area North and South) located in the infrastructure / plant expansion area (Appendix 5, Figure 12). Topsoil from the first boxcut will be stored in the existing topsoil stockpile area at the Mine for rehabilitation (Appendix 5, Figure 11).

Additional product and concentrate / process stockpile areas are included in the infrastructure / plant expansion area (Appendix 5, Figure 12).

All stockpile areas in the infrastructure / plant expansion area will incorporate slotted drain coils and any seepage from the stockpiles will be decanted into sumps and returned (pumped) to the process water dams. MSR estimates that the moisture content of the ROM stockpiles will be ~4%, the concentrate and process stockpiles ~10% and the product stockpiles ~1%.

3.4 Transport of Product to Saldanha and Cape Town

Transport of product to the Port of Saldanha (for bulk export) and Port of Cape Town (for bagged product export in containers) will be on public roads, using 36 t road trucks (B Doubles). Annual saleable mineral production will range from 354 000 tpa to 421 000 tpa which equates to 27 to 32 truck movements per day between the Mine and the Ports of Saldanha and Cape Town. Running down the existing Garnet Concentrate stockpiles increases the average truck movements to 43 per day, until the stockpiles are depleted in ~4 years' time[6]. Approximately 79 000 tpa to 91 000 tpa is expected to be transported to the Port of Cape Town, with the remainder transported to the Port of Saldanha.

MSR is currently exploring the option of carting material via rail and is discussing this option with Transnet and various service providers[7].

3.5 Tailings Management

3.5.1 Beach Mining

A front-end loader or excavator will load the ore into the PBC where the heavy and light particles will be separated by means of gravity separation, with seawater added via a slurry pump (Figure 11). Tailings (mainly quartz [beach sand]) from the PBC will be discharged onto the beach (above the tide level) and, because of the low solids content of the slurry and the energy of the waves, will disperse quickly on the beach.

Approximately 1-2% of beach mine tailings will be discharged via the existing tailings discharge pipeline from the processing plant onto the beaches adjacent to Farm Geelwal Karoo 262 (Appendix 5, Figure 12).

[6] As MSR initially anticipated higher annual production of ~750 000 tpa saleable product, the traffic specialist based the assessment on a worse case scenario of 54 truck movements per day. The assessment is thus very conservative.

[7] As an agreement between MSR and Transnet has not yet been finalised, the traffic specialist has assessed the worst case scenario for the number of truck movements per day between the Mine and the Port of Saldanha and Port of Cape Town.

Figure 11: Example of an excavator and slurry pump potentially to be used by MSR on the beaches

Source: MSR, 2017

3.5.2 Inland Mining

The average tailings production is approximately 711 ktpa. Total anticipated tailings from inland mining will be approximately 6.6 Mt. Tailings will have a (seawater) water content of ~ 55% with the aim of extracting 100 % of free-flowing (decant) water after settlement.

Tailings will be pumped as a slurry from the processing plant, via the Tailings Disposal Plant (Appendix 5, Figure 12), and backfilled in the mine void, with a portion used to construct (temporary) containment cells within the mine void. Tailings, including fine tailings, from the processing plant will be conveyed by pipeline and deposited in the containment cells (Table 7). The total length of the tailings disposal pipelines from the processing plant to the north and south inland mine areas will be ~ 5 km with an inside diameter of up to 350 mm.

Table 7: Location of tailings disposal pipeline corridor

	Start	Middle	End
North Inland Mine Area	31°32'59.35"S; 18° 5'44.65"E	31°32'30.00"S; 18° 5'17.29"E	31°31'51.76"S; 18° 4'45.33"E
South Inland Mine Area	31°32'59.65"S; 18° 5'45.10"E	31°33'27.24"S; 18° 6'10.56"E	31°33'58.80"S; 18° 6'30.06"E

The fine tailings and slimes (slimes estimated to be ~1% by volume) will be allowed to settle in the containment cells. Water in the fine tailings and slimes will either be pumped from the containment cells via a decant pipeline or will drain through the containment (sand) walls to a sump and pumped to the process water dams for reuse in processing (Figure 12). The return water pipeline (inside diameter of 350 mm) from the mine void to the process water dams will be installed in the tailings disposal pipeline corridor (Table 7) and the proposed process water pipeline corridor (see Section 3.8, "Water Supply").

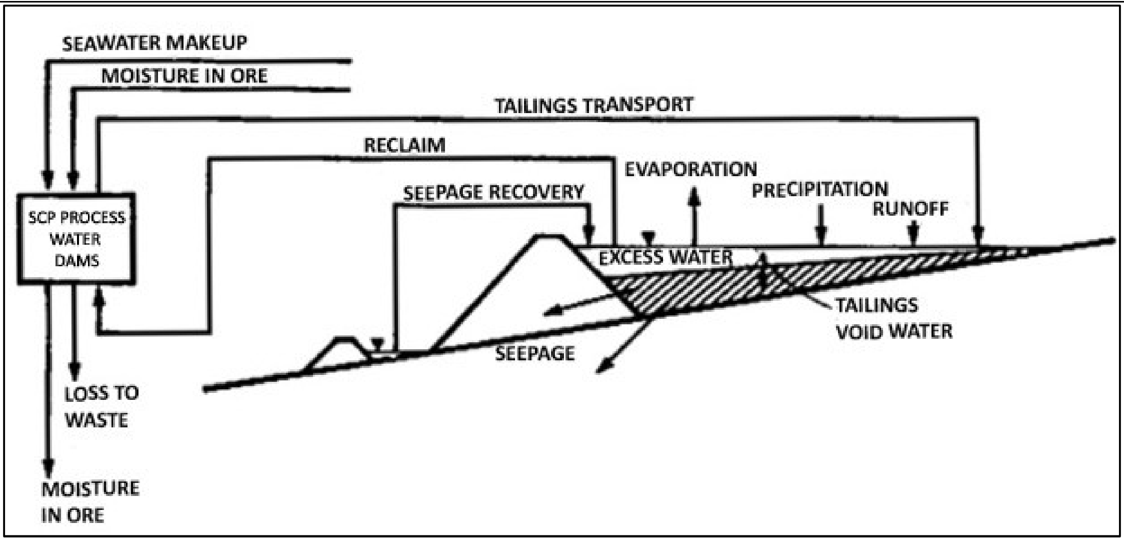


Figure 12: Conceptual diagram of the tailings water balance

Source: Adapted from AEMCO, 2017

Backfilled tailings and overburden will be profiled to mimic original topography as closely as possible before topsoil is replaced for rehabilitation following reseeding, where required.

Mine Residue (Waste) Classification

The Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits (GN 632 of 2015) specify requirements for managing mine residue deposits based on the type of the residue (mine waste). In accordance with section 7 of the Regulations, the design of residue stockpiles and residue deposits must take cognizance of the residue characterisation (to ensure no harm to the environment).

The National Norms and Standards for the Disposal of Waste to Landfill (GN636 - promulgated in terms of the National Environmental Management Waste Act 59 of 2008 [NEM:WA]) specify design requirements for residue deposit facilities (in this case the mine void) based on the type of the residue (in this case tailings and fine tailings). Waste type is determined (classified) based on chemical characterisation. The Regulations specify the class of residue disposal facility required for each waste type.

Residue Characterisation

The residue characterisation study by AEMCO (Appendix 13) analysed the chemistry of the residue material and the chemistry of the receiving environment at Tormin Mine. Based on the chemical analysis (Table 8), no acid forming minerals (e.g. sulphides) were identified. Based on samples taken, AEMCO considers the tailings at Tormin Mine to be inert and chemically stable with no potential to generate harmful leachate, even with the use of seawater in processing. The use of seawater in processing will introduce additional salts into the receiving environment. These salts are highly soluble and can be easily mobilised by groundwater or rainwater and leach into the surrounding environment.

The AEMCO study indicates that the salt load introduced into the mine void is comparable to the salinity levels of the receiving environment (Table 9). The bedrock clayey sand-schist layer and the strand line material is brackish to highly brackish. This is because the receiving material is the product of marine erosion and deposition and was exposed to seawater during formation. The material with the lowest salt load is the near surface material (topsoil) with a salt load of 1785 mg/kg (Table 9). This is still considered by AEMCO to be brackish alkaline material.

Table 8: Chemical analysis of residue material at Tormin Mine

			Sea Water	Plant return wate	Inland Strandline					Basement	
		Units		S/P (Slimes)	T/S (Topsoil)	C/S (Clayey Sand)	A/S (Aeolian Sand)	M/L (Strandline)	P/L (Pebbly Layer)	C/C (Clayey Sand/ Channel Clay)	S/T (Schist)
Chemistry Parameters	Alkalinity-Total as $CaCO_3$	(mg/kg as $CaCO_3$)	141	69.6	119	523	28.8	110	167	75.9	19.8
	pH @25°C	pH units	7.5	9.34	8.09	8.66	7.07	8.23	8.5	8.24	7.06
Physical Parameters	Electrical Conductivity @25°C	mS/m	5300	2148	255	807	864	389	429	708	1410
	Total Dissolved Solids @105°	mg/kg	**37100**	**15036**	**1785**	**5649**	**6048**	**2723**	**3003**	**4956**	**9870**
Cations and Anions	Calcium as Ca	mg/kg	426	693	7.11	25.2	16.1	2.51	4.65	29.9	66.1
	Sodium as Na	mg/kg	11300	3860	465	1720	1670	777	863	1390	2830
	Magnesium as Mg	mg/kg	1100	68.8	4.93	5.79	16.6	2.17	5.29	20.2	80.8
	Potassium as K	mg/kg	603	217	53.4	96.6	178	36.1	54.9	88.2	191
	Chloride as Cl^-	mg/kg	20400	6540	570	1950	2340	1002	1104	2280	3840
	Fluoride as F^-	mg/kg	1.07	2.73	0.57	3.33	<0.3	1.44	2.85	0.66	0.84
	Sulphate as $SO4^{2-}$	mg/kg	2740	1080	195	451	569	184	249	328	719
	Nitrate as N	mg/kg	<0.5	1.8	1.8	2.1	<1.5	<1.5	3	1.8	1.5
	Bromine as Br_2	mg/kg	<0.1	4.38	12.8	20.4	0.78	11.8	11.9	1.8	2.25
		Total Soluble Salts cations & anions (mg/kg	**36,570**	**12,468**	**1,311**	**4,274**	**4,790**	**2,017**	**2,299**	**4,141**	**7,731**
		Ranking (Soluble Salts/ Electrical Conductiv	1	2	9	5	4	8	7	6	3

Source: AEMCO, 2017

Table 9: Chemical analysis of receiving material at Tormin Mine

			Sea Water	Plant return water	Inland Strandline					Basement		Tails	
		Units		S/P (Slimes)	T/S (Topsoil)	C/S (Clayey Sand)	A/S (Aeolian Sand)	M/L (Strandline)	P/L (Pebbly Layer)	C/C (Clayey Sand/ Channel Clay)	S/T (Schist)	T/SW (Wet Tails)	T/SD (Dry Tails)
Chemistry Parameters	Alkalinity-Total as	(mg/kg	141	69.6	119	523	28.8	110	167	75.9	19.8	143	92.1
	pH @25°C	pH units	7.5	9.34	8.09	8.66	7.07	8.23	8.5	8.24	7.06	8.27	9.11
Physical Parameters	Electrical Conductivity @25°C	mS/m	5300	2148	255	807	864	389	429	708	1410	5270	1641
	Total Dissolved Solids @105°C	mg/kg	[illegible]	[illegible]	1785	5649	6048	2723	3003	4956	9870	[illegible]	[illegible]
Cations and Anions	Calcium as Ca	mg/kg	426	693	7.11	25.2	16.1	2.51	4.65	29.9	66.1	715	510
	Sodium as Na	mg/kg	11300	3860	465	1720	1670	777	863	1390	2830	12900	2610
	Magnesium as Mg	mg/kg	1100	68.8	4.93	5.79	16.6	2.17	5.29	20.2	80.8	1710	131
	Potassium as K	mg/kg	603	217	53.4	96.6	178	36.1	54.9	88.2	181	710	230
	Chloride as Cl^-	mg/kg	20400	6540	570	1950	2340	1002	1104	2280	3840	22100	5430
	Fluoride as F^-	mg/kg	1.07	2.73	0.57	3.33	<0.3	1.44	2.85	0.66	0.84	1.1	<0.10
	Sulphate as $SO4^{2-}$	mg/kg	2740	1080	195	451	569	184	249	328	719	3600	714
	Nitrate as N	mg/kg	<0.5	1.8	1.8	2.1	<1.5	<1.5	3	1.8	1.5	0.9	2.1
	Bromine as Br^-	mg/kg	72.8	8.6	2.2	2.5	3.1	1.04	1.18	2.2	4.6	99.6	26
			Fresh										
			Brackish										
			Highly Brackish										
			Saline										
			Sea Water										

Source: AEMCO, 2017

The residue characterisation study by AEMCO concluded the following:

- Discharged tailings are benign and contain no harmful chemicals or substances. However, seawater is used during processing, which produces a slurry with elevated salinity levels;
- The source material holds no risk of creating acid mine drainage;
- The tailings material is sourced from its depositional host material and reflects the chemistry type of the receiving environment;
- The environment is dry and has a negative water balance. The potential of rainfall mobilising a salt plume is low;
- Limited groundwater has been found by MSR below the inland mining area to a depth of ~20 m below sea level or ~60 m below the proposed mining area; and
- Groundwater quality in the area is saline and not suitable for potable use.

Waste Classification

The waste classification study undertaken by SRK (Appendix 13) comprised a chemical analysis and assessment of representative samples of the tailings generated at Tormin Mine. The samples taken are an accurate representation of the waste stream that will be generated during inland mining. The samples were tested at accredited laboratories and analysed in accordance with the Waste Classification and Management Regulations (GN 634) and the MPRDA.

Acid Base Accounting analysis evaluates the balance between acid generation processes (oxidation of sulfide minerals) and acid neutralising processes (dissolution of alkaline carbonates, displacement of exchangeable bases, and weathering of silicates). The analysis determines the Total Acid Potential and the Neutralisation Potential of the waste. The results of the Acid Base Accounting analysis of the waste samples (provided in Table 10) indicate that the waste is **non-acid generating**.

Table 10: Results of the Acid Base Accounting analysis

Sample ID	Total Sulphur (%)	Total Acidity Potential ($CaCO_3$ kg/t)	Gross Neutralisation Potential ($CaCO_3$ kg/t)	Net Neutralisation Potential ($CaCO_3$ kg/t)	TNPR
SRK8606	<0.01	<0.31	54.3	53.9	175

X-Ray Diffraction analysis of the samples confirmed that quartz is the major mineral phase present in the waste, with calcite the dominant minor phase. No chemically reactive minerals, or minerals prone to oxidation and generation of acidic leachate, were identified. The results of the X-Ray Diffraction analysis are provided in Table 11. These results confirm that the waste comprises of a relatively **inert mineral assemblage**.

Table 11: Results of the X-Ray Diffraction analysis

Phase	Ideal Formula	Wt%
Quartz	SiO_2	92.83
Calcite	$CaCO_3$	3.34
Topaz	$Al_2F_2SiO_4$	1.54
Almandine	$Al_2Fe_3(SiO_4)_3$	1.32
Halite	NaCl	0.6
Augite	Fe	0.4

In terms of Regulation 7(2) of the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN 635), the potential risk level associated with disposal or downstream use of waste must be assessed according to the prescribed leach test protocols. The procedures require the determination of both the Total Concentration (TC in mg/kg) and Leachable Concentration (LC in mg/L) of a particular contaminant in a waste to be assessed against the Total Concentration Thresholds (TCT) and the Leachable Concentration Thresholds (LCT). The threshold levels for the TCT and LCT determine the risk profile and corresponding waste classification, as set out below:

- **Type 4 Waste**: wastes with all determinand concentrations below the LCT0 and TCT0 values;
- **Type 3 Waste**: wastes with any determinand concentration above the LCT0 but below the LCT1 value and all determinand concentrations below the TCT1 values;
- **Type 2 Waste**: wastes with any determinand concentration above the LCT1 but below the LCT2 values, and all determinand concentrations below the TCT1 values;
- **Type 1 Waste**: wastes with any determinand concentration above the LCT2 but below the LCT3 values, or above the TCT1 but below the TCT2 values; and
- **Type 0 Waste**: wastes with any determinand concentration above the LCT3 or TCT2 values.

Total and leachate analyses of the waste sample is provided in Table 12. The results of the analyses show that:

- The total concentrations of all determinands in the waste sample are below the respective TCT0 threshold concentrations; and
- The leachate concentrations of all determinands in the waste sample are below the respective LCT0 threshold concentrations.

The waste can therefore be classified as a **Type 4 waste material**.

Table 12: Abridged Total and Leachate Concentration results

Lab number	TM Tailings		LCT0 mg/l	LCT1 mg/l	LCT2 mg/l	LCT3 mg/l	TCT0 mg/kg	TCT1 mg/kg	TCT2, mg/kg
	TC (mg/kg)	LC (mg/L)							
Antimony, Sb	<1.0	<0.002	0.01	0.5	1.0	4.0	5.8	500	2 000
Arsenic, As	1.5	<0.003	0.7	35	70	280	63	6 250	25 000
Barium, Ba	5.0	0.101	0.5	25	50	200	150	15 000	60 000
Cadmium, Cd	<0.1	<0.001	0.003	0.15	0.30	1.2	7.500	260	1 040
Chromium (total)	14.0	<0.002	0.50	25	50	200	50	5 000	20 000
Chromium (VI)	<0.3	<0.006	0.05	2.5	5.0	20	46 000	800 000	800 000
Cobalt, Co	0.6	<0.002	0.05	2.5	5.0	20	6.50	500	2 000
Copper, Cu	<1.0	<0.007	2.0	100	200	800	16.0	19 500	78 000
Lead, Pb	<5.0	<0.005	0.01	0.30	0.60	2.4	0.93	160	640
Manganese, Mn	42.0	<0.002	0.50	25.0	50.0	200	1 000	25 000	100 000
Mercury, Hg	<0.1	<0.001	0.07	3.5	7.0	28	40	1 000	4 000
Molybdenum, Mo	<0.1	<0.002	0.07	3.5	7.0	28	91	10 600	42 400
Nickel, Ni	1.7	<0.002	0.01	0.5	1.0	4.0	20	1 900	7 600
Selenium, Se	<1.0	<0.003	0.02	1.0	2.0	8.0	10	75	300
Vanadium, V	4.0	<0.002	0.01	0.5	1.0	4.0	10	50	200
Boron	4.1	0.030	0.2	10	20	80	150	2 680	10 720
Zinc, Zn	<5.0	<0.003	5.0	250	500	2 000	240	160 000	640 000
TDS		564	1 000	12 500	25 000	100 000	*	*	*
Chloride,Cl		32.9	300	15 000	30 000	120 000	*	*	*
Sulfate		231	250	12 500	25 000	100 000	*	*	*
Nitrate as N		<0.2	11	550	1 100	4 400	*	*	*
Fluoride,F	<0.3	<0.3	1.50	75	150	600	100	10 000	40 000
Cyanide,CN	<0.5	<0.01	0.07	3.5	7.0	28	14	10 500	42 000

The standard containment barrier design and landfill disposal requirements for different waste types are detailed in GN 636. According to these requirements, the tailings material needs to be disposed of to a Class D landfill, designed in accordance with sub regulation 3(1)(a) of GN 636, as shown in Figure 13. A Class D landfill does not require an engineered synthetic liner or compacted clay layer. The design requirement is limited to the preparation of a 150 mm thick base layer. Within the context of an in-pit backfilling operation, the base layer will comprise the footwall material compacted by the operation of mining vehicles.

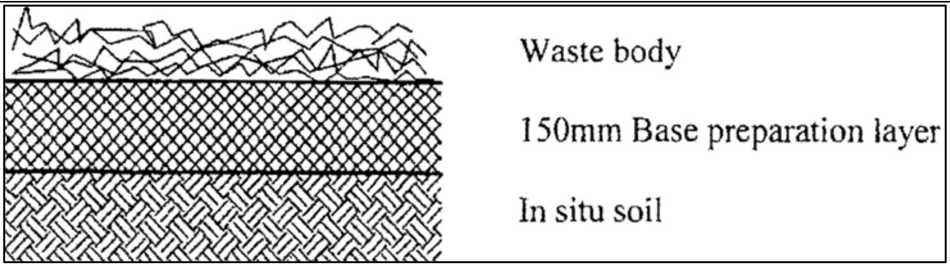


Figure 13: Class D inert landfill barrier design

3.6 Primary Concentration Circuit Improvements

MSR has optimized the performance of its Primary Concentration Circuits (PBC and TSP modules) to increase throughputs to ~160-170 tph per unit, for a total effective throughput of 320-340 tph of ROM. These improvements have been made by de-bottlenecking the feed and tails systems. This provides sufficient capacity for each PBC to process 1.1 Mtpa of ore.

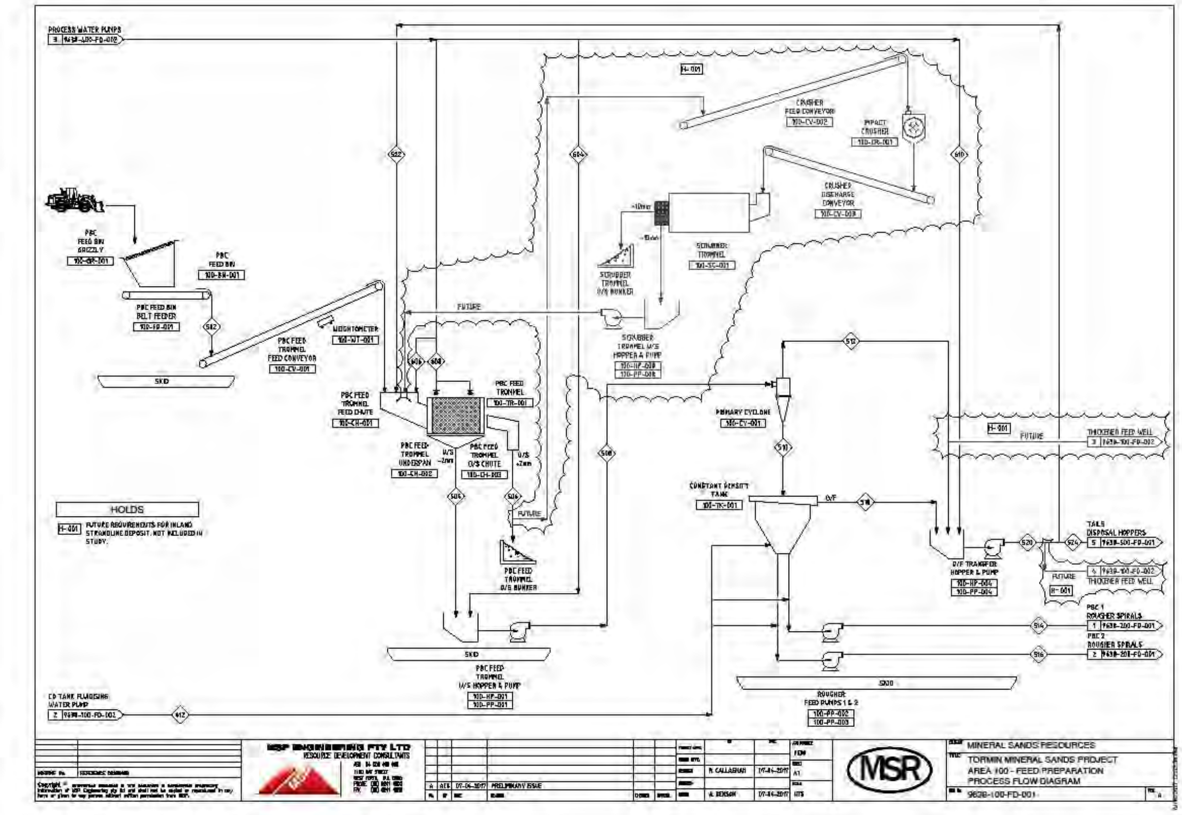
MSR will utilize one of the PBC-TSP modules as the interim gravity separation plant for inland mining. This plant will be augmented with a feed preparation circuit and a tailings circuit (Figure 14). The feed preparation circuit (Trommel, Crusher, Deslime Cyclones and Constant Density Tank) is designed to break-up mineral agglomerates in the inland ore, remove fines from the feed to the gravity circuit and provide a consistent feed to the gravity circuit. The tailings circuit (Thickener and Sand Cyclone Stackers) is designed to maximize water recovery from the tailings prior to their deposition in the mine void.

The PBC-TSP module is to be used as an interim gravity separation plant for inland mining. A fit-for-purpose gravity separation plant is expected to be in operation by the third year of operations. This plant (based either on new higher performance spirals gravity separators or reflux classifier technology) will target improvements in recoveries (e.g. zircon recoveries of ~95%).

No changes will be made to the existing feed preparation and tailings circuits.

The other PBC module (semi-mobile) will move to the larger of the northern beaches during northern beach mining.

The Primary Concentration Circuits will be relocated to the infrastructure / plant expansion area (Appendix 5, Figure 12).



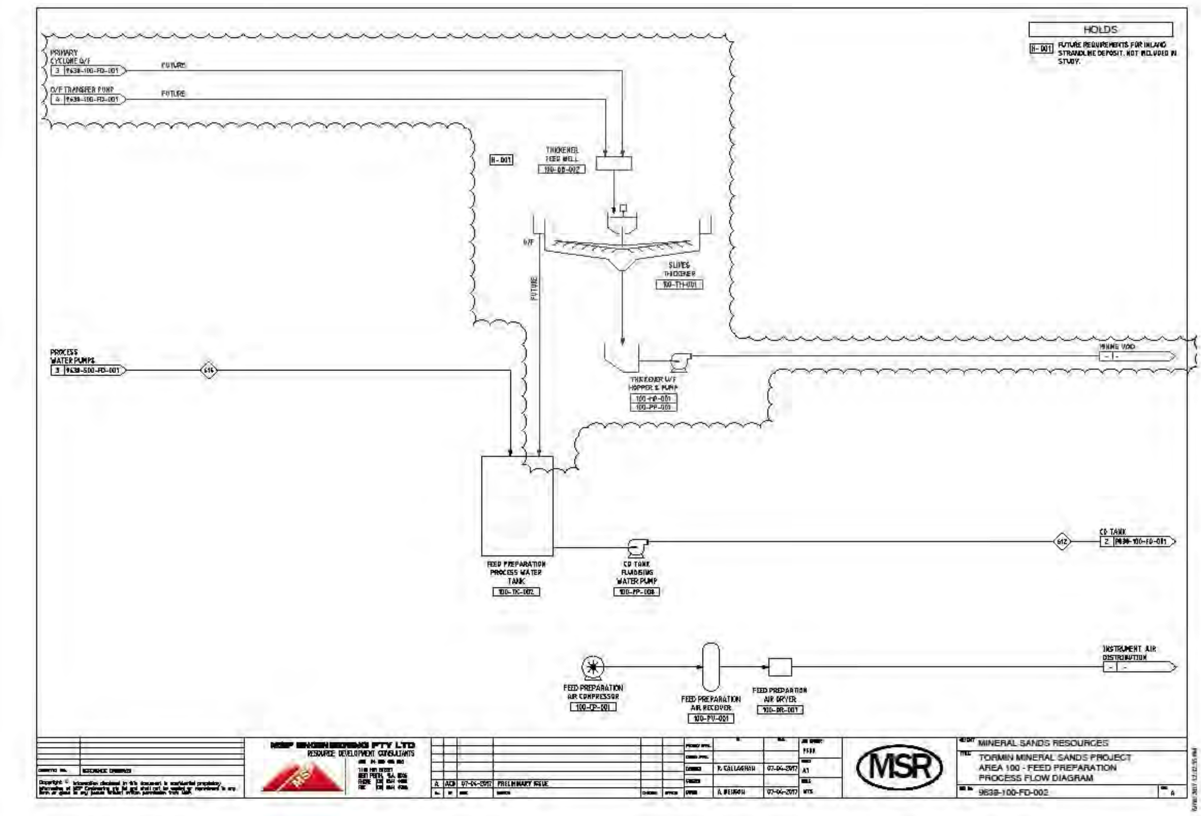


Figure 14: Additional Front-End and Tailings Circuits for inland mining

Source: MSP Engineering, 2017

Table 13: Current and anticipated concentrate production rates

Description	Unit	Current	Anticipated - Northern Beaches	Anticipated - Current Beaches	MSR Design Allowance
HMC Concentrate Production	tph	76.6	90.4	93.4	100
Annual HMC Concentrate Production	tpa	576 840	680 761	702 907	752 850
Annual Garnet Concentrate	tpa	170 658	205 006	138 086	284 127
Annual Ilmenite Concentrate	tpa	81 696	186 113	145 591	109 858
Annual Non Mag Concentrate	tpa	19 977	44 046	35 464	29 293
Annual Magnetite Concentrate	tpa	-	23 187	18 953	-
Seawater Requirement	m^3/h	337	-	-	500
Seawater Requirement per tonne HMC Concentrate	m^3/t	4.39	-	-	4.34

Currently, MSR uses 4.39 m^3 seawater to produce 1 tonne of HMC concentrate. With the proposed processing plant improvements, seawater use for production is likely to be of a similar magnitude (4.34 m^3/h) for each tonne of HMC concentrate produced. The total (proposed) seawater use at Tormin Mine is provided in Section 3.8.

3.7 Mineral Separation Plant

MSR proposes to construct an MSP at Tormin Mine to beneficiate the ore (from the beaches and the strand line) and increase overall mineral recovery. The MSP will separate the constituent minerals in the Ilmenite Concentrate and Garnet Concentrate into final ilmenite and garnet products for export; and recover zircon and rutile into a Non-Mags Concentrate. The MSP will have a design capacity to produce approximately:

- 150 000 tpa of Ilmenite product; and
- 115 000 tpa of Garnet product.

A Non-Magnetics Circuit may be considered as an additional option. However, presently there is significant demand for MSR Non-Magnetics Concentrate and a Non-Magnetics Concentrate Circuit significantly increases the complexity of the MSP.

The MSP and associated facilities will be constructed within the infrastructure / plant expansion area (Appendix 5, Figure 12). The MSP will consist of the main plant building (~45 m x 25 m x 20 m), three storage sheds (total: ~100 m x 75 m x 15 m), an administration building (~20 m x 20 m x 5 m) and a stockpile area. Whilst the individual processing units of the MSP are well understood, the overall performance of the MSP, with respect to throughput and recovery, is dependent on the intermediate recycle streams. There are opportunities to simplify and optimise the design of the MSP further, and these will be evaluated prior to final approval for construction. The dimensions of the MSP infrastructure described above may change following detailed design but will remain within the infrastructure / plant expansion area.

The MSP will consist of four main sub-circuits:

- Drying Circuit, with an Optional Washing Stage;
- Garnet Concentrate Processing Circuit;
- Ilmenite Concentrate Processing Circuit; and
- A potential Non-Magnetics Processing Circuit.

These sub-circuits are described below.

3.7.1 Drying Circuit

The Drying Circuit consists of two rotary dryers to separately dry the Garnet and Ilmenite Concentrates and the Non-Mags Concentrate (Figure 15).

Concentrate is fed by a Front-End Loader into a feed hopper which feeds the appropriate rotary dryer. The rotary dryer heats the concentrate to remove moisture so that the MSP separation circuits (discussed below) are supplied with dry mineral for separation by magnetic and electrostatic separators. Moisture in the feed adversely affects the performance of the separators.

After the rotary dryer, the Garnet and Ilmenite Concentrate is fed through a cooler to lower the temperature of the dried product to protect the rare-earth magnets in the downstream circuit, as exposure to temperatures above ~100°C will degrade the magnets.

Cooling is not required for the Non-Mags Concentrate as the front-end of the Non-Magnetics Processing Circuit consists of electrostatic separators that can operate at higher temperatures. Furthermore, at higher temperatures, no moisture occurs on the surface of the mineral during cooling – surface moisture adversely affects the electrostatic separation of the minerals.

Washing in a washing circuit, prior to drying, may be required to wash (naturally occurring) chlorides from the concentrates, particularly the Garnet Concentrate stream. The requirements for washing will be assessed through discussions with end-customers. At this stage, it is assumed that washing is not required, or that washing will be conducted by the customer.

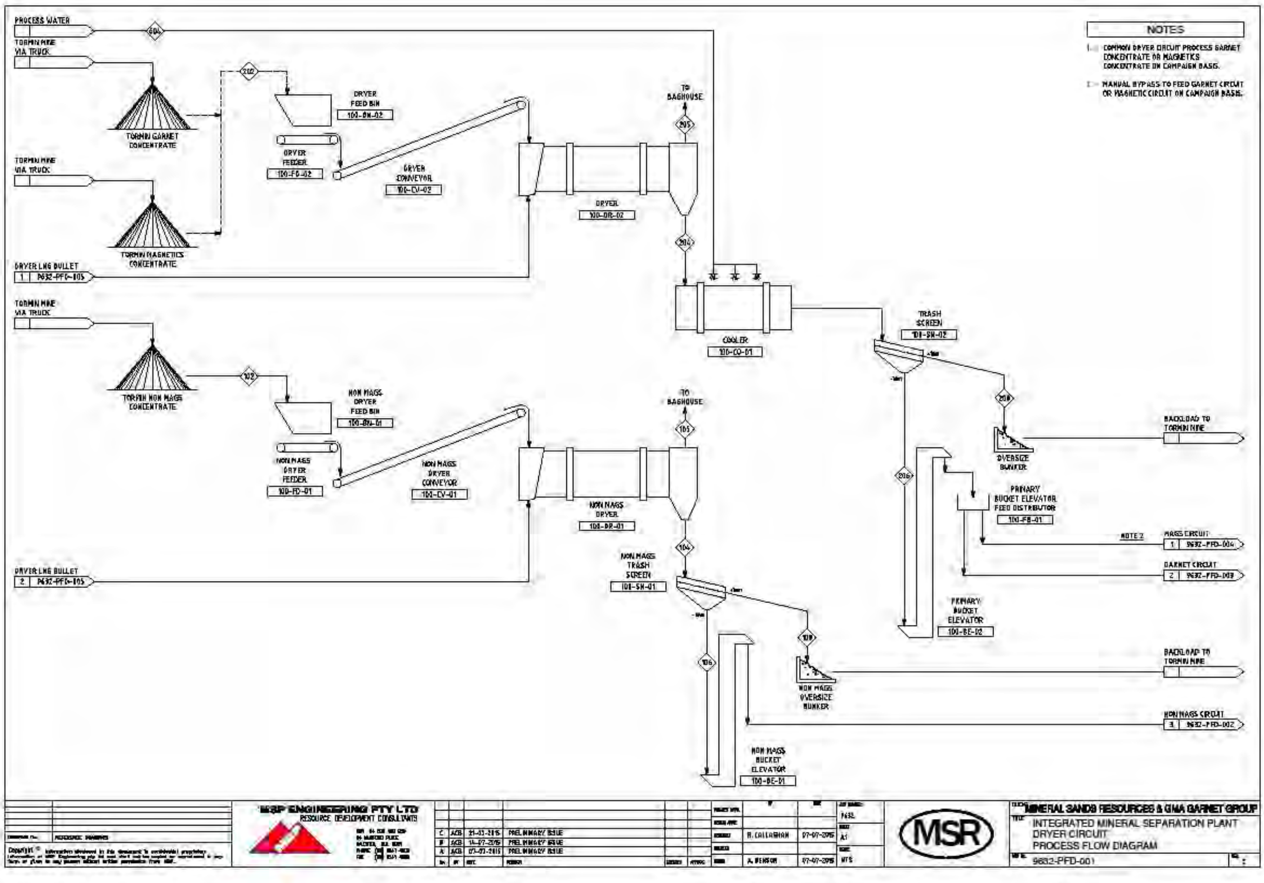


Figure 15: MSP Drying Circuit

Source: MSP Engineering, 2017

3.7.2 Garnet Concentrate Processing Circuit

The purpose of the Circuit is to maximise recovery of garnet whilst removing ilmenite to the Magnetics Concentrate and zircon, rutile and quartz to the Non-Magnetics concentrate.

The Circuit consists of:

- A scavenger magnet to remove magnetic trash which may otherwise damage the downstream rare earth magnetic separators;
- Three stages of rare earth magnetic separators; and
- Bucket elevators and conveyors for materials handling.

Almandine garnet is a paramagnetic mineral, with magnetism that falls between ilmenite and the non-magnetic minerals in the feed (zircon, rutile, quartz and other light-heavies). Consequently, almandine garnet reports to the mids stream of the magnetic separators, with ilmenite reporting to the magnetics stream, and rutile, zircon and quartz to the non-magnetics stream.

The circuit produces a Non-Magnetics rich stream and a Magnetics rich stream. These streams are stockpiled for reprocessing in the Non-Magnetics and Magnetics sub-circuits respectively. The Circuit also produces a final garnet product that is stored in a product shed.

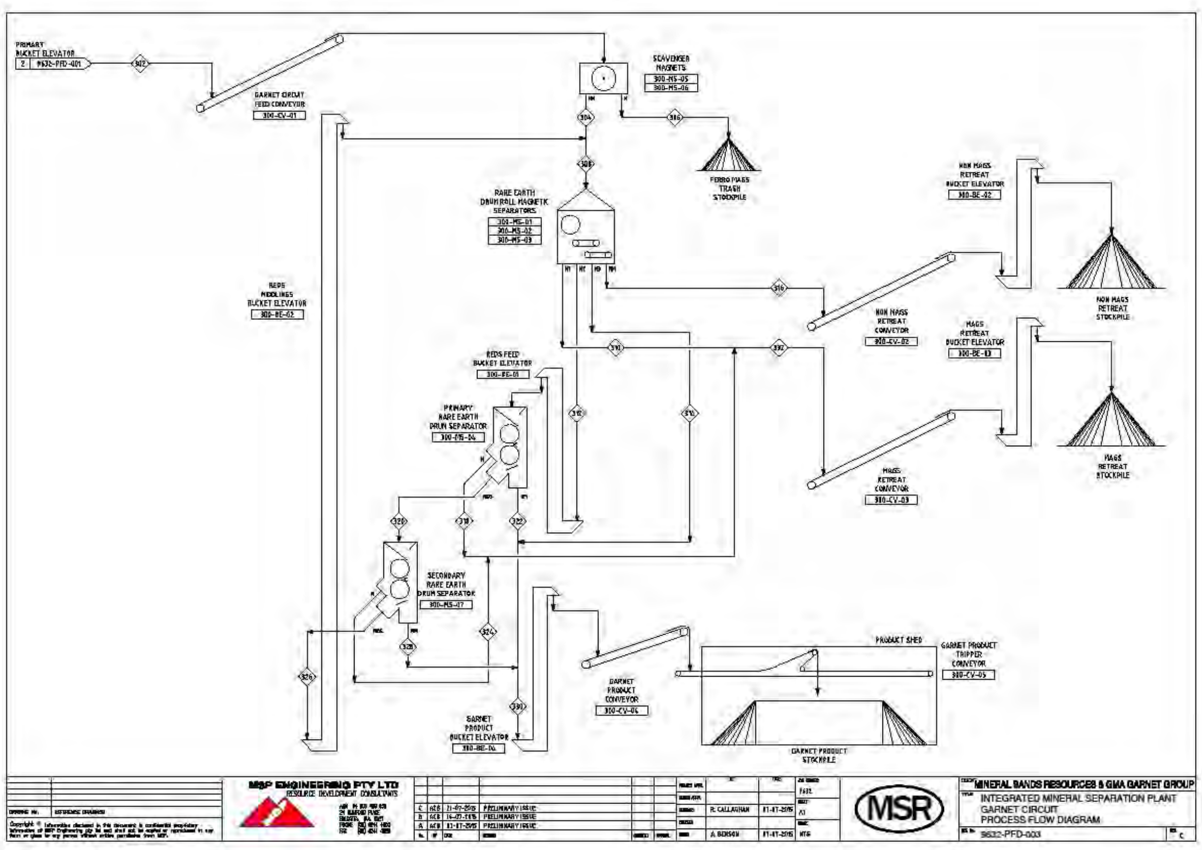


Figure 16: MSP Garnet Concentrate Processing Circuit

Source: MSP Engineering, 2017

3.7.3 Ilmenite (Magnetics) Concentrate Processing Circuit

The Ilmenite Concentrate Processing Circuit (Figure 16) uses a combination of electrostatic separators and magnetic separators to separate magnetic and conductive ilmenite from less magnetic (and non-conducting) garnet, as well as non-magnetic concentrate.

An electrostatic separator separates the feed into conductors and non-conductors. The conductors stream contains predominately ilmenite and some rutile, whilst the non-conductors contains predominately garnet, with some quartz, zircon and other minerals (such as diopside and plagioclase).

The conductors are processed through two stages of magnetic separators to remove non-mags, followed by a final stage of electrostatic separation to remove non-conductors (predominately garnet).

The non-conductors from the electrostatic separator at the start of the Circuit report to a magnetic separator to separate paramagnetic garnet from the non-magnetics.

The circuit produces three products:

- A Non-Magnetics product for reprocessing and recovery of zircon and rutile in the Non-Magnetics Circuit;
- A garnet rich product for reprocessing and recovery of garnet in the Garnet Circuit, and
- An ilmenite final product that is stockpiled in the product shed.

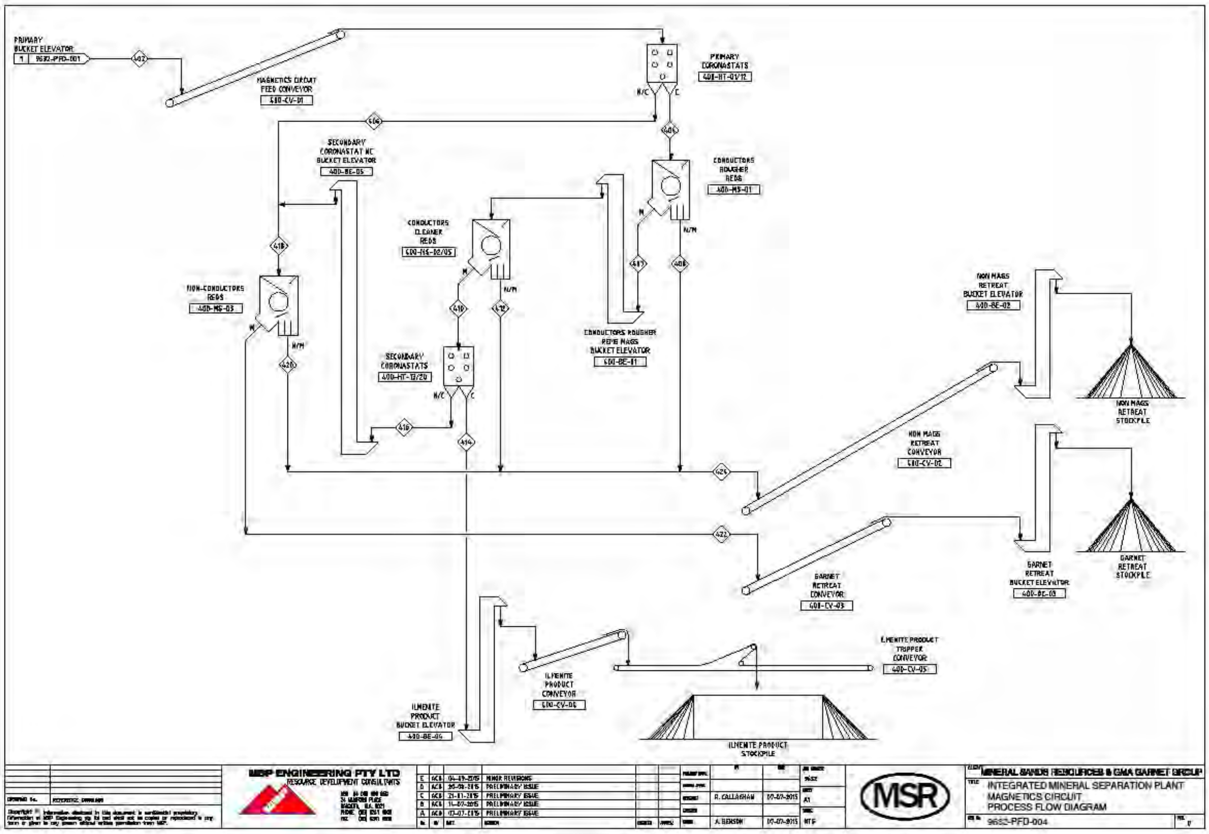


Figure 17: MSP Ilmenite Concentrate (Magnetics) Processing Circuit
Source: MSP Engineering, 2017

3.7.4 Non-Magnetics Processing Circuit

The Non-Magnetics Concentrate Processing Circuit is significantly more complex than the other two concentrate processing circuits discussed above. This complexity is driven by the fact that quartz (and intermediate density minerals such as diopside, plagioclase and kyanite) are non-magnetic and non-conductors, as is zircon, the most valuable mineral in the Non-Magnetics Concentrate. There is significant demand for Non-Magnetics Concentrate from Tormin Mine. The Non-Magnetics Processing Circuit is therefore not considered in the base case but is an option for further expansion in the future.

The Circuit uses a combination of electrostatic separation, magnetic separation, secondary wet processing (followed by an additional stage of drying, and air tabling (dry gravity separation) to produce:

- A final zircon product for storage and sale;
- A final rutile product for storage and sale;

- A Magnetics Concentrate for reprocessing in the Magnetics Circuit for ilmenite recovery;
- A Garnet Concentrate for reprocessing in the Garnet Circuit; and
- MSP tailings.

The Non-Magnetics Circuit produces a tailings stream which will be combined with the tailings from the primary processing circuit, the GSP and the SCP for disposal.

A schematic of the Circuit is shown in Figure 18 and process flow diagram in Figure 19.

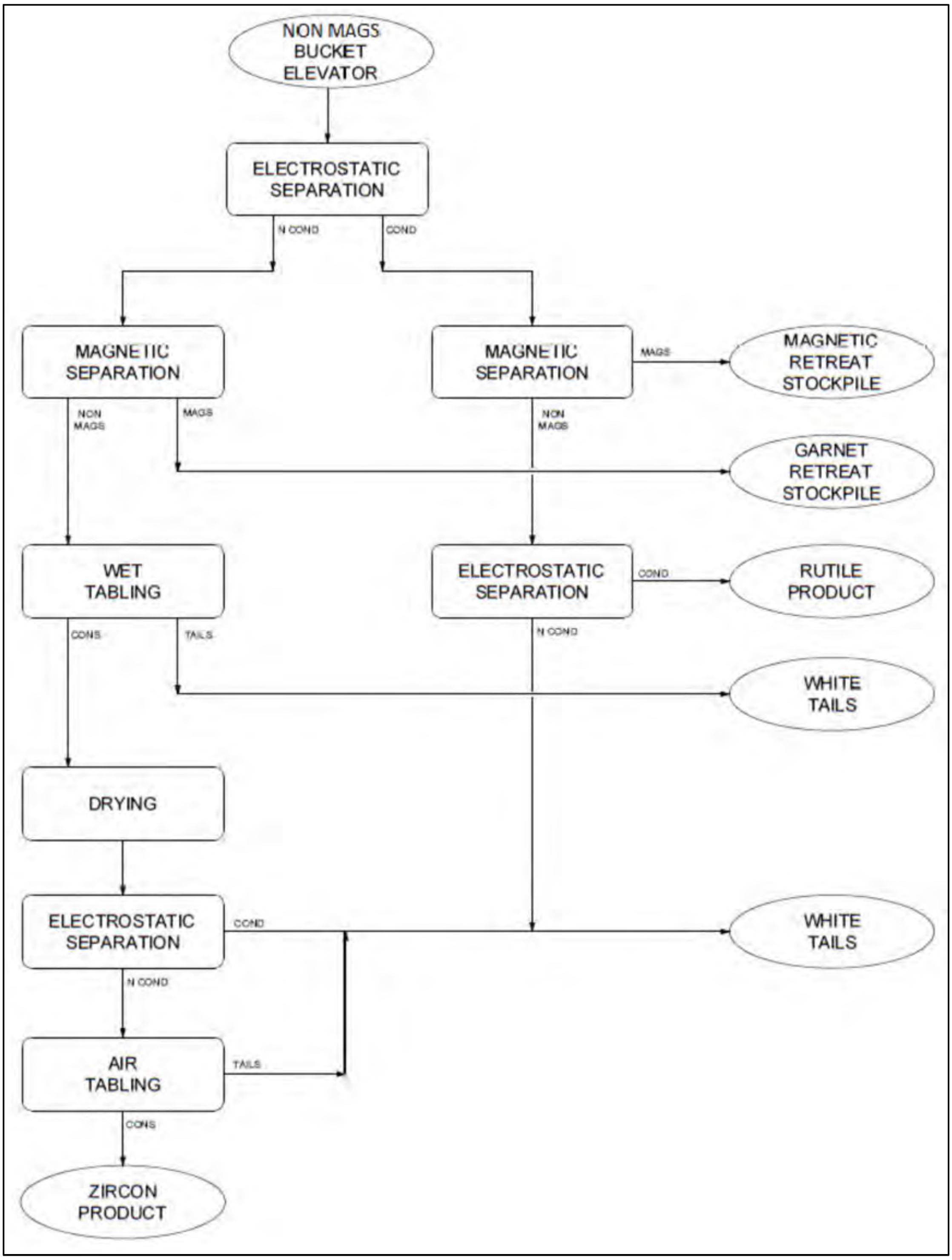


Figure 18: Schematic of the Non-Magnetics Circuit

Source: MSP Engineering, 2017

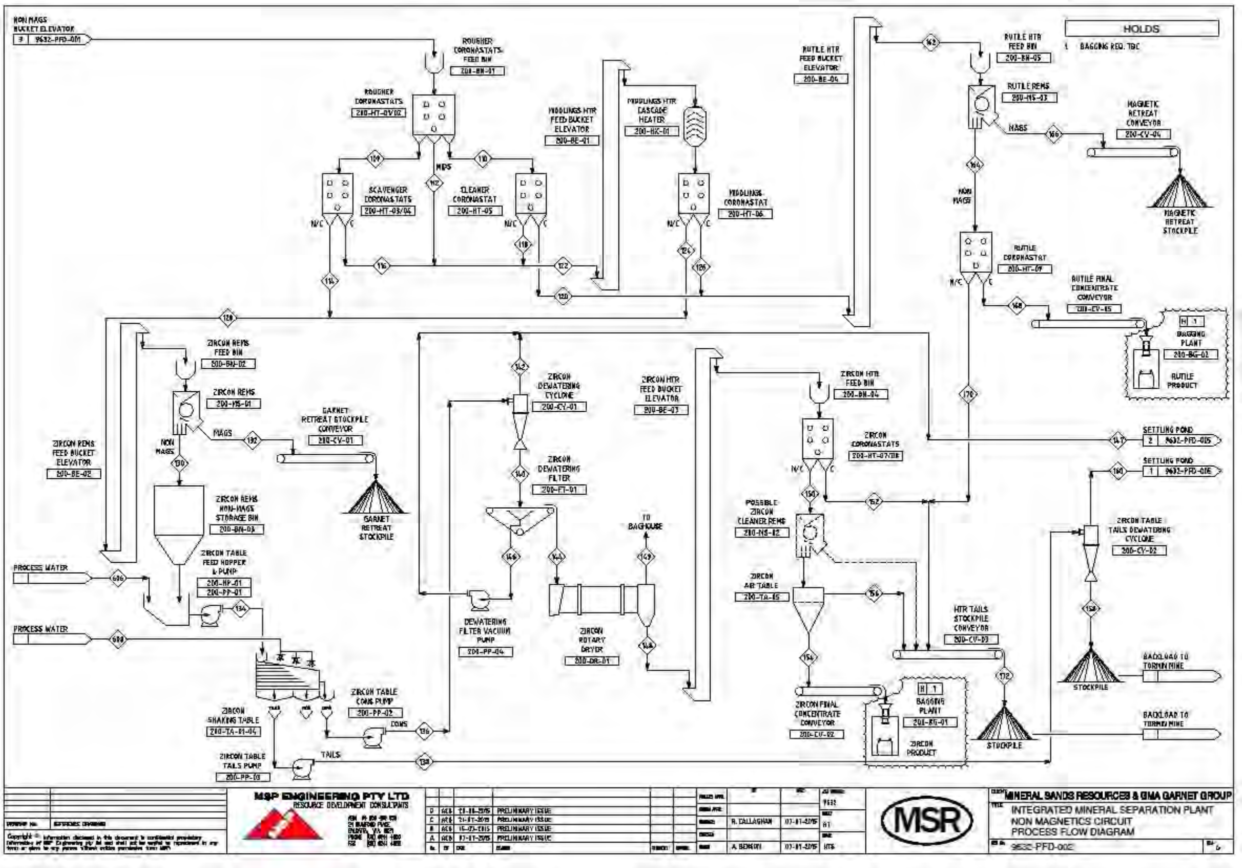


Figure 19: Non-Magnetics Concentrate Processing Circuit

Source: MSP Engineering, 2017

3.7.5 Associated Facilities and Services

All final product stockpiles from the MSP will be transferred by conveyors from the MSP to concrete pads in new concrete storage sheds located adjacent to the MSP.

Installed power required for the MSP is estimated at 1.4 MW. The current gensets cannot economically meet this demand. With the proposed extended LoM, MSR proposes to connect to the grid and is in discussions with Eskom to connect to the Sere wind energy facility (see Section 3.11, “Power Supply”).

3.8 Water Supply

Limited additional freshwater will be required for domestic purposes for the additional employees at Tormin Mine. MSR will therefore continue to truck in water from Lutzville.

The seawater intake volume will be similar to the current seawater intake volume (Section 3.6).

Currently, MSR extracts 337 m^3/h seawater for production and dust suppression. It is anticipated that with production improvements (Section 3.6), and if mining of the current beaches recommences, seawater extraction may increase to 500 m^3/h (Table 14). No additional infrastructure will be required for increased seawater extraction and storage.

A new process water pipeline (inside diameter of 350 mm) will be required from the existing process water dams to provide process water to the MSP. The coordinates of the proposed process water pipeline corridor are provided in Table 15.

Table 14: Seawater use at Tormin Mine

Seawater Use	Unit	Current	Anticipated
Steady State Requirement for Production (including dust suppression)	m^3/h	337	500
Total per day	m^3/d	8 088	12 000

Table 15: Location of process water pipeline corridor

Start	Middle	End
31°33'6.44"S; 18° 5'33.84"E	31°32'59.85"S; 18° 5'37.16"E	31°33'1.31"S; 18° 5'51.92"E

3.9 Surface Water Management

Roads and operational areas potentially affected by stormwater runoff will be protected by earth bunds (windrows). The earth bunds will prevent ingress of "clean" stormwater and egress of "dirty" stormwater from these areas. As is currently the practice at the Mine, MSR will capture stormwater on-site and pump the stormwater to the process water dams.

3.10 Effluent and Waste Water Management

Process water from the processing plant is recycled, with some water losses to evaporation and deposition of (slurried) tailings to the beach. There will be additional water loss from the processing plant through seepage from tailings deposited in the inland strand line mine void. MSR will recover as much water as possible from the containment cells via decant for reuse at the processing plant.

Process water from the MSP will be recycled or transferred to the process water dams (via a return process water pipeline in the process water pipeline corridor, see Table 15) for reuse within the processing plant.

Domestic effluent from ablution facilities at the MSP will be connected to a new conservancy tank.

3.11 Solid Waste Management

Domestic waste generated in expansion areas will be collected and taken to the existing on-site solid waste storage site for final disposal at a licensed waste disposal facility.

Hazardous waste (such as used oils) generated in expansion areas will be collected and temporarily stored in the existing on-site hazardous waste storage area for collection by a contractor.

3.12 Power Supply

MSR has made an application to Eskom to provide power from the national grid to replace the current gensets and, more importantly, provide a cost-effective power supply option for the MSP.

The current intention is to connect to the network at the Skaapvlei Substation on the adjacent Sere wind energy facility. In this event, a 22 kv powerline of approximately 4 km (2 km of underground line within the wind farm and 2 km of overhead power line) will be installed from the Sere wind energy facility to a new transformer near the MSP (Appendix 5, Figure 12).

If a connection to Eskom's network is not possible, MSR will install additional gensets to meet increased electricity demand.

MSR has two 20 000 litre containerised diesel tanks on site stored in a bunded area (Figure 20). The existing bunded fuel storage area will be expanded to accommodate four additional (20 000 litre) fuel storage tanks.

Figure 20: Diesel storage area
Source: MSR, 2018

The PBCs used for beach mining will be fitted with an on-board 450 kva generator set and double-bunded fuel tank.

3.13 Air Quality Management

MSR implements dust suppression measures to reduce dust emissions from haul roads. A sub-contractor continually applies seawater and groundwater to all internal and external haul roads as required, including the DR2225 public gravel road to Koekenaap.

MSR will continue to implement dust suppression measures on haul roads including those to the beaches north of Tormin Mine.

3.14 Workforce

As at 1 February 2017, when Tormin Mine was operating at full production, MSR employed 216 people, of whom 170 were from the local area, with ~ 88% of local employees categorised as Historically Disadvantaged South Africans (HDSA).

Approximately 80 additional employment opportunities will be created by the proposed Mine extension, predominantly at the MSP.

Up to 300 jobs will be created in the construction phase.

3.15 Mine Schedule

The proposed beach mining and inland strand line mining will extend the overall LoM of Tormin by ~11 years.

In discussion with DMR, MSR has developed a mine schedule to achieve an economic and conservative production profile. MSR proposes to mine at the following rates (Table 16):

- Annual average of ~1.1 Mt on the northern beaches and beaches adjacent to Farm Geelwal Karoo 262 currently being mined; and

- Annual average of ~1.1 Mt in the inland strand line.

MSR will therefore mine a total of ~2.2 Mtpa.

Beach mining will alternate annually between the currently mined beaches (adjacent to Farm Geelwal Karoo 262) and the northern beaches. Mining of each beach system will occur at 1.1 Mtpa followed by a year of no mining (where the other beach system will be mined), resulting in an effective average rate of 0.55 Mtpa for the current beaches and the northern beaches. The LoM of the northern beaches is estimated to be ~4 years without any beach replenishment. However, MSR's experience with the current beaches shows that replenishment is a very significant component of the total resources on the beaches, such that the total resource over the LoM is a multiple of the original resource. For the northern beaches, the smaller beaches may be mined within two months, whilst the larger beaches could take more than a year to mine. Replenishment of the beaches will be monitored through resource audits. Based on MSR's experience with the current beaches, re-mining of the northern beaches, in particular, the larger beaches (e.g. Beach 10, Beach 7 and Beach 5) will occur in subsequent northern beaches mining years.

The advance rate for inland strand line mining is ~0.5 km per year for an annual mining rate of 1.1 Mtpa. MSR proposes to mine the southern section of the strandline first, and then the northern section to simplify mine planning and management.

As discussed in Section 4, MSR will reprofile the beaches as required once mining on each beach has ceased. The access tracks will be returned to a suitable state at the end of beach mining. MSR will rehabilitate the inland strand line as soon as the mining path (cut and fill) allows, and the infrastructure / expansion area will be rehabilitated at the end of operations at Tormin Mine.

Table 16: Mine schedule

	Current Beaches	Northern Beaches	Inland Strand	Total
Year				
1 H1	0.55	0.3	-	0.85
1 H2	-	0.55	0.25	0.80
2 H1	0.55	-	0.55	1.1
2 H2	0.55	-	0.55	1.1
3 H1	-	0.55	0.55	1.1
3 H2	-	0.55	0.55	1.1
4 H1	0.55	-	0.55	1.1
4 H2	0.55	-	0.55	1.1
5 H1	-	0.55	0.55	1.1
5 H2	-	0.55	0.55	1.1
6 H1	0.55	-	0.55	1.1
6 H2	0.55	-	0.55	1.1
7 H1	-	0.55	0.55	1.1
7 H2	-	0.55	0.55	1.1
8 H1	0.55	-	0.55	1.1
8 H2	0.55	-	0.55	1.1
9 H1	-	0.55	0.55	1.1
9 H2	-	0.55	0.55	1.1
10 H1	0.55	-	0.55	1.1
10 H2	0.55	-	0.55	1.1
Total	**6.1**	**5.3**	**10.15**	**21.45**

3.16 Investment

The project will require initial capital investment in excess of R 52 million and will generate some R1.5 billion per annum in taxable revenue. Through local procurement of ~R500 million, the project is expected to contribute significantly to the local economy.

4 Decommissioning and Closure

Section 24P of NEMA requires that an applicant for EA relating to prospecting, mining, exploration, production or related activities on a prospecting, mining, exploration or production area must make the prescribed financial provision for the rehabilitation, management and closure of environmental impacts, before the Minister responsible for mineral resources issues the EA. The Financial Provision Determination is provided in Section 2 (m) of the EIA Report.

The EIA Regulations, 2014, stipulate that a Closure Plan, containing all information set out in Appendix 5 of the Regulations, must be provided with the EIA Report. A Decommissioning and Closure Plan is included in the EMPr (Part B, Section 1(ix)).

Decommissioning, closure and rehabilitation methods to be applied to the mine extension areas are briefly described below.

A Rehabilitation Plan is provided as Appendix 6 of the Terrestrial Ecology Impact Assessment (Appendix 11F).

4.1 Closure Objectives

The closure vision and objectives for the mine expansion project are based on the objectives previously developed by GCS for Tormin Mine (2012 and 2014). The objectives are also informed by the environment specifically affected by the proposed expansion activities.

The overall closure vision for Tormin Mine is to ensure operations are safe, stable and non-polluting over the long-term to integrate with the current agricultural, eco-tourism and economic activities of the area in which the mine is located.

The vision is underpinned by the objectives provided below:

- Undertake on-going (concurrent) rehabilitation to ensure that the area will return to near pre-mining land use capability (refer to Section 6.2.3, “Land Capability”) as soon as possible after closure;
- Ensure all areas are stable and there is no risk of erosion;
- Prevent alien plant invasion on the site until the site is in a stable state;
- Ensure that all areas are free-draining and non-polluting; and
- Ensure reshaped areas are visually suited to the surrounding landscape.

According to the terrestrial ecology specialist (refer to Appendix 6 of the Terrestrial Ecology Impact Assessment, Appendix 11F), the ultimate goals of rehabilitation are to:

- Restore ecological function; and
- Remediate and improve the visual impact of the post-mining landscape.

In terms of restoring ecological function, the main metrics of success are vegetation cover and structure. While diversity is important in the long-term, the short- to medium-term focus should be to restore a self-sustaining cover of perennial vegetation to protect the soil and facilitate the natural (fauna and flora) recolonisation of the area.

4.2 Beach Mining

In MSR's experience, tidal and wave action often reinstate the beach profile within a very short period (weeks) (refer to Figure 21). However, MSR will flatten sand berms (on beaches) and will reshape the beach profile to expedite rehabilitation where required.

Figure 21: Beach mining on 20 January 2018 (left) compared to the status of the beach on 2 February 2018 (right)
Source: MSR, 2018

All equipment and vehicles will be removed from the beach once mining has ceased.

The main haul road will not be rehabilitated and will remain under the authority of the Western Cape Department of Transport and Public Works. All access tracks to the beach will be returned to a suitable state in consultation with the Department of Public Works.

4.3 Inland Mining

Rehabilitation of the inland strand line mining area will be undertaken as soon as the mining path allows (see Section 3.2 and Figure 22). Sand tailings from the Primary Concentrator will be pumped to skid-mounted tailings stackers for dewatering. The cycloned sand tails will be used to construct the decant cell walls (for fine tailings/slimes storage) and to fill the mining void behind the active mining area. The tailings return operations will occur in an area approximately 150 m long, behind the active mining face. Towards the rear of the tailings return area, dozers will profile the backfilled tailings and overburden to mimic the original landform shape. Topsoil will then be replaced for revegetation. Consequently, rehabilitation will take place continuously behind the advancing mine face. This will limit the extent of the mine void and will reduce the storage duration of the topsoil.

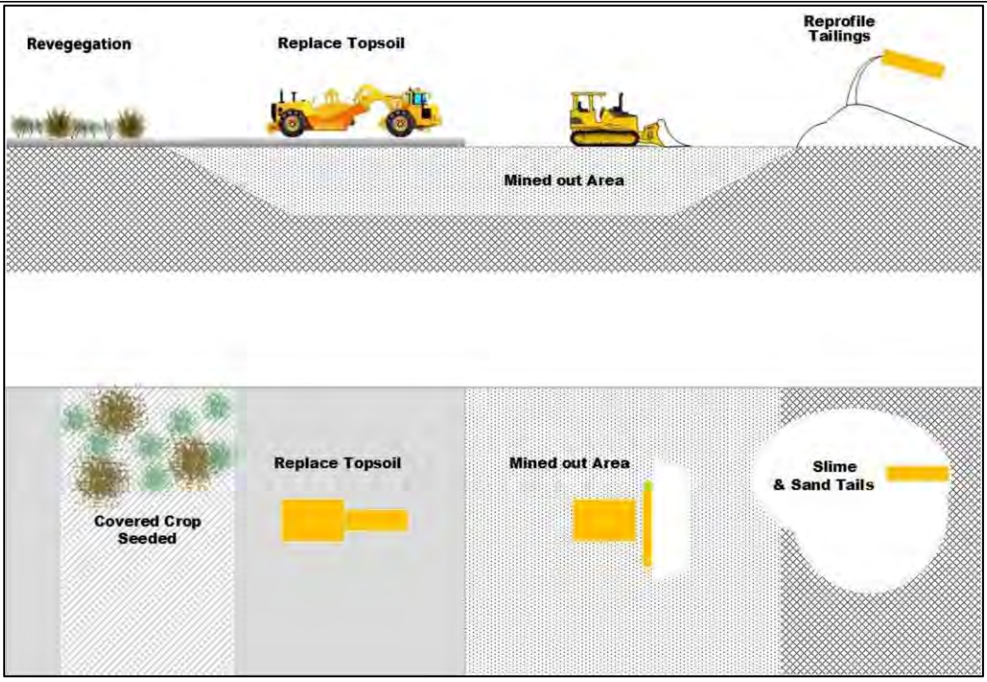


Figure 22: Diagram indicating rehabilitation process for inland mining

Source: Adapted from MSR, 2018

4.4 Infrastructure / Plant Expansion Area

MSR will dismantle or demolish all structures / infrastructure in the infrastructure / plant expansion area and will either sell the material or dispose of the material at a licensed waste disposal facility.

Contaminated soil will be treated on-site or removed from site and disposed of at a licensed waste disposal facility.

The disturbed footprint will then be ripped and reseeded.

e) Policy and Legislative Context

Table 17: Governance framework

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT *(a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).*	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT**
National Environmental Management Act 107 of 1998 (NEMA)	MSR (the proponent) has a responsibility to ensure that the proposed activities and the Scoping and Environmental Impact Reporting (S&EIR) process conform to the principles of NEMA. The proponent is obliged to take actions to prevent pollution or degradation of the environment in terms of Section 28 of NEMA, and to ensure that the environmental impacts associated with the project are considered and mitigated where possible.
EIA Regulations, 2014 (GN R982) as amended by GN R 326 on 7 April 2017	The proponent is obliged to apply for Environmental Authorisation (EA) for the activities listed in Table 2. A S&EIR process is required to assess activities listed in terms of NEMA and NEM:WA. The

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT *(a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).*	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT**
	proponent is therefore required to undertake an S&EIR process in support of the application, in accordance with the procedure stipulated in GN R982 under NEMA.
National Environmental Management: Waste Act 59 of 2008 (NEM:WA)	The project requires a Waste Management Licence (WML) in terms of NEM:WA for the activities listed in Table 2.
National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM:ICMA)	The project will include the development of infrastructure in the coastal protection zone (defined as being within 1 km of the shoreline in rural areas). Impacts on the coastal environment have been assessed in the Marine Ecology Impact Assessment (Appendix 11D) and the Terrestrial Ecology Impact Assessment (Appendix 11F).
National Environmental Management: Biodiversity Act 10 of 2004 (NEM:BA)	Although a bioregional plan has not been formally adopted for the Matzikama Municipality, terrestrial Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) have been identified in the project area by CapeNature in the 2017 Western Cape Biodiversity Spatial Plan. The impacts of the project on the biodiversity of the area and, in particular, the CBAs and ESAs, have been assessed in the Terrestrial Ecology Impact Assessment (Appendix 11F).
National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA)	As the drying process in the MSP will use an electric heater and not a dedicated combustion installation, an Atmospheric Emission Licence (AEL) is not required in terms of section 21 of NEM:AQA. The impacts of the project on air quality have, however, been assessed in the Air Quality Impact Assessment (Appendix 11B).
Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015	The planning, design, operation and decommissioning of the residue stockpiles and deposits must be compliant with the requirements of GN R632. Refer to Section 3.5 ("Tailings Management") for the characterisation and waste classification of the mine residue.
Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)	The mine holds two Mining Rights (MR162 and MR163), covering an area of 119.9 ha, and an approved EMPr to mine VHM below the high-water mark adjacent to Farm Geelwal Karoo 262. As well as the requirement of EA and WML (for which the Department of Mineral Resources [DMR] is the competent authority), in terms of Section 102 of the MPRDA, MSR must apply to the DMR for an amendment of their existing Mining Rights and EMPr. MSR has submitted an amended Mining Work Programme (MWP) to DMR for the proposed mine operations expansion. In terms of Regulations 53 and 54 of the MPRDA Regulations, 2004, MSR is required to make financial provision for the interim and final rehabilitation activities on site. This provision must be reviewed annually for adequacy and amended to compensate for

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	new activities and/or inflation[8].
National Water Act 36 of 1998 (NWA)	The proposed widening of the northern haul road and the access road to Beach 1 triggers water use activities in terms of section 21 (c) and (i) of the NWA. MSR will apply for Water Use Authorisation from the Department of Water and Sanitation (DWS) prior to the widening of these roads.
National Heritage Resources Act 25 of 1999 (NHRA)	The project and associated infrastructure triggers listed activities in Section 38(1) of the NHRA: • Any development or activity that will change the character of a site (i) exceeding 5 000 m^2 in extent, (ii) involving three or more existing erven or subdivisions thereof. The proponent is required to notify Heritage Western Cape (HWC) of the proposed activities through the submission of a Notice of Intent to Develop (NID). The NID was submitted to HWC on 4 May 2017. The potential impacts on heritage resources have been assessed in the Archaeology Impact Assessment (Appendix 11G) and the Palaeontology Impact Assessment (Appendix 11H).
Western Cape Land Use Planning Act (2014) (LUPA)	LUPA indicates that municipalities are responsible for land use planning and zoning in their respective municipal areas. Chapter 3 of LUPA states that the Province must compile a Spatial Development Framework (SDF), which outlines the spatial vision for the province, an assessment of the current and future land use plans for the province, and the province's priorities, objectives and strategies. The Municipal SDFs are required to align with the Provincial SDFs. Any authorisations required in terms of LUPA are excluded from SRK's Scope of Work.
The Western Cape Spatial Development Framework (2014)	The Provincial SDF identifies several policy objectives. Of most relevance to the project, Policy R3 ("Safeguard the Western Cape's agricultural and mineral resources, and manage their sustainable use") states the following: • The location of mineral deposits and known reserves of construction materials in municipal SDFs must be recorded; • Land use policies that reserve mineral deposits for possible use must be introduced and applied (subject to environmental

[8] On 20 November 2015, the NEMA Financial Provisioning Regulations, 2015 (GNR1147), were promulgated. The 2015 Regulations were immediately applicable to new applicants for the various MPRDA permits / rights. Holders of an existing right / permit had to comply with the Financial Provisioning Regulations, 2015 by February 2017, later extended to 19 February 2019.

As MSR has existing rights for Tormin Mine, and MSR is not applying for a new Mining Right (i.e. MSR is not a new applicant), MSR must apply with the Financial Provisioning Regulations, 2015, by February 2019.

The financial provision for the mine expansion activities has therefore been determined in accordance with the requirements of the MPRDA Regulations.

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT *(a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).*	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT**
	authorisation); • Ecosystem requirements must be reconciled with conflicting land development pressures through proactive spatial planning, and application of a land use management system that safeguards biodiversity, protects resources and opens up opportunities for improved livelihoods and jobs; and • New mine ventures should first take place in transformed areas.
West Coast District Municipality (WCDM) Integrated Development Plan (IDP) (2017 - 2022)	The WCDM IDP recognises mining in the West Coast District as a contributing factor towards South Africa's mining industry. Mining and quarrying contributes approximately 1% to the regional economy. Furthermore, the IDP also notes a high level of poverty in the WCDM and a need to enhance job creation projects that alleviate poverty. The strategic objectives of the WCDM's IDP include: • Ensuring environmental integrity for the West Coast; • Pursuing economic growth and facilitation of job opportunities; • Promoting social well-being of the community; • Promoting bulk infrastructure development services; and • Ensuring good governance and financial viability. According to the IDP, sand mining is seen as a threat as it causes scars on the landscape which affect tourism.
West Coast District Municipality Spatial Development Framework (2014)	The WCDM's SDF (2014) recognises that careful management is required to ensure environmental sustainability along the West Coast. Unsustainable utilisation of resources, poor management practices, limited access to the coast, and conflicts between users are recognised to pose a threat to the environment and the human livelihoods which are dependent on natural resources. The SDF states that the WCDM has a vast number of mineral resources, some of which are currently not exploited. It acknowledges that mining could potentially increase its current economic contribution to the regional economy should these resources be utilised in future. In addition to this, the SDF recognises the potential negative impacts that mining could have on natural resources and existing road infrastructure and recommends that this aspect be carefully considered.

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT *(a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).*	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT**
West Coast District Municipality Integrated Coastal Management Programme (ICMP) (2013)	The WCDM ICMP identifies objectives to guide the identification and implementation of strategies for coastal zone management in the WCDM. The objectives are based on the coastal zone management vision and unique needs and challenges of the WCDM. The objectives are to: • Facilitate co-ordinated, integrated and inclusive management of the coastal zone by all spheres of government, in accordance with the principles of co-operative governance and within the framework of NEM:ICMA and all other relevant legislation; • Preserve and effectively manage the ecological integrity, cultural values and ecosystem services of the coastal zone; • Effectively facilitate and manage the sustainable utilisation and development of the coastal zone; • Preserve, protect, extend and enhance the status of coastal public properly as being held in trust by the State on behalf of all South Africans, including future generations; • Secure equitable access to the opportunities and benefits of coastal resources and public properly for current and future communities; • Ensure the coastal zone is safe for local communities and visitors; • Ensure the coastal zone is kept clean for local communities and visitors; and • Enable and guide the allocation and securing of adequate financial and human resources to achieve the above objectives.
West Coast District Regional Economic Development Strategy (REDS) (2007)	The WCD REDS articulates four main aims for the economic development of the WCDM, namely: • Retain existing jobs; • Grow competitive businesses; • Attract new investments and funding; and • Share the benefits of growth. The following specific objectives are listed: • To reduce the number of households living below the poverty line; • To achieve an economic growth to an annual average of 4.5% - 6% p.a.; and

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT *(a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).*	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT**
	• For 40% of all visitors to the Western Cape to visit the WCDM.
Matzikama Local Municipality (MLM) Integrated Development Plan (2012-2017)	The MLM's IDP (2012-2017) is the over-arching strategic plan of the municipal organisation with the main purpose of articulating the vision of MLM and how it should be accomplished. Strategic focus areas of the IDP include: • Economic development; • Financial stability; • Good governance and municipal transformation; • Good quality municipal basic services; • A socially advanced community; • Capacitated and informed communities; and • A sustainable natural and built environment. The MLM recognises the mining sector as one of the slower growing sectors (approximately 4% of the local economy) in the region that will increase its contribution to the local economy with the opening of new companies.
Matzikama Local Municipality Spatial Development Framework (2014)	The vision of this SDF is to optimise the agricultural, mining, tourism and heritage related resources, existing and proposed mines, the coastal corridor, the Knersvlakte and northern Cederberg and Kouebokkeveld Mountains and the historic homesteads and core of Vanrhynsdorp for the social and economic development of its communities (CNDV, 2014). Relevant aspects of this vision to the project are as follows: • The major mines in the area should make the greatest contributions possible to long term social, economic and infrastructure development and their legacy effects should be maximized; • Opportunities for a strong overlap between biodiversity conservation and wilderness tourism should be explored; and • Integration is required between bio-diversity conservation and mining operations and their rehabilitation. The SDF therefore recognises the importance of the contribution of the mining sector to the regional economy, and specifically states that an implication of the development vision for the local municipality is to sustain existing mining operations, and to promote new mining ventures. The SDF promotes the integration of biodiversity management, tourism and industry.
Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA)	SPLUMA provides broad principles for provincial laws that regulate planning. SPLUMA also provides clarity on how planning law

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT *(a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).*	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT**
	interacts with other laws and policies. SPLUMA delegates the responsibility for land use and zoning applications to the municipality. The land use, zoning and spatial planning is therefore driven by the municipal level IDP and SDF which, according to SPLUMA, must be aligned with the Provincial IDP and SDF. The municipal SPLUMA by-laws prescribe the mechanisms for land use applications and appeals. A property is compliant with SPLUMA if: • There are approved building plans; • The use of the property is in accordance with the municipal zoning; and • There are no encroachments over the building lines and property boundaries.
Matzikama Municipality By-Law on Municipal Land-use Planning (2015)	According to the By-law, no person may commence, continue, or cause the commencement or continuation of, land development, without the approval of the Municipality. The owner of the property may apply to the Municipality for land-use approval, in terms of the By-law, in relation to the development of the land concerned.
DEA's Needs and Desirability Guideline of 2017	Refer to Appendix 7.
DEA's Draft Companion to Environmental Impact Assessment Regulations of 2010	The S&EIR process will be guided by DEA and DEA&DP's guidelines. DEA&DP's Information Document Series includes guidelines on Generic ToR for EAPs and Project Schedules, Public Participation, Alternatives, Need and Desirability, and Exemption Applications and Appeals.
DEA&DP's EIA Guideline and Information Document Series (DEA&DP, 2013)	

f) Need and desirability of the proposed activities.

(Motivate the need and desirability of the proposed development including the need and desirability of the activity in the context of the preferred location).

5 Analysis of Need and Desirability

Best practice, as well as the EIA Regulations, 2014 (Appendix 3 Section 3 [f]) requires that the need and desirability of a project (including viable alternatives) are considered and evaluated against the tenets of sustainability. This requires an analysis of the effect of the project on social, economic and ecological systems; and places emphasis on consideration of a project's justification not only in terms of financial viability (which is often implicit in a [private] proponent's intention to implement the project), but also in terms of the specific needs and interests of the community and the opportunity cost of development (DEA&DP, 2013).

The principles in NEMA serve as a guide for the interpretation of the issue of "need", but do not conceive "need" as synonymous with the "general purpose and requirements" of the project. The latter might relate to the applicant's project motivation, while the "need" relates to the interests and needs of the broader public. In this regard, an important NEMA principle is that environmental management must ensure that the environment is "held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage" (DEA, 2014).

There are various proxies for assessing the need and desirability of a project, notably national and regional planning documents which enunciate the strategic needs and desires of broader society and communities: project alignment with these documents must therefore be considered and reported on in the EIA process. With the use of these documents or - where these planning documents are not available - using best judgment, the EAPs (and specialists) must consider the project's strategic context, or justification, in terms of the needs and interests of the broader community (DEA&DP, 2013).

The consideration of need and desirability in EIA decision-making therefore requires the consideration of the strategic context of the project along with broader societal needs and the public interest (DEA, 2014). However, it is important to note that projects which deviate from strategic plans are not necessarily undesirable. The DEA notes that more important are the social, economic and ecological impacts of the deviation, and "the burden of proof falls on the applicant (and the EAP) to show why the impacts…might be justifiable" (DEA, 2010b).

The need and desirability of the project, in the context of the DEA Need and Desirability Guideline (2017), is discussed in more detail in Appendix 7.

5.1 Social Aspects

The social component of need and desirability can be assessed using regional planning documents such as SDFs, IDPs and EMFs to assess the project's social compatibility with plans. These documents incorporate specific social objectives and emphasise the need to promote the social well-being, health, safety and security of communities, especially underprivileged and/or vulnerable communities. These documents describe specific social objectives and emphasise the need to:

- Retain existing jobs;
- Enhance job creation projects that alleviate poverty;

- Promote social well-being of the community and share economic benefits; and
- Manage the sustainable utilisation and development of the coastal zone and secure equitable access to all.

The MLM requires economic growth and job creation as a means for improved social wellbeing. The project will secure existing long-term employment opportunities at the Mine and the project could therefore benefit the local and regional communities and economy.

Coastal access along the West Coast is largely inequitable and access to the coast is particularly limited north of the Olifants River Estuary. The project may affect public access to the coast in the proposed beach mining extension area.

The potential social impacts of the project are assessed in the Appendix 10.

5.2 Economic Aspects

The *economic* need and desirability of a project can be assessed using national, provincial, district and local municipal planning documents to assess the project's economic compatibility with plans. These documents describe specific economic objectives and emphasise the need to:

- Promote economic growth;
- Promote development in transformed areas and in areas with proven economic potential;
- Retain existing jobs;
- Enhance job creation projects that alleviate poverty;
- Reserve mineral deposits for future use;
- Attract new investments; and
- Share economic benefits.

Regional planning documents also emphasise the need to increase the role of the tourism sector, which promises to provide economic growth and employment coupled with greater protection of the environment (the main draw card for tourists in the area). Protection of the coastal zone is recognised as a key objective in this regard.

Notwithstanding the above, regional planning documents also highlight the need to retain existing jobs and exploit mineral resources sustainably. Tormin Mine employs approximately 216 employees and is therefore an important employer in the region.

The potential economic impacts of the project are assessed in Appendix 10.

5.3 Ecological Aspects

It is essential that the implementation of social and economic policies takes cognisance of strategic *ecological* concerns such as climate change, food security, as well as the sustainability in supply of natural resources and the status of our ecosystem services. Sustainable development is the process that is followed to achieve the goal of environmental sustainability (DEA, 2014). The regional planning documents include specific ecological objectives and emphasise the need to:

- Ensure environmental integrity and reconcile ecosystem requirements with conflicting land development pressures;
- Promote tourism through the protection and rehabilitation of the environment;
- Integrate bio-diversity conservation and mining through rehabilitation;
- Use environmental resources sustainably; and
- Manage the sustainable utilisation and development of the coastal zone.

Sustainable development implies that a project should not compromise natural systems. In this regard, the Best Practicable Environmental Option (BPEO) is that which provides the most benefit and causes the least damage to the environment, at a cost acceptable to society, in the long term as well as in the short term.

NEMA and the EIA Regulations, 2014, call for a hierarchical approach to the selection of development options, as well as impact management which includes the investigation of alternatives to avoid, reduce (mitigate and manage) and/or remediate (rehabilitate and restore) negative (ecological) impacts (DEA, 2014).

There will be ecological impacts associated with an extension of the mining footprint, which will need to be carefully planned and managed. The potential environmental / ecological impacts of the project have been identified and are assessed in Appendix 10.

5.4 Summary of Need and Desirability

In summary:

- The expansion of the Mine (and related LoM) is compatible with some, but not all, of the regional planning objectives, and addresses many of the needs expressed in these policies, particularly with regards to job creation and economic growth;
- The socio-economic benefits of continued mining at Tormin Mine need to be considered and weighed up against ecological concerns; and
- Social, economic and ecological factors have been considered and are assessed in Appendix 10. Mitigation measures have been recommended to prevent, minimise (and optimise) impacts and to secure stakeholders' environmental rights. An EMPr has been drafted and must be implemented to ensure that potential environmental pollution and degradation can be minimised, if not prevented.

g) Motivation for the preferred development footprint within the approved site including a full description of the process followed to reach the proposed development footprint within the approved site.

NB!! – This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.

i) Details of the development footprint alternatives considered.

With reference to the site plan provided as Appendix 4 and the location of the individual activities on site, provide details of the alternatives considered with respect to:

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity; and
(f) the option of not implementing the activity.

(a) Location / Site Alternatives

Mine areas

MSR owns Farm Geelwal Karoo 262, the property on which the Tormin Mine and the inland strand line is located.

The locations of the VHM beach deposits and inland deposits are fixed, which dictates possible mining locations. MSR is applying for extension into areas in immediate proximity to existing operations, infrastructure and facilities at Tormin Mine to take advantage of such infrastructure and facilities and maximise operational efficiency.

Location / site alternatives for the mine sites have thus not been considered for assessment. However, specialists considered the location of new mining and infrastructure footprints within the extension areas, considering environmental constraints identified during their site visits. The specialists did not identify any specific areas of high sensitivity within the proposed mining and infrastructure footprints that should be designated as “exclusion zones”.

MSP

The proposed MSP is an addition to the processing facility. Possible location alternatives initially considered for the MSP by MSR during the pre-feasibility phase included:

- Tormin Mine;
- Saldanha Bay; and
- Lutzville industrial area.

Based on capital costs, operating costs and hauling costs, MSR identified Tormin Mine as the most feasible location for the MSP and no location alternatives have been assessed for the MSP.

Beach 1 Access Road

MSR proposes to utilise existing informal gravel roads to access the target beaches. After discussions with the freshwater ecologist, MSR identified an alternative beach access road to Beach 1 to reduce the potential impact on a drainage line (refer to Appendix 5, Figure 3). Both access road alternatives to Beach 1 have been assessed by the relevant specialists.

(b) Activity Alternatives

The purpose of the project is to expand existing mining operations north along the coastline and inland of the processing plant to ensure the ongoing operation of Tormin Mine. No other activity alternatives (other than the No-Go alternative) are considered acceptable or viable by the proponent, and activity alternatives (other than the No-Go alternative) are not considered further in the EIA process.

(c) Design Alternatives

MSR proposed a layout design for the infrastructure / plant expansion area that extended close to the eastern (fenced) boundary of Farm Geelwal Karoo 262 (refer to Figure 23). On advice of the terrestrial ecology specialist, MSR revised the layout of the infrastructure / plant expansion area (refer to Appendix 5, Figure 12) to increase the ecological corridor between the infrastructure / plant expansion area and the eastern fenceline. The revised layout will also reduce the overall disturbance footprint as the Infrastructure Buffer Area North and South will now be located partly over areas to be mined. This layout design has been selected for assessment and no other design alternatives were assessed.

Figure 23: Initial layout of the infrastructure / plant expansion area - screened out

Source: MSR, 2017

(d) Technology Alternatives

Several technology alternatives were considered by MSR during the Pre-Feasibility phase:

- Technology alternatives for **transporting ore to the processing plant**:
  - Conveyors;
  - Pump an ore slurry; or
  - Use dump trucks.

  MSR does not consider conveyors and pipelines to be feasible, as these alternatives will require significant capital outlay and the infrastructure will significantly increase the disturbance footprint. MSR has also committed to processing the ore on the beaches using mobile PBCs. This will significantly reduce the number of truck trips between the beaches and the processing plant.
- Technology alternatives **enabling beach mining**:
  - Use dredging techniques and machinery; or
  - Geofabric “socks” as an alternative to sand berms and wave breakers.

  The high energy environment during most high tides does not allow for safe mining. Mining will therefore focus on the use of mobile excavators during lower tides.
- MSR considered three alternatives for **additional electricity supply**:
  - Connect to the Eskom network at the Sere wind energy facility;
  - Install additional generator sets (gensets); or
  - Install photovoltaic panels to generate electricity on-site.

  A connection to the Eskom network at the Sere wind energy facility is MSR’s preferred alternative. Installing photovoltaic panels as the sole supply of electricity to the Mine is not considered viable by MSR. MSR may need to install additional gensets if the Mine is unable to connect to the wind energy facility.
- MSR considered four alternatives for **additional fresh water supply**:
  - Continue to truck in water from Lutzville;

- Apply for an allocation from the Lower Olifants River canal;
- Groundwater; or
- Seawater desalination (RO Plant).

MSR initially considered seawater desalination as the only viable option for freshwater supply as trucking of water was not considered to be feasible due to cost, the Lower Olifants River Water User Association canal has insufficient unallocated water available for Tormin Mine and no aquifers were identified. However, with changes to the MSP (wash circuit not required, see Section 3.7.1 "Dry Circuit"), limited additional freshwater will be required (for domestic purposes) and MSR will continue to truck water from Lutzville.

e) Operational Alternatives

Given the nature of beach and strip mining, alternative physical mining technologies are not expected to have any meaningful implications for environmental impacts.

(f) No Go Alternative

The No-Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2014. The No-Go alternative implies no change in the sites' *status quo*. The No-Go alternative will have implications for the sustainability of Tormin Mine as it is likely that mining operations will need to be scaled down or closed for Care and Maintenance should resource grades remain low.

ii) Details of the Public Participation Process Followed

Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB the affected parties must be specifically consulted regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.

The overall aim of stakeholder engagement is to ensure that all Interested and Affected Parties (IAPs) have adequate opportunity to provide input into the process and raise their comments and concerns. More specifically, the objectives of stakeholder engagement are to:

- Identify IAPs and inform them about the proposed development and S&EIR process;
- Provide stakeholders with the opportunity to participate effectively in the process and identify relevant issues and concerns; and
- Provide stakeholders with the opportunity to review documentation and assist in identifying mitigation and management options to address potential environmental issues.

Activities Undertaken during the prior EIA Process

SRK initiated an EIA Process for the proposed extension of Tormin Mine in January 2017 (DMR Reference Number: WC 30/5/1/2/2 MR). A Draft Scoping Report (SRK Report No. 507228/2, dated April 2017) was released for stakeholder comment in April 2017. On 22 November 2017 DMR refused the Environmental Authorisation at the Scoping Phase, citing the undertaking of a section 24G (s24G) process in terms of NEMA for the rectification of unlawful activities. MSR appointed SRK to undertake a s24G application process. The final s24G documentation was submitted to DMR in July 2018.

Although not part of this EIA process, Table 18 provides a brief overview of the stakeholder engagement activities undertaken during the prior EIA process (to demonstrate that the project has been extensively disclosed).

Table 18: Stakeholder engagement activities during the prior EIA process

Task	Objectives	Dates
Advertise commencement of EIA process and release a Background Information Document (BID)	To notify IAPs of the commencement of the EIA process and to provide an initial description of the proposed project and the affected environment.	24 January 2017
Release Scoping Report for public comment period	To provide a description of the proposed project and the affected environment, as well as a description of potential environmental issues, and the proposed approach to the Impact Assessment Phase.	24 – 26 April 2017
Public comment period	To provide stakeholders with the opportunity to review and comment on the results of the Scoping Phase.	28 April – 29 May 2017
Public Open Day	To present the findings of the Scoping Report to stakeholders and provide an opportunity for questions and discussion.	10 May 2017

Activities during the Scoping Phase of the current EIA Process

A new EIA process for the proposed extension of Tormin Mine was initiated on 12 April 2018 with the submission of the EA application to DMR.

The activities undertaken during the Scoping Phase of the current EIA process are outlined in Table 19.

Table 19: Stakeholder engagement activities during the Scoping Phase

Task	Objectives	Dates
Advertise commencement of EIA process and release of Scoping Report for public comment	To notify IAPs of the commencement of the EIA process and to provide an initial description of the proposed project and the affected environment.	6 April 2018
Release Scoping Report for public comment period	To provide a description of the proposed project and the affected environment, as well as a description of potential environmental issues, and the proposed approach to the Impact Assessment Phase.	12 April 2018
Public comment period	To provide stakeholders with the opportunity to review and comment on the results of the Scoping Phase.	13 April – 14 May 2018
Compile Issues and Responses Summary and finalise Scoping Report	To record all issues and concerns raised and collate these comments in the final report which provides DMR with information to decide whether to accept the Scoping Report.	May 2018

As required by the EIA Regulations, 2014, relevant local, provincial and national authorities, conservation bodies, local forums and representatives and surrounding landowners and occupants were notified of the EIA and the release of the Scoping Report for comment. In addition, all IAPs who were registered on the stakeholder database during the prior EIA process for this project were also directly notified.

Relevant authorities (Organs of State) were automatically registered as IAPs. In accordance with the EIA Regulations, 2014, all other persons must request in writing to be placed on the register, submit written comments or attend meetings in order to be registered as stakeholders and included in future communication regarding the project. As specified in GN R 982, all persons who submit written comments, attend meetings or request in writing to be placed on the register will be registered as IAPs, and advertisements advised that IAPs register as such.

A list of stakeholders registered at the end of the Scpoing Phase is provided in Appendix 8A. The stakeholder database will be updated throughout the process.

Newspaper advertisements announcing the EIA process, availability of the Scoping Report for review and inviting IAPs to register on the project database were placed in:

- One regional newspaper:
  - Die Burger (in Afrikaans); and
- One local newspaper:
  - Ons Kontrei (in English and Afrikaans).

English and Afrikaans site posters with details of the project and EIA process and EAP contact details were placed at Tormin Mine and along the access road to Gert du Toit-se-Baai.

Hard copies of the full Scoping Report were available for viewing at the following venues:

- Lutzville Public Library;
- Vredendal Public Library; and
- SRK's office in Rondebosch.

An electronic version of the report was also available on SRK's website www.srk.co.za (via the 'Library' and 'Public Documents' links).

Stakeholders were provided with a 30-day comment period until 14 May 2018.

All stakeholders on SRK's database were notified by email or letter of the commencement of the S&EIR process and availability of the Scoping Report for comment on 12 April 2018.

iii) Summary of issues raised by I&APs

(Complete the table summarising comments and issues raised, and reaction to those responses)

During the prior EIA process, 22 stakeholder comments were received, and during the current EIA process a further 10 stakeholder comments were received on the April 2018 Scoping Report. Stakeholders who submitted written comments are listed in Table 20. All comments received during the prior EIA process (on the Background Information Document [BID] and 2017 Scoping Report) and during the current EIA process on the April 2018 Scoping Report are included in the Issues and Responses Summary provided in Appendix 8B.

Table 20: Stakeholders who submitted comments on the BID and Scoping Reports

No	Name	Affiliation	Comment date
Authorities			
1	Alana Duffell-Canham	CapeNature	3 February, 17 May 2017 and 15 May 2018
2	Malcolm Watters	DTPW	17 March, 6 June 2017 and 19 April 2018
2	Adri La Meyer	DEA&DP	29 May 2017 and 14 May 2018
4	Doretha Kotze	WCDM	29 May 2017 and 7 May 2018
5	Derrick Makhubele	DEA	2 June 2017
6	Rassie Niewoudt	DWS	6 June 2017
7	Andrew September	HWC	6 June 2017
8	Briaan Smit	Matzikama Municipality	3 May 2018
Other Stakeholders			
9	Martin Calitz	Private	25 January 2017
10	Dr Philip Desmet	Private	25 January 2017
11	Nick Helme	Private	25 January 2017
12	Hansie Visser	Adjacent property owner	27 January 2017
13	Jacobus Nolte	Private	30 January 2017
14	Mike Winfield	Elands Bay Environmental and Development Action Group	5 February and 2 May 2017
15		Centre for Environmental Rights	24 February, 29 May 2017 and 11 May 2018
16	Carel Nolte	Private	4 May 2017
17	Allen Lyon	Strandfontein Ratepayers Association	18 May 2017
18	Dinah Louw	Private	29 May 2017 and 8 May 2018
19	Johan Bornman	Property owner (Tronox Namakwa Sands)	29 May 2017
20	Sandra du Plessis	Olifants River Estuary Management Forum	29 May 2017 and 14 May 2018
21	Glenn Ashton	Private	29 May 2017
22	Lionell van Wyk	Private	29 May 2017
22	Jan Briers	Private	31 May 2017 and 12 May 2018

The main issues raised by stakeholders are:

1) A Section 102 application process is the incorrect procedure to apply for an extension of Tormin Mine, and may potentially not be submitted while the Prospecting application is still under review;

2) Authorisation should not be granted to MSR as they are not in compliance with their existing authorisations / approvals (relating to inter alia mining area, process and transportation) and MSR must undertake a Section 24G rectification process;

3) Road transport has a significant impact on other road users and the existing road network; rail must be investigated;

4) It is not clear how MSR obtained the required prospecting data to determine the resource and financial viability of the proposed mine extension;

5) Insufficient information has been provided for the proposed beach access roads and beach mining areas;

6) Impacts related to seawater in tailings and cliff stability must be investigated;

7) The removal of beach sand may result in beach, cliff and dune erosion, and setback lines should be stipulated;

8) The extension of Tormin Mine will restrict public access to the coast, affecting the tourism value of this stretch of coastline; and

9) The project may compromise the ecological functioning and integrity of the CBA and rehabilitation is very difficult; a biodiversity offset may be required.

i) The Environmental attributes associated with the development footprint alternatives. (The environmental attributed described must include socio- economic, social, heritage, cultural, geographical, physical and biological aspects)

(1) Baseline Environment

(a) Type of environment affected by the proposed activity.

(its current geographical, physical, biological, socio- economic, and cultural character).

6 Biophysical Environment

6.1 Geology and Topography

The geology and topography of the area, together with the semi-arid climate and the proximity to the coast, have determined the basic landscape features and visual elements of the study area.

The geology of the study area is complex with a diversity of metamorphic formations and sedimentary and igneous rock types. The most prominent and resistant are volcano-sedimentary metamorphites and gneisses of the mid-Protozoroic Namaqualand Metamorphic Complex and the limestones, dolomites and phylites of the Pan-African Gariep Supergroup (AEMCO, 2016). Formations in the study area include ancient fluvial deposits (Koingnaas Formation), the marine Kleinzee, Avontuur and Hondeklip Bay Formations and aeolian formations of various ages, including the Graauw Duinen Formation and the Olifants River Formation (ACO, 2016).

The coastline of Farm Geelwal Karoo 262 consists of wide beaches separated by rugged rocky promontories. Steep dunes and rocky cliffs (maximum cliff vertical height of 24 m) are a feature of the area. Unconsolidated material overlies a highly weathered clay-rich basement representing weathered schist (AEMCO, 2015 in Middindi, 2018). The cliffs predominantly comprise the following material (Davies, Lynn & Partners, 2006 in Middindi, 2018):

- Loose to medium dense reddish orange medium-grained sands;
- Cemented reddish orange moderately clayey sands and sandy clays;
- Cemented light grey sands and gravel in a clay matrix; and
- Weathered rocks of the Gariep Formation.

The coastal platform is almost flat before rising to a ridgeline along the western boundary of Farm Geelwal Karoo 262.

The coastline to the north of Tormin Mine is characterised by a rocky shoreline with isolated beaches in small bays. The character of the coastline changes further north, as longer beaches and primary dune systems become more prominent. The northern coastline is primarily covered by aeolian sands and calcrete lenses overlying the base materials (Middindi, 2018). The vertical change from the high-water mark to the inland zone is less abrupt; the topography rises gently to a ridgeline ~ 5 km inland.

6.2 Soils and Land Capability

This section is based on information provided by the soil and land capability specialist, TerraAfrica (refer to the Soil and Land Capability Impact Assessment, Appendix 11A).

6.2.1 Soil Forms

Eight different soil forms were identified within the study area. The soil profiles ranged in depth between 0.55 m to deeper than 2 m. The largest part of the study area consists of the Bloemdal and Clovelly soil forms. Most of the surface and middle horizons of the profiles are single grained and weakly structured or structureless (apedal). Firm more clayey subsurface horizons above the dorbank show some signs of structural development. The soil forms are described below and presented in Figure 24.

- **Bloemdal**: This soil form is abundant in the inland mining area. It is a non-calcareous soil form, where an orthic A-horizon overlies a red apedal horizon that is overlying unspecified material with signs of wetness. The depths of the soil profiles ranged between 1.3 to deeper than 1.5 m. The soil profile is dominated by the sand fraction (90.65%) with very low organic matter content (organic carbon is 0.13%). The cation exchange capacity is dominated by sodium because of the proximity of the ocean and the effect of evaporation of salt-containing dew from the soil surface. In areas of higher rainfall, this soil form usually has high arable potential for dryland crop production, however, because of the very low rainfall of the study area, this soil form can only support indigenous vegetation that may be used for small stock grazing;

- **Clovelly**: The Clovelly form can also be found in the inland mining area. The soil profiles identified in this soil group have very sandy, orthic A horizons (92.38% sand) overlying highly permeable yellow-brown B horizons. The Clovelly profiles identified on site are deeper than 1.5 m where it is possibly underlain by dorbank. The cation exchange complex is dominated by sodium while the phosphor content is low as expected for undisturbed soil under natural vegetation. Clovelly soil can be stripped for topsoil conservation purposes to a depth of 0.5-1m;
- **Namib**: The beaches were all classified as the Namib soil form (regic sand). This soil form consists of an orthic A horizon (91.06% sand) underlain by regic sand. Regic sands are found widely in arid regions of the country and coastal areas. Regic sand is defined as sand or cover sand that has experienced limited or no soil development. Horizon differentiation resulting in a slight darkening of the orthic A horizon caused by decomposing organic matter was not visible (organic carbon is only 0.25%). This is because of the absence of vegetation cover (or very sparse vegetation cover). The sodium content is high, as expected from the accumulation of salt through seawater movement over the surface;
- **Tukulu**: An area of 9 ha of the Tukulu soil form is present in the northern area of the infrastructure / plant expansion area. The Tukulu soil form consists of an orthic A horizon, overlying a neocutanic B horizon on unspecified material with signs of wetness. Soils of the Tukulu form are deep and generally highly suited to cultivation but rainfall in the study area is extremely limited and erratic thereby reducing the arable potential of this soil form. It has signs of wetness beneath the neocutanic horizon. The A-horizon's texture is dominated by the sand fraction (88.66%) with very low organic matter content (organic carbon is 0.10%). The cation exchange capacity is dominated by sodium. The areas where the Tukulu soil form occurs have wilderness land capability;
- **Witbank**: Witbank is the only soil form that describes the anthropic group of soils in South Africa. Anthropic soils are those soils that have been so profoundly affected by human disturbance that their natural genetic character (i.e. their link to the natural factors of soil formation) has largely been destroyed or has had insufficient time to express itself. The Witbank soil form encountered in the study area consists of old alluvial diamond mining areas where topsoil stockpiles have been left derelict and in the existing processing plant area. In these areas, the subsoil horizons have been mixed with the topsoil and this has changed the original physical (and most likely chemical) soil properties. The areas where the Witbank form occurs have wilderness land capability;
- **Garies**: The Garies soil form was identified at the northern end of the northern beach haul road. This soil form consists of an orthic A horizon (30 cm or more) overlying a red apedal horizon with dorbank underneath. This dorbank horizon is formed by silica cementation and is very hard. The subsurface dorbank layer is typical of the arid regions of South Africa. The orthic A and red apedal B1-horizon has a sandy texture with associated high water infiltration rates, but the dorbank layer has water retaining properties that assists in conserving water in the landscape. The dorbank can be ripped up and used as road construction material (Fey, 2010), but the disturbance of this horizon impedes the water storage ecosystem service provided by it;
- **Oudtshoorn**: The Oudtshoorn soil form is prevalent to the north of Tormin Mine and consists of an orthic A horizon overlying a neocutanic B horizon that is underlain by dorbank. The neocutanic B horizon is characterised by the aggregation of soil particles to the extent that it is no longer structureless, but insufficient to qualify as a diagnostic pedocutanic or prismacutanic B horizon. The agricultural use of this soil is limited by several factors – not least of which is the arid climate in which they are found. Further limitations include shallow soil depth and low water holding capacity. The Oudtshoorn soil form has

wilderness land capability. The soil chemical composition of this form is dominated by calcium and magnesium while sodium are higher than potassium levels because of the proximity to the ocean; and

- **Pinedene**: The Pinedene soil form is present in the northern extent of the study area and consists of an orthic A horizon overlying a yellow-brown apedal B horizon that is underlain by unspecified material with signs of wetness. The Pinedene soil form has a moderately high degree of weathering, depletion of bases and moderate acidity and a sandy loam structure. Dolomitic lime would be needed to achieve good crop yields. The soil is suited to dryland crop production, subject to appropriate chemical amelioration and sufficient rainfall. The climatic conditions in the study area are not suited to crop production if irrigation water is not available and is best used as grazing for small stock or wildlife. The Pinedene form in the study area has wilderness land capability.

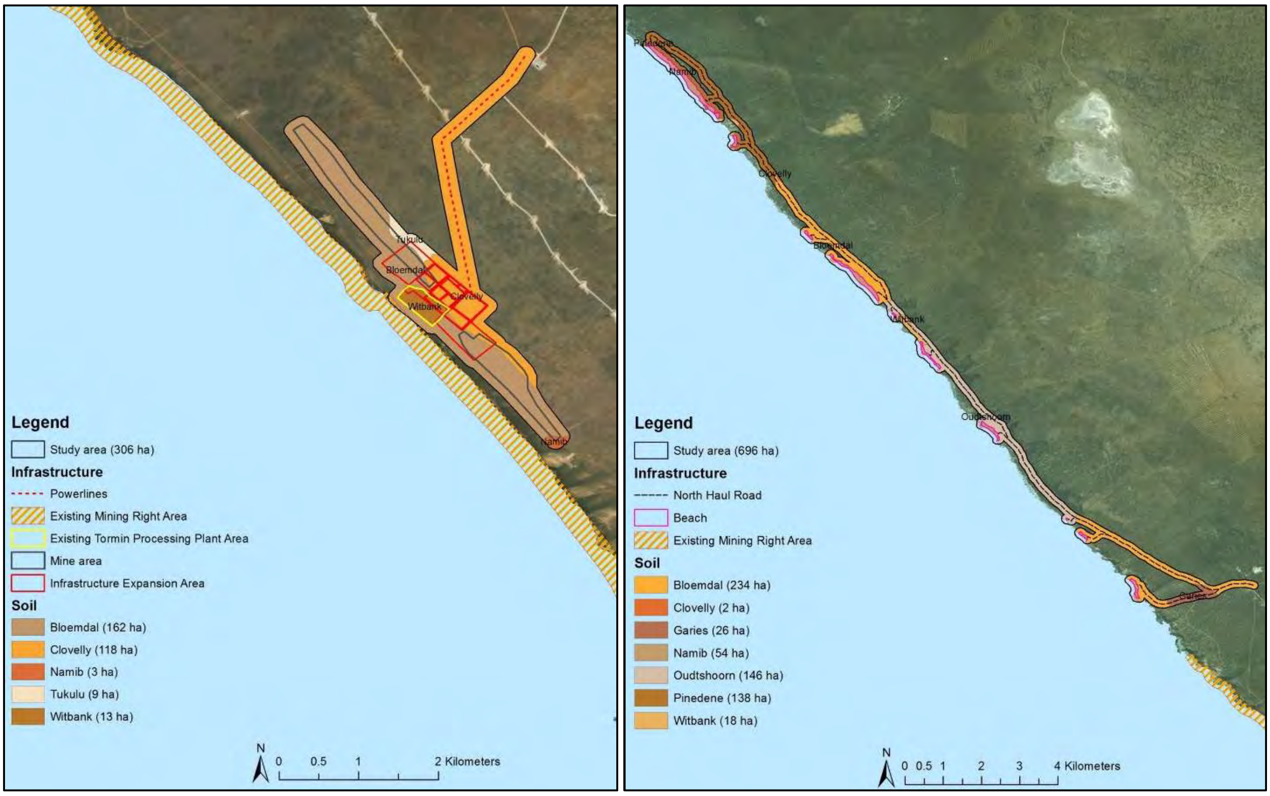


Figure 24: Soil forms of the study area

Source: TerraAfrica, 2018

6.2.2 Soil Chemical Properties

Five soil samples were collected in the study area. The pH of these samples ranges between 6.98 and 7.71 which is neutral to slightly alkaline, an indication of a high saturation of the base cations (K^+, Ca_2^+, Mg_2^+ and Na^+). The high sodium levels of all samples analysed correlates well with the study area's proximity to the sea where the presence of salt in the dew precipitates on the soil surface. These high sodium levels make the soil forms unsuitable for crop production, although the natural vegetation is well-adapted to high salinity levels. The high bulk densities of the soils in this region reflect the presence of heavy minerals. Significant amounts of heavy minerals sometimes provide a false indication of bulk density as an indicator of soil compaction.

6.2.3 Land Capability

Table 21 indicates the set of criteria as stipulated by the guidelines outlined in Section 7 of The Chamber of Mines Handbook of Guidelines for Environmental Protection (Volume 3, 1981) to group soil forms into different land capability classes.

The soil and land types identified in the study area could all be classified as land with wilderness land capability. Even though the Clovelly, Bloemdal and Tukulu forms have the potential for arable agriculture, the very low rainfall of the study area makes it unsuitable for crop production. The study area could be suitable for grazing by small stock, but this may negatively affect faunal biodiversity. Small stock grazing occurred on Farm Geelwal Karoo 262 until MSR bought the property in August 2016.

Table 21: Pre-mining land capability criteria

Criteria for Wetland	• Land with organic soils; or • A horizon that is gleyed throughout more than 50 % of its volume and is significantly thick, occurring within 750mm of the surface.
Criteria for Arable Land	• Land which does not qualify as a wetland; • The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm; • The soil has a pH value of between 4,0 and 8.4; • The soil has a low salinity and SAR; • The soil has a permeability of at least 1,5 mm per hour in the upper 500 mm of soil; • The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100 mm in diameter in the upper 750 mm; • Has a slope (in %) and erodibility factor (K) such that their product is <2.0; and • Occurs under a climatic regime, which facilitates crop yields that are at least equal to the current national average for these crops or is currently being irrigated successfully.
Criteria for Grazing Land	• Land, which does not qualify as wetland or arable land; • Has soil, or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm; and • Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants, utilizable by domesticated livestock or game animals on a commercial basis.
Criteria for Wilderness Land	• Land, which does not qualify as wetland, arable land or grazing land.

6.2.4 Land Use and Agricultural Potential

According to Ndeinoma (2006), the larger Namakwaland region is used for grazing, mining and in very small areas irrigated crop production in the Olifant's River valley. However, the dominant agricultural activity in the Namaqualand region is sheep and goat farming.

During the specialist site visit, it was evident that the dominant land use in the study area is small livestock farming. There are also beehives present on Farm Graauw Duinen. Ndeinoma (2006) indicates the grazing capacity of the Namakwa Sands area as 10 – 20 ha per Small Stock Unit (the equivalent of one sheep or one goat).

This region is not suited to the production of arable agricultural products owing to the low rainfall. Consequently, there is no record of any significant form of agricultural production in any of the proposed strand line and process plant expansion areas. This was confirmed by the specialist during the site visit as there was no evidence of historical or recent dryland or irrigated crop production in the study area.

6.3 Climate

This section is based on information provided by the air quality specialist, Airshed Planning Professionals (refer to the Air Quality Impact Assessment, Appendix 11B).

6.3.1 Regional Climate

The Western Cape has a Mediterranean climate, with wet winter and dry summer seasons. Inland and coastal temperatures usually differ as the mild, dry and very sunny summers warm the coast with temperature lows of around 20°C and highs averaging around 30°C, and inland temperatures are often 3-5 °C higher than the coastal areas. Summer starts around September and lasts until April. Winters are spread across the months of

May to July and may extend into August. The region is semi-arid with the highest rainfall months between May and August. June is the highest rainfall month with approximately 28 mm of rainfall. The lowest rainfall months are between January and March with January and February reaching approximately 3 mm of rainfall for both months.

6.3.2 Wind

The predominant wind direction for the area, based on data from the South African Weather Station (SAWS) in Vredendal, is from the south-west and west-south-west. These wind directions are also associated with strong winds of above 10 m/s. For day-time conditions, winds from the west and south-south-west predominate with increased winds from the west-north-west occurring during night-time conditions.

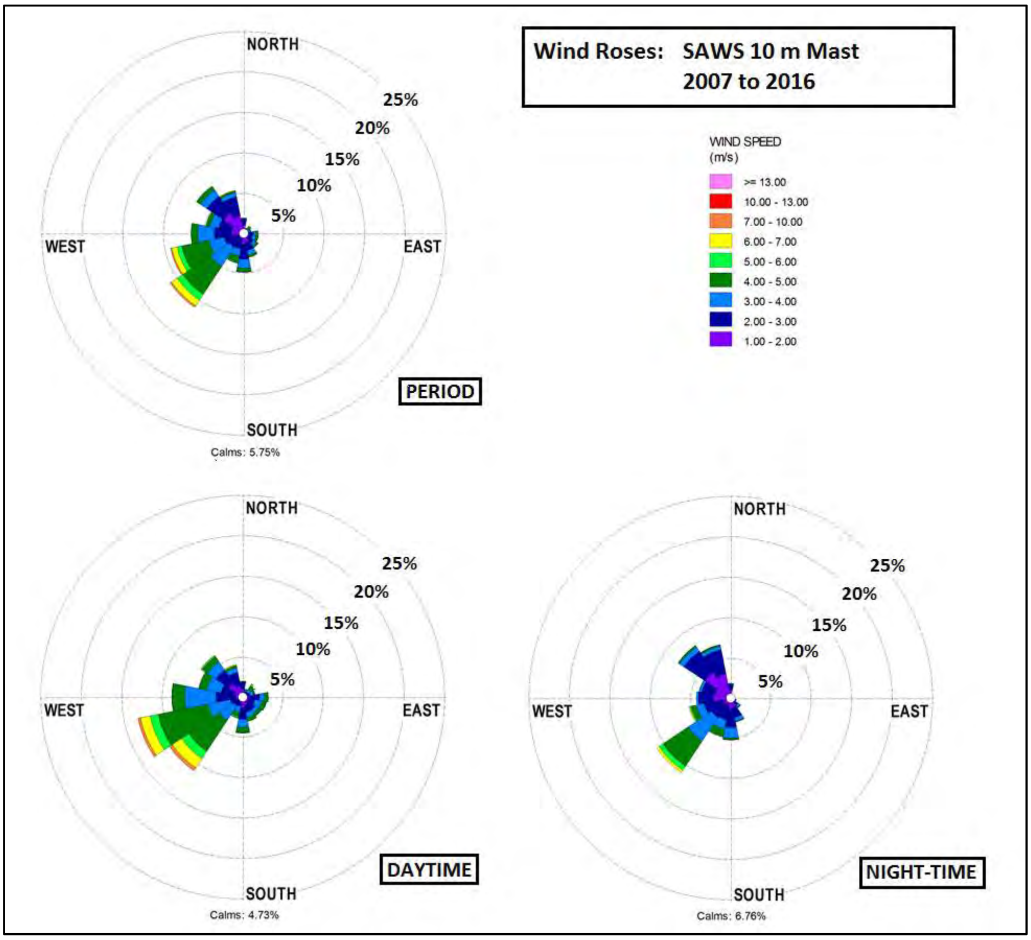


Figure 25: Period, day- and night-time wind roses as observed at 10 m on the SAWS weather station mast in Vredendal for the period 2007-2016

Source: Airshed, 2018

The wind conditions at Tormin Mine are expected to be slightly different due to the proximity to the coastline. In the absence of onsite measurements, a comparison is made to the observations at Brand-se-Baai, approximately 9 km north of Beach 10. The predominant wind directions differ considerably with the winds at Brand-se-Baai following the coastline (south-east and north-west) with a very predominant southerly component.

During daytime there is an increase in winds from the south and south-south-west. Nocturnal wind flow reflects predominant winds from the south-east and north westerly sectors. Night-time conditions also reflect a decrease in wind speeds ranging mainly from 1-2 m/s in comparison to daily wind speeds of 3-4 m/s.

As shown in the seasonal wind roses (Figure 27), the north-westerly winds are more predominant during the winter (including autumn and spring), with significantly less occurrences during the summer months. Winter also observes considerably less southerly winds. During the summer months, strong winds from the south and south-east dominate with wind speeds of up to 15 m/s. Strong winds also occur from the north-westerly sector. Infrequent but strong winds are also noted to occur from the north-easterly sector. During autumn (April to May), a similar pattern of wind flow is observed with winds blowing more frequently from the south and south-east with some strong winds from the north-west. Winter months reflect more frequent flow from the north-westerly sector. During springtime wind flow becomes more dominant from the south and south easterly sector with an increase in wind speed. Wind speeds are similar throughout the year with slightly lower wind speeds during the winter months.

Mean daily wind speeds are generally in the range of 1 m/s to 4 m/s, with maximum daily speeds typically ranging from 5 m/s to 15 m/s.

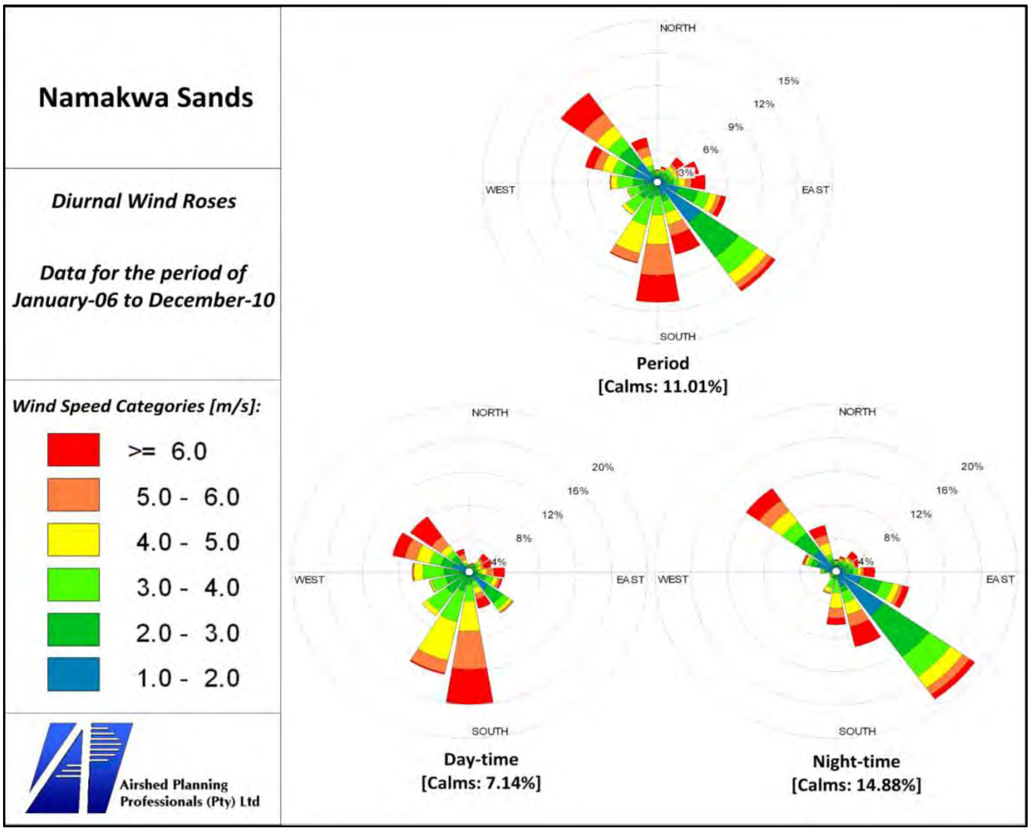


Figure 26: Diurnal wind roses for the period January 2006 to December 2010

Source: Airshed, 2018

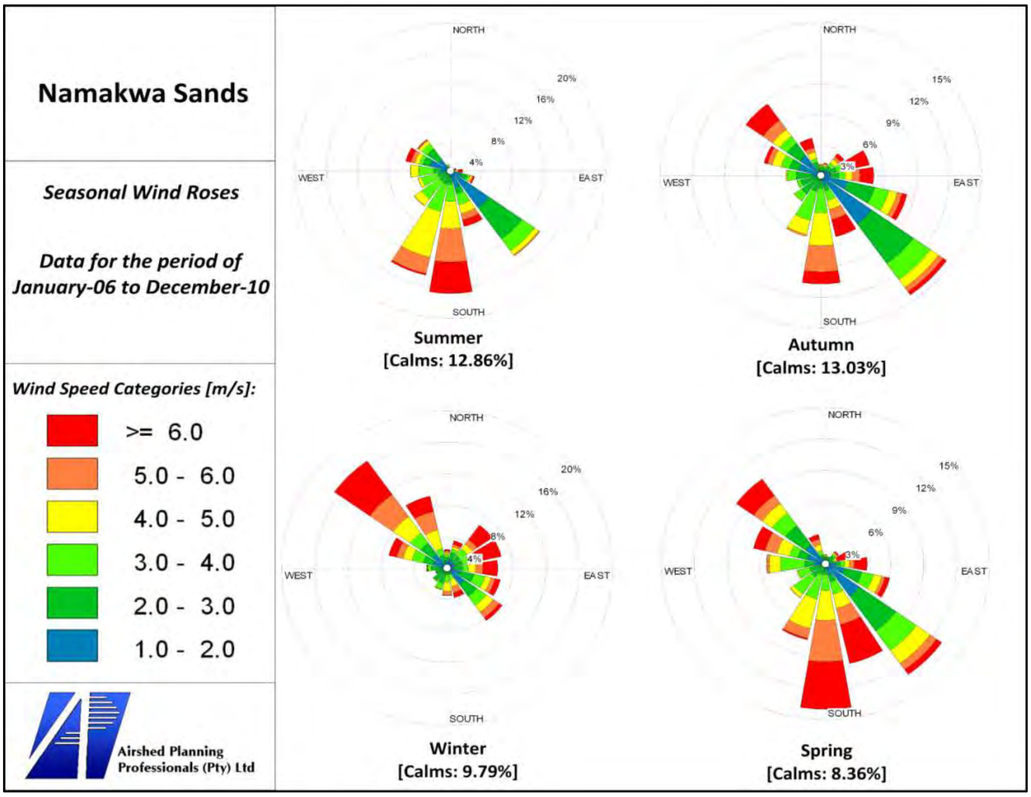


Figure 27: Seasonal wind roses for the period January 2006 to December 2010

Source: Airshed, 2018

6.3.3 Precipitation

No historical data is available for the Tormin Mine and reference was made to long-term SAWS rainfall statistics (Schultz 1986) for Vredendal and summarised produced for the Matzikama SDF (2013). Figure 28 depicts the distribution of the mean annual rainfall in the Matzikama Municipality. This figure generally shows that a band running south-west to north-east, east of Klawer, receives the highest rainfall in the municipality (200 mm to 600 mm of rainfall per annum). Whilst small parts of the study area receive the lowest rainfall of between 0 mm and 100 mm per annum, most receives between 100 mm and 200 mm.

This is also clearly shown in the long-term monthly average rainfall figures for Vredendal, as provided in Table 22 (Schultz 1986), i.e. 145 mm. Rain falls mainly in winter from May to August, with the peak being in June (~ 28 mm). The lowest rainfall months are between January and March.

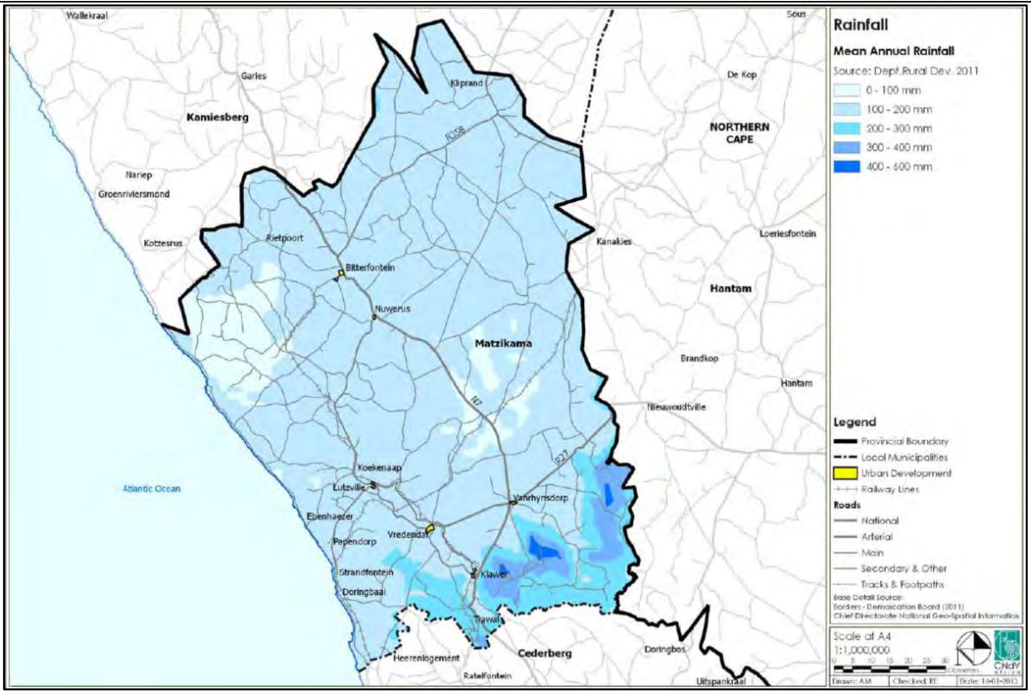


Figure 28: Mean annual rainfall

Source: Matzikama SDF, 2013 in Airshed, 2018

Table 22: Long-term average monthly rainfall figures (mm) for the Vredendal station (1957-1984)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Vredendal	2	3	5	14	23	30	17	20	8	8	9	6	145

Source: Airshed, 2018

No historical data for temperature trends was available for the Tormin Mine and reference is made to long-term average maximum, mean and minimum temperatures for Vredendal. Long-term average maximum, mean and minimum temperatures for Vredendal (1957-1984) are given in Table 23 (Schulze, 1986). Annual mean temperature is given as 22.3°C, with a minimum of 14.8°C and a maximum of 29.8°C. The proximity to the coast is expected to reduce the average temperature conditions, especially considering that fog is very prevalent along the coast, notably in the morning. As shown in Burger and Gresse (2012), the annual mean temperature for Brand-se-Baai is 13.7°C, with a minimum of 8°C and a maximum of 18.8°C.

Table 23: Long-term minimum, maximum and mean temperature for Vredendal

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Maximum	29.8	30.3	29.7	27.2	23.5	21.2	20.9	21.2	23.3	25.2	27.6	28.9	29.8
Mean	22.3	22.5	21.8	19.6	16.4	14.4	13.8	14.2	15.9	17.9	20.0	21.4	22.3
Minimum	14.8	14.7	13.8	12.0	9.2	7.6	6.6	7.2	8.5	10.6	12.5	13.9	14.8

Source: Schulze, 1986 in Airshed, 2018

6.3.4 Air Quality

This section is based on information provided by the air quality specialist, Airshed Planning Professionals (refer to the Air Quality Impact Assessment, Appendix 11B).

South African National Ambient Air Quality Standards

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria. These generally include carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), Particulate Matter (PM) and ground level ozone (O_3).

In determining ambient air quality, concentrations of pollutants are measured and/or modelled and compared against air quality standards. These standards are intended to protect human health and environmental degradation and, as such, focus on emissions perceived to pose a health or environmental risk. The National Ambient Air Quality Standards (NAAQS) and additional standards for particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$) are provided in Table 24. These standards are based on international best practices and aim to protect human health and indicate safe exposure levels for most of the population throughout an individual's lifetime, including the very young and the elderly.

Table 24: National Ambient Air Quality Standards

Pollutant	Averaging Period	Concentration (µg/m³)	Permitted Frequency of Exceedance	Compliance Date
SO_2	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate
	24 hour	125	4	Immediate
	1 year	50	0	Immediate
Benzene	1 year	5	0	1 January 2015
CO	1 hour	30000	88	Immediate
	8 hour(a)	10000	11	Immediate
Lead	1 year	0.5	0	Immediate
NO_2	1 hour	200	88	Immediate
	1 year	40	0	Immediate
O_3	8 hour(b)	120	11	Immediate
$PM_{2.5}$	24 hour	40	4	1 January 2016 till 31 December 2029
	24 hour	25	4	1 January 2030
	1 year	20	0	1 January 2016 till 31 December 2029
	1 year	15	0	1 January 2030
PM_{10}	24 hour	75	4	1 January 2015
	1 year	40	0	1 January 2015

Source: Airshed, 2018

National Dust Control Regulations

The National Dust Control Regulations (NDCR) prescribe general measures for the control of dust. The standard for acceptable dustfall rates is set out in Table 25 for residential and non-residential areas. According to these regulations, the dust fall at the boundary or beyond the boundary of the premises where it originates cannot exceed 600 mg/m²/day in residential and light commercial areas; or 1 200 mg/m²/day in areas other than residential and light commercial areas.

In addition to the dust fall limits, the NDCR prescribe monitoring procedures and reporting requirements.

Table 25: Acceptable dust fall rates

Restriction Area	Dust-fall rate (D) (mg/m²/day, 30-day average)	Permitted frequency of exceeding dust fall rate
Residential	D < 600	Two within a year, not sequential months.
Non-residential	600 < D < 1 200	Two within a year, not sequential months

Source: Airshed, 2018

Typical Health Effects

Carbon Monoxide

CO is a colourless, odourless and poisonous gas produced by incomplete burning of carbon in fuels. Majority of CO emissions are from transportation sources, particularly highway motor vehicles. Other major CO sources are wood-burning stoves, incinerators and fuel combustion at industrial sources. When CO is inhaled, it enters the bloodstream and reduces the delivery of oxygen to organs and tissues.

Nitrogen Oxides

NO and NO_2 (commonly referred to as NOx) are the most important oxides of nitrogen in the context of local air quality. Nitrous oxide (N_2O), the only other oxide found in appreciable quantities, plays an important role in the enhanced “greenhouse effect” as well as being involved in other reactions in the upper atmosphere, but is of far lesser significance in the lower atmosphere.

NOx form when fuel is burned at high temperatures. The major emission sources in urban areas include motor vehicles, stationary fuel combustion sources, rail and aviation activities, and domestic burning of wood, coal and natural gas. The major mechanism for the formation of NO_2 in the atmosphere is the oxidation of the primary air pollutant NO. The proportion of NO to NO_2 in the discharge from combustion sources is typically 90-95% NO. There is, therefore, little NO_2 that is discharged directly into the air.

NOx are important precursors to photochemical reactions, ozone and acid rain and may affect human health and terrestrial and aquatic ecosystems. Excess levels of ozone in the lower atmosphere are formed by the photolysis of NO_2. Other products of photochemical reactions include nitric acid (HNO_3), peroxyacetyl nitrate (commonly written as PAN) and various organic particulates containing nitrogen. NOx interacts with other compounds in the air to form inorganic particulates, which may have impacts on health and visibility.

Sulphur Dioxide

SO_2 is formed when the sulphur in fuels combines with oxygen at high temperature. SO_2 is a colourless, pungent gas that is a respiratory irritant and is a precursor to acid rain. SO_2 can also interact with other compounds in the air to form PM contributing to visibility impairment. Ambient SO_2 results largely from stationary sources, such as coal and oil combustion, steel mills, refineries, pulp and paper mills and non-ferrous smelters. In the project area, the most common source of SO_2 is likely to be vehicle emissions, as there are few large industries in the area.

Particulate Matter

Particulates are pollutants of much concern regarding their health and environmental effects, especially in the inhalable / respirable size ranges. Particulates can be referred to as total suspended particulates (TSP), as visible smoke, or by direct or indirect descriptions of their size. Common size-related terms are the inhalable and respirable classes, PM_{10} and $PM_{2.5}$ (i.e. particulate matter, with the numbers referring to the maximum particle diameter in micrometers). Particulates originate from a variety of sources:

- Natural sources, i.e. windblown dust and fires;
- Combustion sources, i.e. motor vehicles, power generation, fuel combustion. Combustion sources emit particles of ash or incompletely burned materials;

- Activities, i.e. materials handling, crushing and grinding operations, travel on unpaved roads; and
- Interaction of gases (e.g. NH_3, SO_2, NOx, and Volatile Organic Compounds (VOCs)) with other compounds in the air to form PM.

The chemical and physical composition of PM varies depending on location, time of year and meteorology.

Ambient Air Quality

The air quality of the study area is mostly influenced by activities at the Tronox Namakwa Sands' MSP and current Tormin mining operations, farming activities, domestic fires, vehicle exhaust emissions and dust entrained by vehicles. These emission sources vary from activities that generate relatively coarse airborne particulates (such as farmland preparation, dust from paved and unpaved roads and the Tormin Mine) to fine PM such as that emitted by vehicle exhausts, diesel power generators and dryers. Other sources of PM include occasional fires in the residential areas of Koekenaap, Lutzville, Vredendal and farm activities.

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in South Africa. Dust emissions from unpaved roads are a function of vehicle traffic and the silt loading on the roads. Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface. Every time that a surface is disturbed e.g. by mining, agriculture and/or grazing activities, its erosion potential is restored.

Sensitive receptors that may be influenced by emissions from Tormin Mine are identified in Table 26 and Figure 29.

Table 26: Potential sensitive receptors

ID	Location	Distance and Direction from Tormin Processing Plant	ID	Location	Distance and Direction from Tormin Processing Plant
1	Brand-se-Baai	34 km NNW	**11**	Ebenhaeser	15 km SW
2	Graafwater	22 km NNW	12	Olifantsdrift	14 km SW
3	Baievlei	21 km NNW	13	Robeiland	12 km SSW
4		14 km NNW	14	Transhex	13 km SSW
5	Gert du Toit se Baai	10 km NW	15	Olifants River Settlement	17 km ENE
6	Skaapvlei	6 km NNW	16	Koekenaap	18 km ENE
7	Skilpadvlei	9 km ENE	17	Lutzville	24 km E
8	Nooitgedagt	6 km ESE	18	Pependorp	20 km SSW
9	Die Toring	6 km SSE	19	Strandfontein	26 km SSW
10	Olifants River Smallholdings	14 km E	20	Vredendal	40 km SW

Figure 29: Locations of sensitive receptors in the study area

Source: Airshed, 2018

Dispersion modelling of routine emissions from Tormin Mine, concluded the following:

- Simulated annual average NO_2 concentrations exceed the NAAQS of 40 µg/m³ at the processing plant, but not at any of the identified sensitive receptors. The 1-hour NAAQS (88 hours of exceedance of 200 µg/m³) is exceeded, but not at sensitive receptors;
- Simulated 24-hour average dustfall rates do not exceed the NDCR non-residential limit of 600 mg/m²-day;
- Simulated annual average PM_{10} concentrations exceed the NAAQS of 40 µg/m³ at the processing plant and along the DR2225, but not at sensitive receptors. The 24-hour NAAQS (4 days of exceedance of 75 µg/m³) is exceeded at Skaapvlei; and
- Simulated annual average $PM_{2.5}$ concentrations do not exceed the NAAQS of 20 µg/m³. The 24-hour NAAQS (4 days of exceedance of 40 µg/m³) is exceeded, but not at sensitive receptors.

6.4 Noise

The site is surrounded by farmland with typical, low noise levels. Along the coast, noise generated by wave action is likely to result in higher than normal ambient noise levels, especially during rough sea conditions.

Mining, processing and the operation and movement of vehicles are sources of noise and vibration locally at the Tormin Mine site. There are very few noise receptors in the area.

6.5 Hydrogeology

This section is based on information provided by the hydrogeology specialist, GEOSS. Refer to the Groundwater Impact Assessment (Appendix 11C).

6.5.1 Regional Hydrogeology

Farm Geelwal Karoo 262 is underlain by sandy deposits of Quaternary age with known heavy mineral deposits (predominantly ilmenite and garnet), with calcareous deposits in the south-west. Underlying this are the schists and phyllites of the Gariep Supergroup, while to the north-west along the beaches, augen gneisses outcrops are evident, derived from biotite granites of the Little Namaqualand Suite.

A cross section from south-west to north-east across the study area is provided in Figure 30 to illustrate the underlying geology.

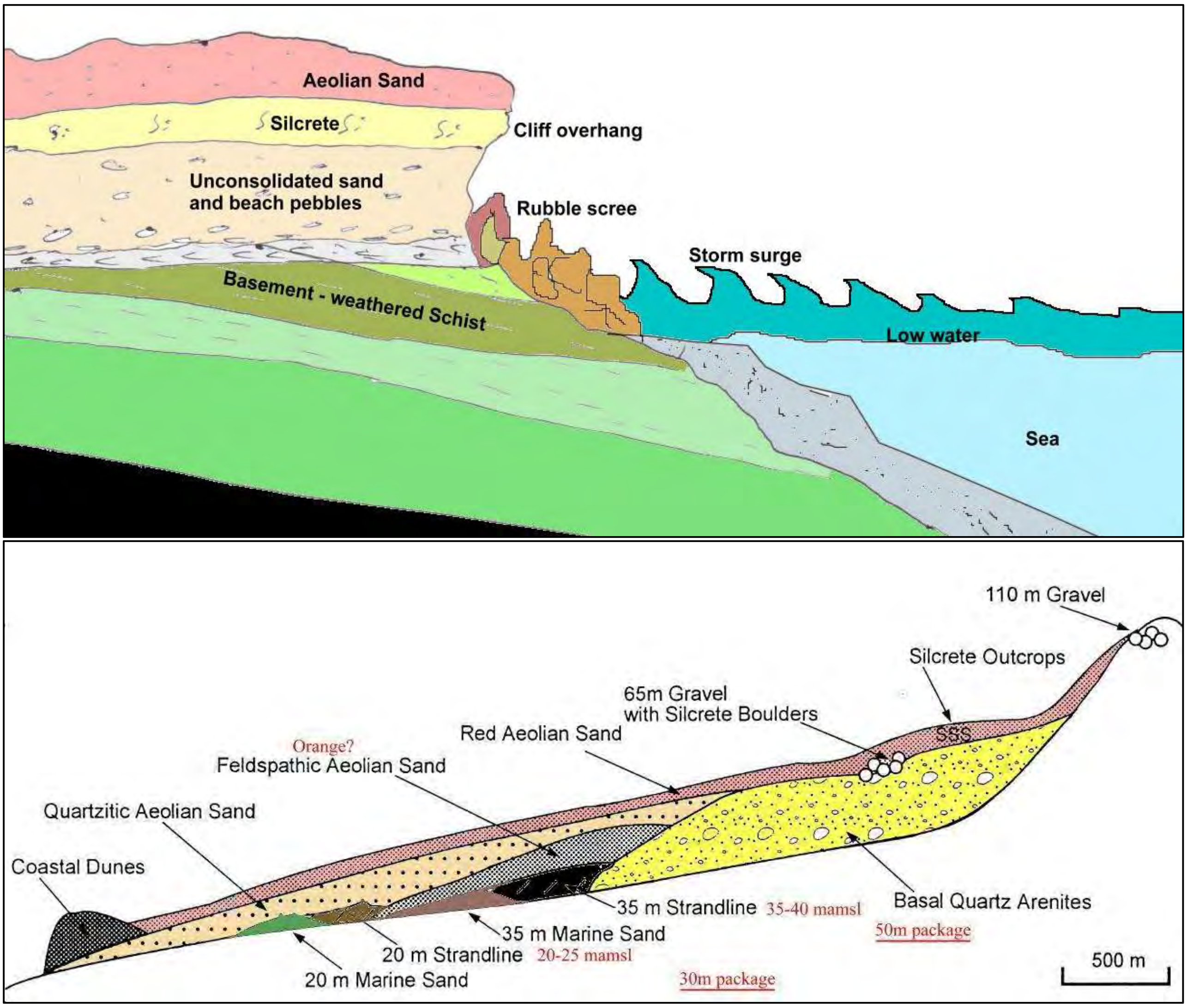


Figure 30: Schematic geological cross-section east to west (top) and detailed geological section across Farm Geelwal Karoo 262 west to east (bottom)

Source: AEMCO, 2018

The cross-section indicates the topographical slope towards the coast, with the inferred geology below, overlain by red aeolian sands and calcrete lenses. Shallow groundwater flow is largely within the sands towards the coast.

According to the 1:500 000 scale groundwater maps produced by DWS (2000), the area contains three classifications of groundwater aquifers (Figure 31):

- The area to the north of Tormin Mine is listed as intergranular and fractured, with an average borehole yield of 0.1 - 0.5 litres per second (L/s);
- The area south of the Tormin processing plant is listed as a karstic aquifer, with an average borehole yield of 0.5 – 2 L/s. Based on field observations and supplied drilling data, the geology does not seem to be that associated with a karst aquifer, but is rather fracture aquifer geology consisting mainly of schist, phyllite and greywacke with an overlying sand layer. No water was found in any of the hydrocensus boreholes visited in this area; and

- The karstic aquifer then becomes a fractured aquifer, further south near the Olifants River, with an average borehole yield of 0.5 – 2 L/s.

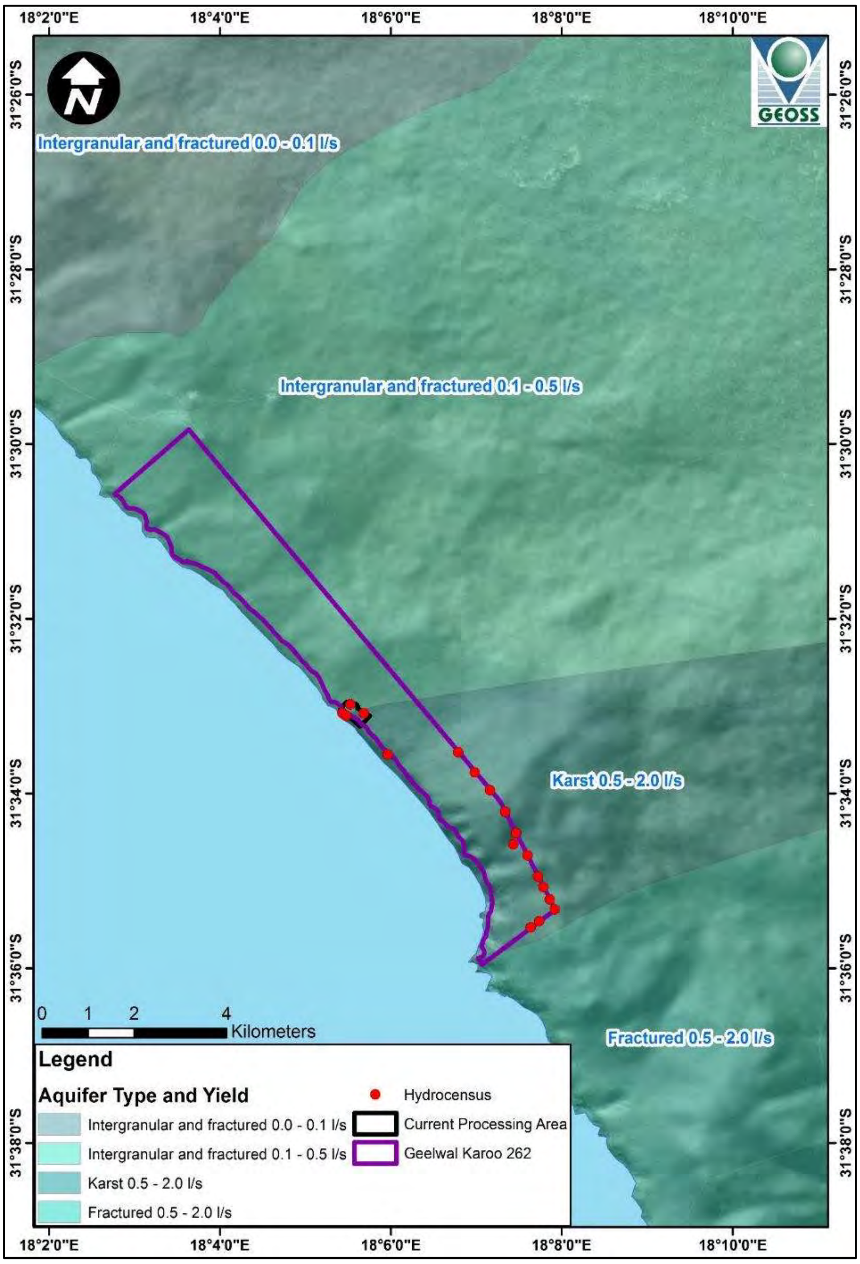


Figure 31: 1:500 000 aquifer type and yield of the Tormin Mine area

Source: DWAF, 2000 in GEOSS, 2018

Despite the variable classifications for the study area, it is likely that the major component of any shallow/medium depth groundwater flow is in the overlying sands, which were evident in the field. These are unsaturated, which may hinder seep flow from the proposed inland mining area towards the coast, as the pore spaces will first require filling, before any substantial flow occurs. The expected aquifer properties for the aeolian sands found in the area are provided in Table 27.

Table 27: Expected aquifer properties

Property	Expected Range	Reference
Hydraulic Conductivity (m/s)	$9x10^{-7} – 5x10^{-4}$	Domenico and Shwartz, 1990
Porosity (%)	25	Heath, 1983
Storativity (unitless)	0.1 – 0.3	Lohman, 1972

Source: GEOSS, 2018

6.5.2 Hydrocensus

There are no groundwater discharge points, such as springs, located in the study area. Two equipped and closed boreholes were identified (TMB01 and TMB04) but are no longer in use. The water from these boreholes was highly saline and, as they are both approximately 150 m from the sea, it is likely that these boreholes may have intersected intruding sea water. A further 13 boreholes were identified on Farm Geelwal Karoo 262, the details of which are provided in Figure 32, Table 32Table 28 and Figure 33 to Figure 35.

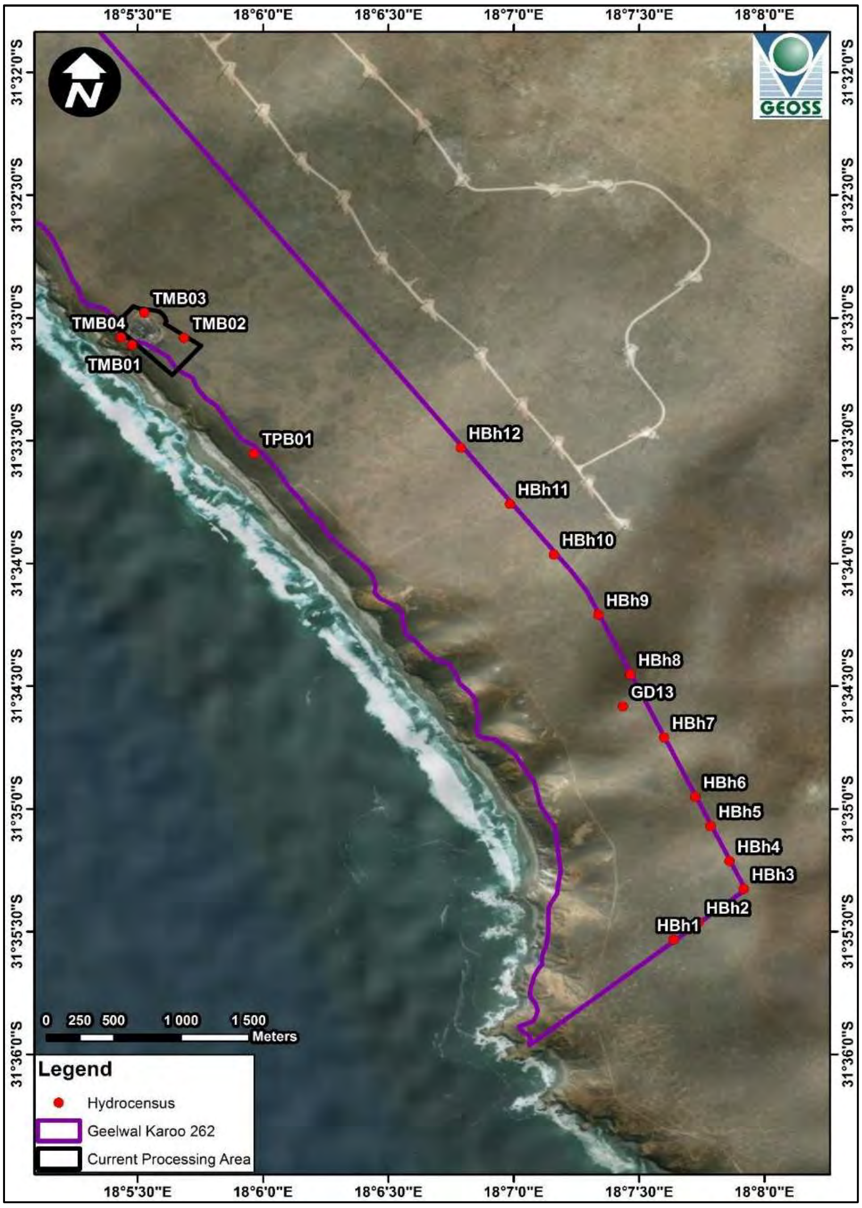


Figure 32: Hydrocensus boreholes visited in the area – all HBh sites were found to be dry

Source: GEOSS, 2018

Table 28: Hydrocensus boreholes

ID	Latitude (S)	Longitude (E)	Depth (mbgl)	Groundwater Level (mbgl)
TMB01	31.551840°	18.091280°	Unable to measure	Unable to measure
TMB04	31.551330°	18.090560°	Unable to measure	Unable to measure
TPB01	31.559210°	18.099380°	30	Dry
HBh1	31.592220°	18.127290°	9	Dry
HBh2	31.591040°	18.128950°	9.5	Dry
HBh3	31.588770°	18.131970°	15	Dry
HBh4	31.586880°	18.131010°	7	Dry
HBh5	31.584500°	18.129750°	4.2	Dry
HBh6	31.582520°	18.128740°	3	Dry
HBh7	31.578490°	18.126660°	Surface collapse	Dry
HBh8	31.574200°	18.124420°	34	Dry
HBh9	31.570160°	18.122290°	Surface collapse	Dry
HBh10	31.566070°	18.119340°	45	Dry
HBh11	31.562640°	18.116410°	5	Dry
HBh12	31.558820°	18.113150°	19	Dry

Source: GEOSS, 2018


Figure 33: Borehole TMB01 – unable to measure water level and no longer in use

Source: GEOSS, 2018


Figure 34: Borehole TMB04 – unable to measure water level and no longer in use (left) and Borehole TPB01 – dry to 30 m (right)

Source: GEOSS, 2018

Figure 35: Dry hydrocensus boreholes showing casing and cap and down borehole photos

Source: GEOSS, 2018

Five boreholes were drilled by MSR at Tormin Mine to source drinking water in the area (Table 29). Of these, TMB02 and TMB03 no longer exist as they were lost during mining activities. MSR recorded that TMB02 and TMB04 contained low, but significant yields, although the water was highly saline and therefore unsuitable for drinking.

Table 29: Boreholes drilled by MSR

ID	Latitude (S)	Longitude (E)	Depth (mbgl)	Water Level (mbgl / (mamsl)
TMB01	31.551840°	18.091280°	48	-
TMB02	31.551360°	18.094747°	18	9 / (34)
TMB03	31.549655°	18.092111°	18	10 / (35)
TMB04	31.551330°	18.090560°	30	5 / (25)
TPB01	31.559210°	18.099380°	31	-
GD13	31.576381°	18.123928°	120	-

Source: GEOSS, 2018

6.5.3 Groundwater Levels and Flow

It is thought that there is very limited groundwater in the area, however theoretical flow is predominantly through the topographical lows and may be hindered by the subsurface fluctuations in bedrock level. This is largely based on data supplied by MSR, which shows that groundwater was intersected within the sandy units overlying the schists and phyllites at TMB02, TMB03 and TMB04 (refer to Figure 36), but that at TPB01 bedrock was encountered at a shallower depth and the borehole was dry to 30 m. This indicates little to no saturation in the bedrock below, and that only the primary, unconfined aquifer has been found on site. It also indicates that flow in this aquifer is not uniform, and may follow subsurface paleochannels, which are not evident on the surface. This is likely the 0.1 – 0.5 L/s classification aquifer (Figure 31). An estimate hydraulic gradient of 0.0417 was calculated between TMB03 and TMB04 (approximately 240 m apart). The estimated linear groundwater velocity, considering the values provided in Table 30Table 27, is 0.013 – 7.20 m/day. The large range is due to the dependence on hydraulic conductivity, which is not accurately known on site. Seep flow from the proposed inland mining area may be expected to take a few months to a few decades to reach the coast.

Table 30: Water levels in relation to the coast

Bh_ID	Latitude	Longitude	Approximate Distance from Coast	Water Level mbgl / (mamsl)
TMB03	-31.549655°	18.092111°	385 m	10 / (35)
TMB04	-31.551330°	18.090560°	140 m	5 / (25)

Source: GEOSS, 2018

A conceptual model of the potential groundwater flow in the area was determined based upon the geological cross section, the hydrocensus and the geological logs provided by MSR. This conceptualisation of potential flow through the area suggests that any flow will accumulate in the shallow subsurface above bedrock material and follow low-lying topographical trends. From the recorded water levels and the topographical map, this suggests that flow would be localised to the middle portion of Farm Geelwal Karoo 262, where it would travel south-west towards the coast. As such, any seep into the subsurface is expected to flow down towards bedrock, where it would accumulate/mound and then begin flowing towards the coast. This would be most pronounced in the current processing area and immediate surrounds. Any sources of contamination in this seep will likely follow a similar path, and over time trend towards the coast. As there are no current groundwater users, the coastal environment is the only receptor to this flow.

The (conceptual) flow only in low-lying / depression areas is supported by no groundwater being intersected at the HBh boreholes, which are predominantly located on the higher elevation areas in the south-east of Farm Geelwal Karoo 262. While GD13 was drilled in a localised depression in the south-east (94 mamsl), the surrounding area is still relatively high and thus, despite the depth of GD13 (120 m), this is not indicative of there being no groundwater at lower topographical elevations.

To illustrate the theoretical flow directions, the three available water levels are shown in metres above mean sea level with the interpreted direction of flow (Figure 36). This is then extrapolated to a larger area shown in Figure 37. As the water levels at TMB04 were recorded to dry up after use of the water, it is likely that there is little to no remaining groundwater, despite intersecting groundwater at these sites.

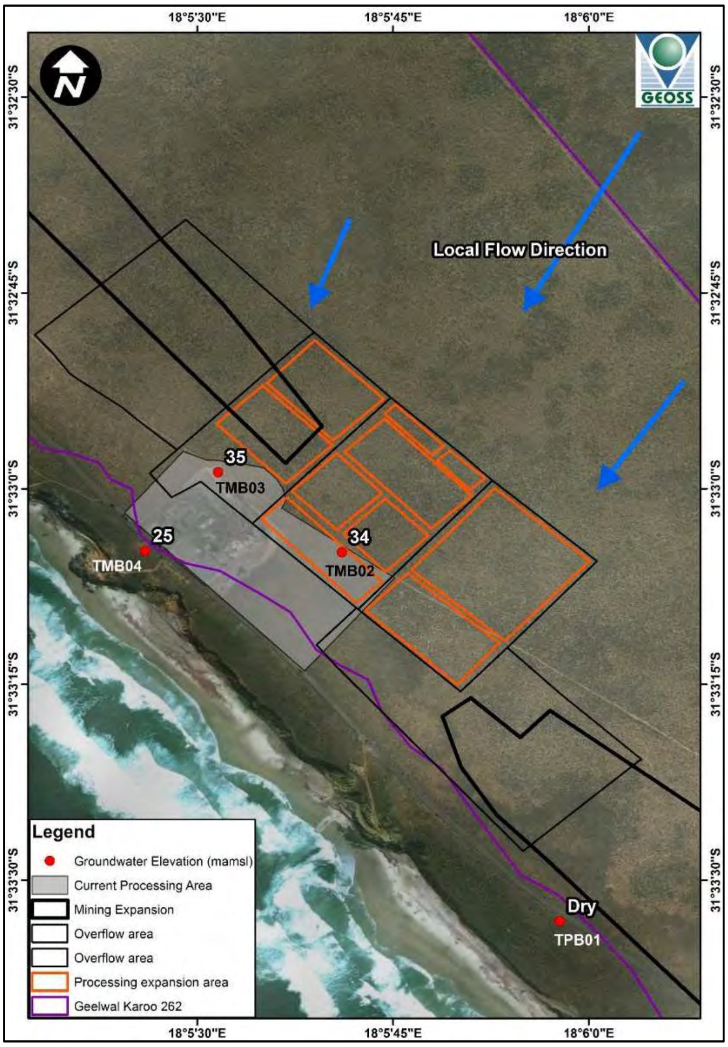


Figure 36: Available groundwater levels (mamsl) supplied by MSR

Source: GEOSS, 2018

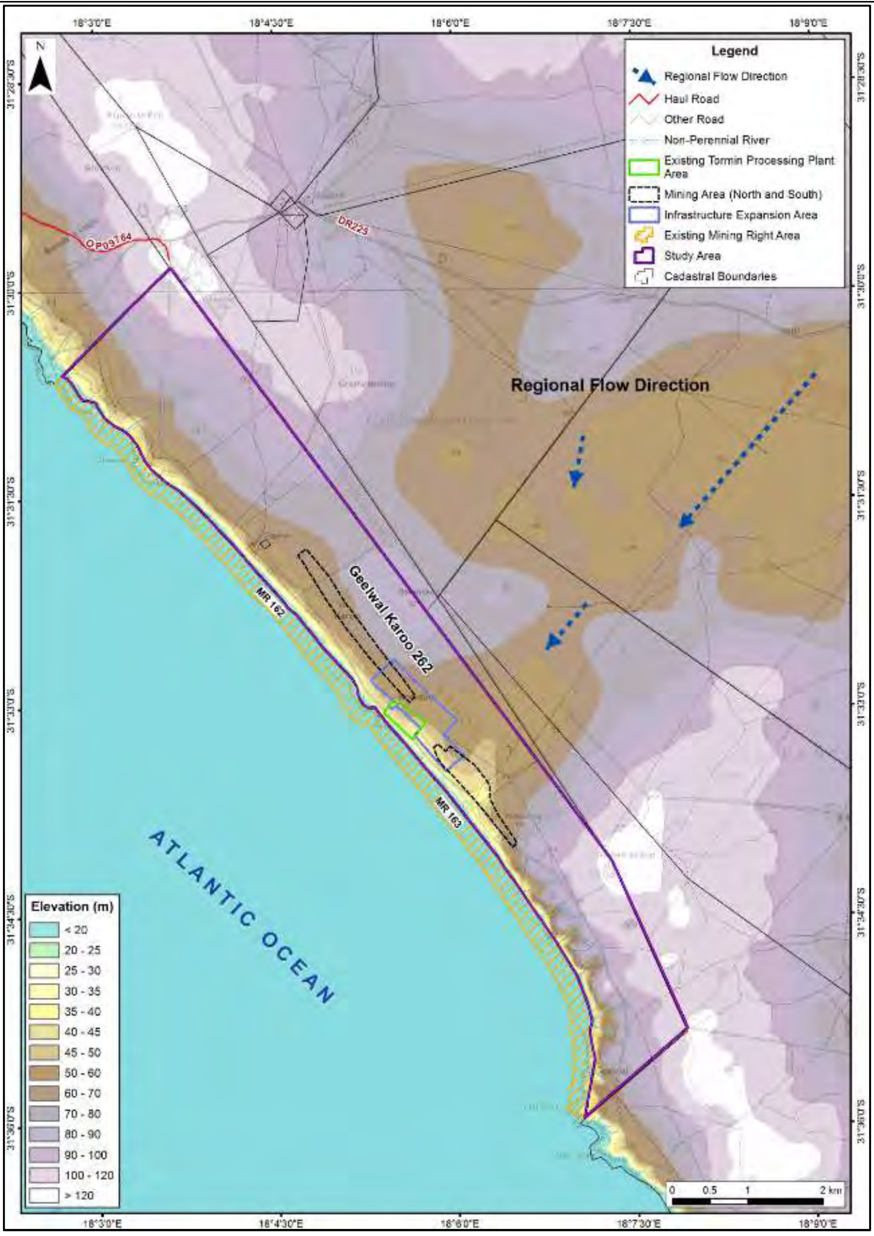


Figure 37: Extrapolated groundwater flow direction as a function of topography and previous groundwater levels on site

Source: GEOSS, 2018

From the groundwater levels of TMB02 and TMB03 (now non-existent), it is possible that the lower portion of the northern inland mining area (~ 350 m which overlaps part of the infrastructure / plant expansion area), has the potential to intersect groundwater within a depth of 15 m (estimated average mining depth). This is unlikely though as water levels were qualitatively noted to decrease at TMB04 with use. However, if groundwater is intersected, it could mark the lowest mineable depth.

6.5.4 Groundwater Quality

The regional groundwater quality varies greatly with the associated geologies of the area, and ranges from *good* to *very poor*. The groundwater electrical conductivity (EC) associated with the project area, as provided by DWAF (2000), ranges from 70 to 1000 mS/m (Figure 38). Groundwater with EC more than 300 mS/m is not considered suitable for prolonged domestic consumption.

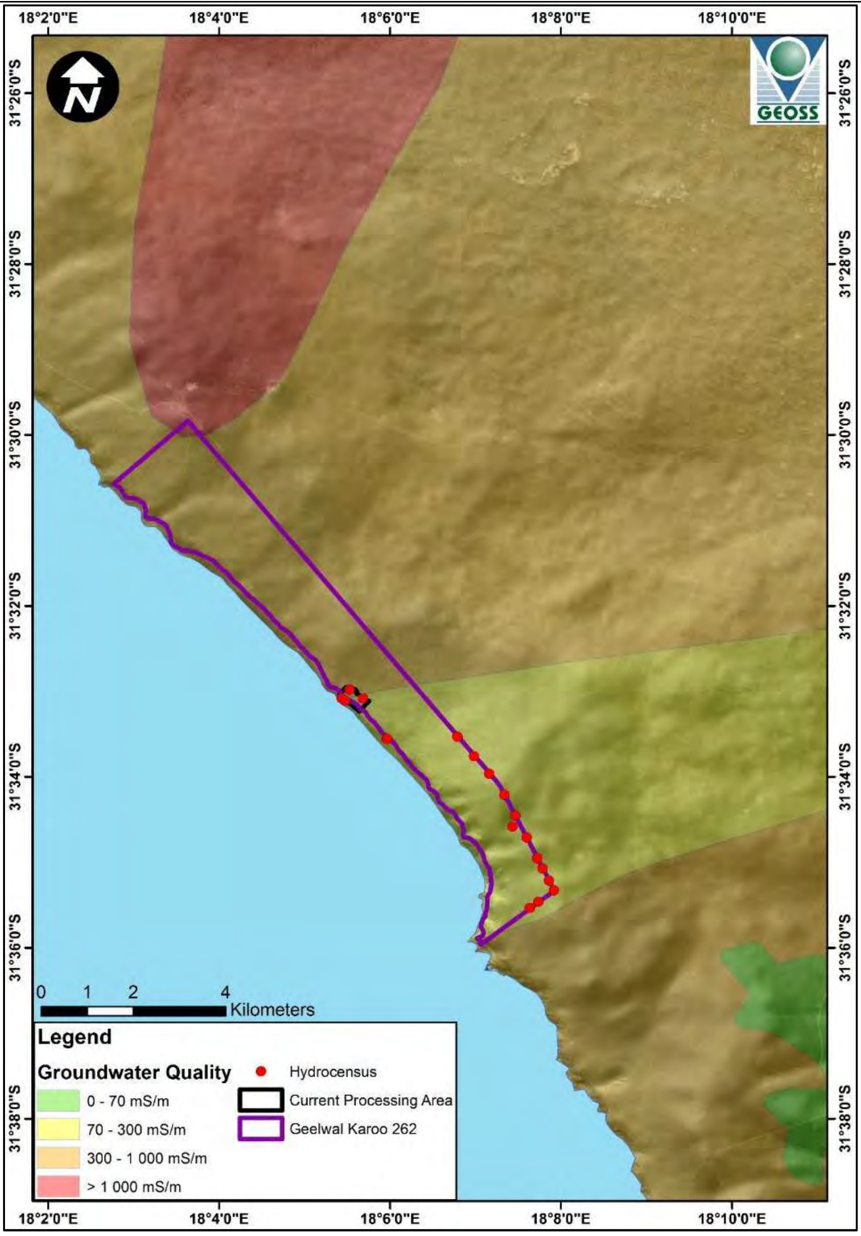


Figure 38: 1:500 000 groundwater quality of the Tormin Mine area

Source: DWAF, 2000 in GEOSS, 2018

There are no existing groundwater contaminants thought to be present in the study area, as the land is not utilised for any activities that interact with the subsurface (i.e. groundwater users, agricultural activities and large infrastructure).

6.6 Coastal and Marine Environment

This section is based on information provided by the marine ecology specialist, Anchor Environmental (refer to the Marine Ecology Impact Assessment, Appendix 11D).

6.6.1 Regional Oceanography

The physical oceanography of an area (particularly water temperature, nutrient and oxygen levels, and wave exposure) is the principal driving force that shapes marine communities. The broader oceanography of the region is influenced by the cold Benguela upwelling system of the West Coast (Figure 39). The Benguela Current originates from the South Atlantic Circulation, which circulates just north of the Arctic Circumpolar Current.

The cool Benguela current (10-14°C) is enhanced by the upwelling of colder nutrient-rich deep water (Branch 1981). The area experiences strong southerly and south-easterly winds which are deflected by the Coriolis force (rotational force of the earth which causes objects in the southern hemisphere to spin anticlockwise). These prevailing conditions deflect the surface waters offshore and draw cold, nutrient rich water to the surface (Figure 40). Phytoplankton bloom when the nutrients reach the surface waters where plenty of light is available for photosynthesis. The phytoplankton is preyed upon by zooplankton, which is in turn eaten by filter feeding fish such as anchovy or sardine. This makes the West Coast one of the richest fishing grounds in the world and attracts large colonies of birds and seals (Branch 1981). The water temperature and nutrient levels are strongly influenced by wind with minimum temperatures and maximum nutrient levels occurring in conjunction with upwelling events (Branch and Griffiths 1988). Cape Columbine and the Cape Peninsula are areas that experience the most intense upwelling activity in the southern Benguela.

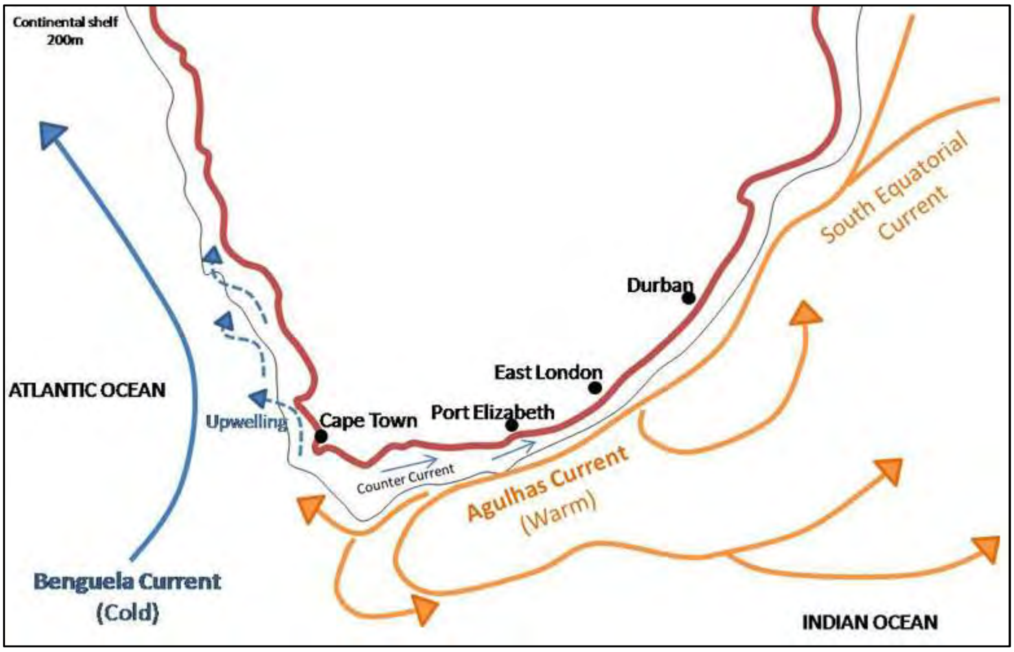


Figure 39: Major current streams around South Africa

Source: Anchor Environmental, 2018

Occasionally phytoplankton blooms contain species that are toxic to marine life and people who consume shellfish. Under certain oceanographic conditions (calm periods following intense upwelling), extremely dense phytoplankton blooms can sink and decay in coastal waters, leading to oxygen depletion of water and the production of hydrogen sulphide, which is toxic to marine life. Both toxic phytoplankton blooms (often referred to as red tides) and low oxygen events (colloquially referred to as black tides) are known to occasionally occur along the entire West Coast. These events are, however, more common in retentive bays downstream of intensive upwelling cells (e.g. St Helena Bay and Elands Bay). The coastline around the study area is at little risk of low oxygen events in the near shore due to the exposed nature of the coastline.

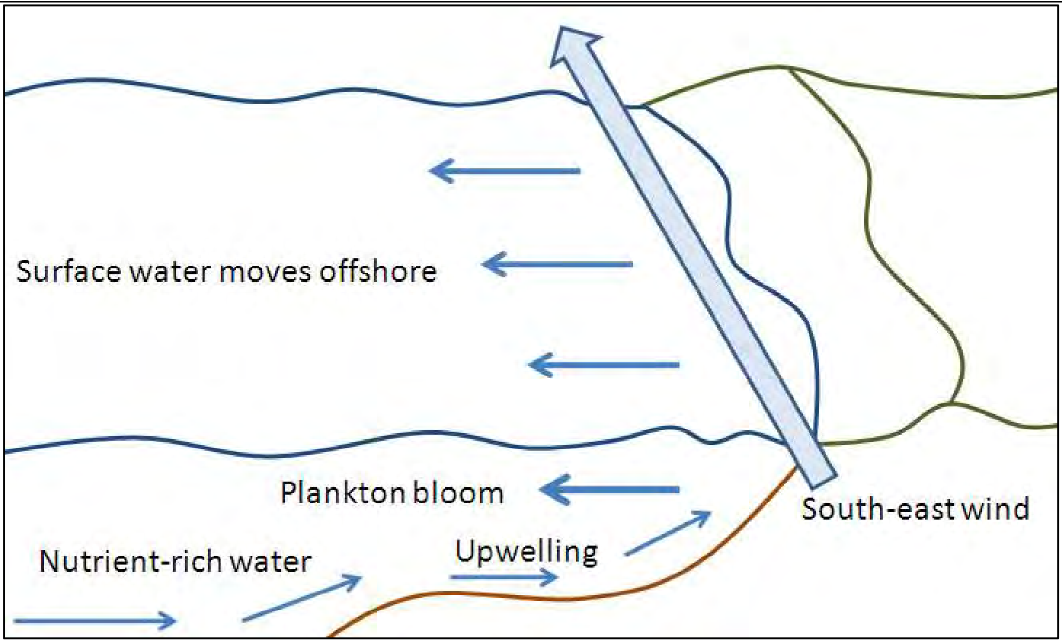


Figure 40: Wind-driven upwelling on the west and south west coasts of South Africa

Source: Anchor Environmental, 2018

6.6.2 Local Oceanography

Tormin Mine is in the southern section of the Benguela Current System, which extends along the West Coast of southern Africa between Cape Agulhas and the Congo River mouth in Angola. The area falls within the Namaqua inshore ecozone, which is nested within the Southern Benguela Ecoregion as defined by Sink et al. (2012) (Figure 41).

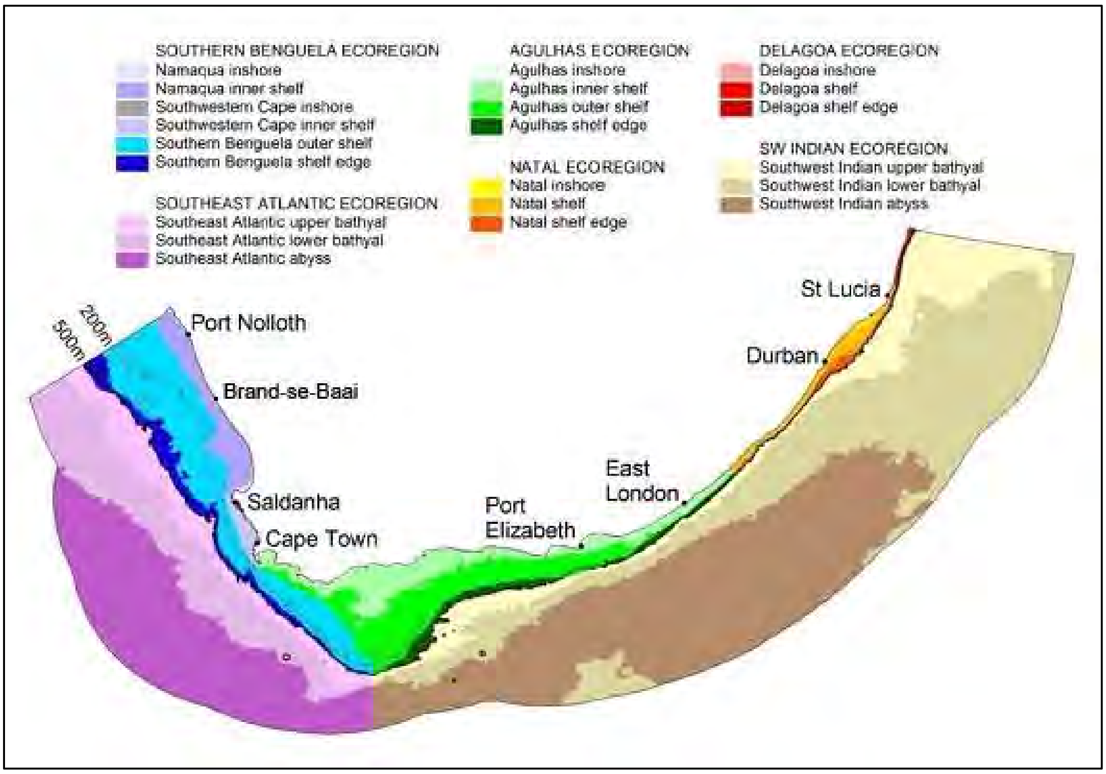


Figure 41: Marine ecoregions and ecozones in the South African marine environment

Source: Anchor Environmental, 2018

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. As such, 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. High tide occurs approximately 25 minutes later every day. 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 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.

Another factor which greatly influences marine ecology and human activities along the coastline is wave energy. Wave size is determined by wind strength and fetch (distance over which it blows) and determines the degree to which breaking waves at the shore will shift sand and erode rock. The West Coast 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 42).

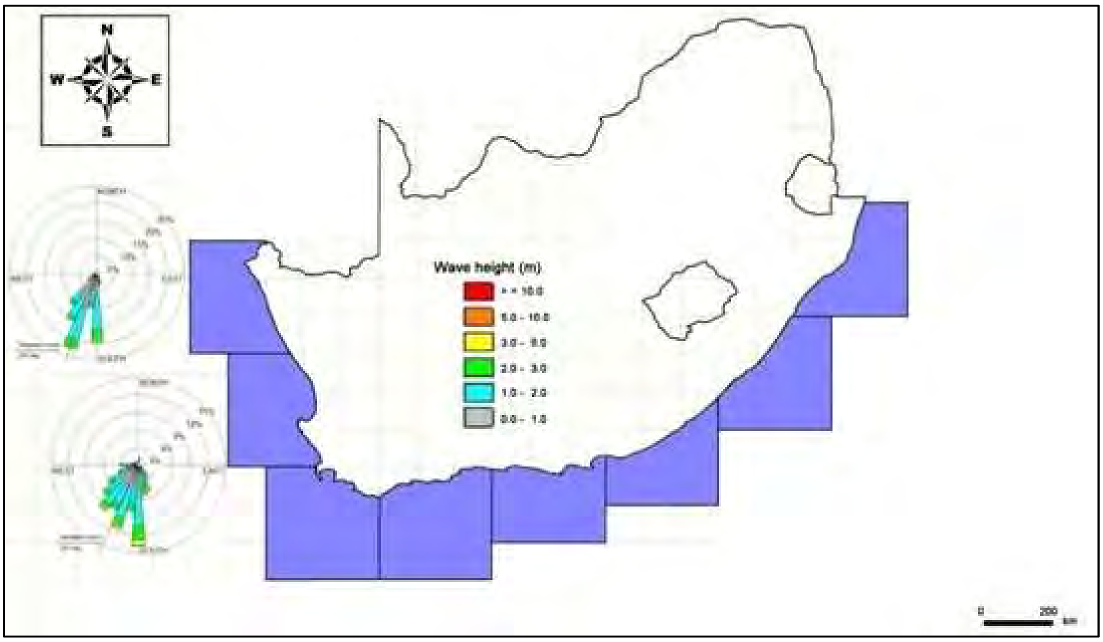


Figure 42: Wave roses showing frequency of wave heights and direction on the West Coast

Source: SADCO Voluntary Observing Ships data in Anchor Environmental, 2018

6.6.3 Marine Ecology

Sandy Beaches

Intertidal sandy beaches are dynamic environments. A wide range of human uses (from recreation to intensive mining operations) alter the physical characteristics and profile of a beach, as do natural processes such as storms (Pulfrich 2011b). The profile of a beach and its characteristics (i.e. grain size and wave exposure) are intricately linked, and directly influence the biotic community composition present on that beach and its surrounds. As such, an alteration in beach profile may result in temporary or permanent changes in faunal communities inhabiting them (Brown and McLachlan 1990; Brown and McLachlan 2002; Gomez-Pina et al. 2002).

Two types of beaches are found within the study site: long stretches of wide, flat dissipative beach with fine sands rich in sandy macrofaunal 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 low 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). 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 offshore 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). Fish such as galjoen (*Dichistius capensis*) and white steenbras (*Lithognathus lithognathus*) 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). Surf zone habitats, particularly medium to low energy beaches, are in fact 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.), isopods and polychaetes. The upper drift line is typified by air-breathing amphipods (*Talorchestia* spp.) and giant isopods (*Tylos* spp.), 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 43: A cumacean (left) and a white Steenbras (right), both found in the surf zone

Source: Hans Hillewaert in Anchor Environmental, 2018

Of importance is the presence of the isopod *Tylos granulatus* on sandy beaches that are likely to be mined (Figure 44). Populations of these invertebrates are easily disturbed and due to declining numbers, Brown (2000) made the recommendation to list these invertebrates as *Vulnerable* in the IUCN Red Data Book.

Figure 44: Holes in sand sediment (left) indicating the presence of *Tylos granulatus* (right)

Source: Hans Hillewaert in Anchor Environmental, 2018

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 greater water circulation through the sediment, thereby replenishing the oxygen that is used up during the decomposition processes.

Much of the benthic infauna 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. clams 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. flounders 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.

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 form an important component of these ecosystems (Barros *et al*. 2001).

Rocky reefs provide substratum to which kelp (*Ecklonia maxima* and *Laminaria pallida*) can attach (Figure 23). These large kelp forests provide food and shelter for many organisms. As light is the limiting factor for plant growth, kelp beds only extend down to approximately 10 m depth (Branch *et al*. 2010). Encrusting coralline is the dominant algae below the kelp canopy. Ephyphitic (grows harmlessly on another plant) algae grows on kelp, while under-storey algae are numerous (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 the amphipods (i.e. *Ampithoe humeralis)* (Branch 1981). West Coast rock lobster (*Jasus lalandii)* and octopus (*Octopus vulgaris)* are two of the most important carnivores that occur within kelp forests. Other kelp forest predators include 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).

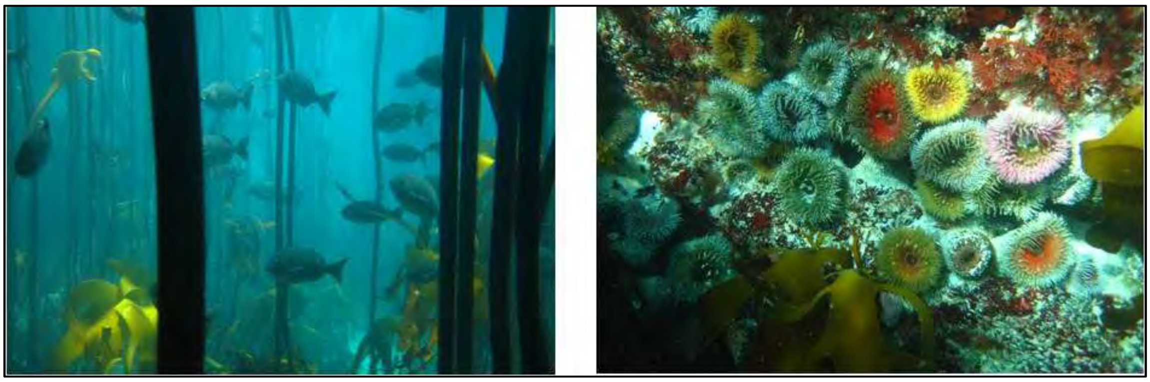


Figure 45: *Ecklonia maxima* kelp forest with *Laminaria pallida* sub-canopy and Hottentot *Pachymetopon blochii* (left). Blankets of sandy anemones *Bunodactis reynaudi* (right) are common both inter- and subtidally

Source: Anchor Environmental, 2018

Rocky Shores

West Coast rocky shores (Figure 46) 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. Rocky shore is a common habitat along this stretch of coast (Coastal Sensitivity Atlas of South Africa, 1984).

The infratidal zone is inhabited by species that cannot withstand long periods of exposure. These species 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, effectively replacing *Scutellastra cochlear*, which are somewhat rare in the region. *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).

The rocky shore survey identified 49 different invertebrate species including filter-feeders, grazers, predators and algae. None of these species are rare or vulnerable locally or regionally and rocky shore is a common habitat along this stretch of coast.

Figure 46: Typical rocky shore at the study site

Source: Anchor Environmental, 2018

6.6.4 Coastal Sensitivity

The coastal habitat survey along the coastline north of Tormin Mine, confirmed the habitat types described in the Coastal Sensitivity Atlas of South Africa (Jackson and Lipschitz 1984) (Figure 47 and Figure 48). Vegetated slopes dominate the supratidal zone, mixed sand and rock is present in the high shore, rocky substrata are abundant in the low shore and subtidal reef interspersed with sand is common subtidally. The greatest stretch of sandy beach is located at Beach 10.

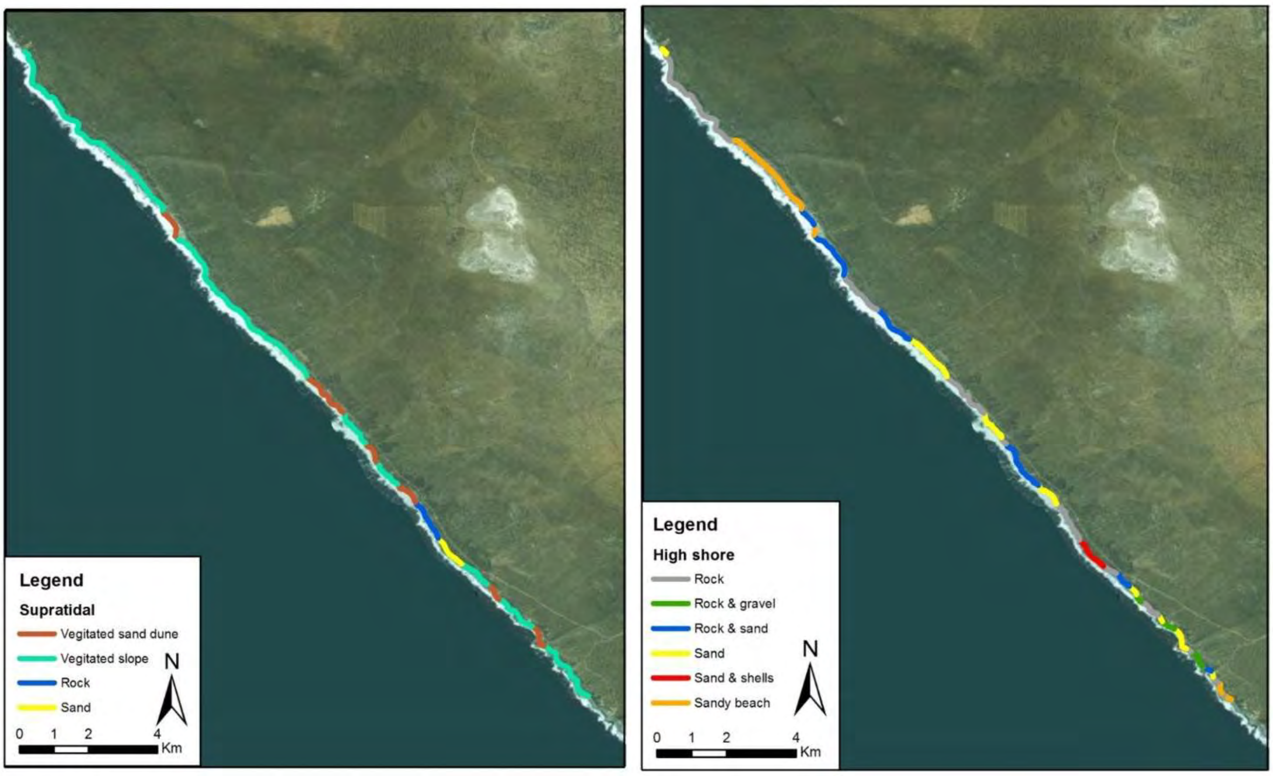


Figure 47: Habitat types for the supratidal zone (left) and the high shore (right)

Source: Anchor Environmental, 2018

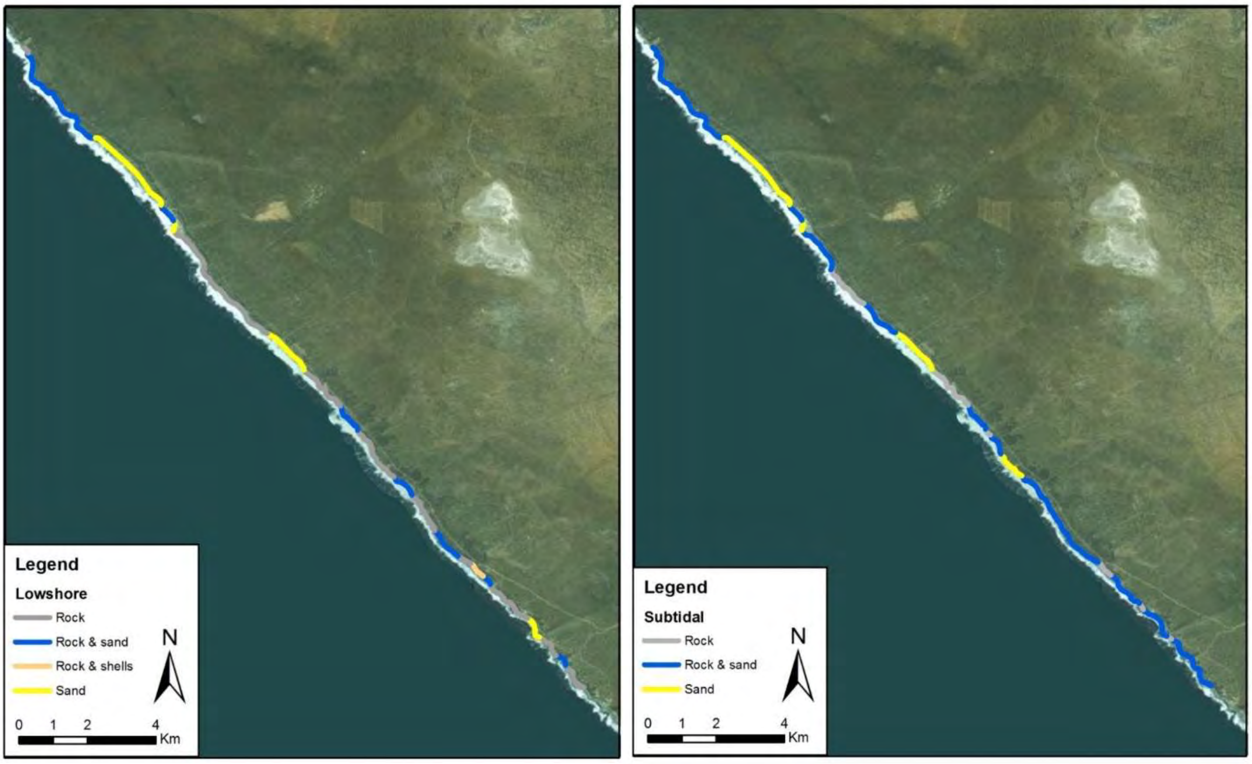


Figure 48: Habitat types for the low shore (left) and the subtidal zone (right)

Source: Anchor Environmental, 2018

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 being found to occur within two to three years in Namibia (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.

The rocky shore survey identified 49 different invertebrate species including filter-feeders, grazers, predators and algae. None of these species are rare or vulnerable locally or regionally. Although rocky shores are more sensitive to disturbance than sandy beaches, the reefs in this area 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 area was found to consist of sandy benthic communities scattered with patches of reef. These rocky patches are generally more diverse than areas consisting solely of sand (Barros *et al.* 2001) and can tolerate higher levels of disturbance due to sand inundation.

According to National Biodiversity Assessment (NBA) spatial data and classifications, ±50% of the study site is identified to be 'endangered', with most of the remaining areas classified as *Least Threatened* and only a small area as *Vulnerable* (Sink et al. 2012). The nearshore environment is classified as *Critically Endangered*, while the offshore environment is *Least Threatened*. As NBA criteria are extremely broad-scaled and are not site specific, the specialist conducted a ground-truthing survey was conducted.

During the ground-truthing survey, existing mining impacts, largely due to historical and current diamond and mineral sands mining, were apparent. These activities have affected the marine environment and continue to do so. Land-based excavations have left deep furrows in the coastal zone that are vulnerable to erosion; while marine diamond mining with suction hoses render the subtidal environment barren.

6.7 Hydrology and Surface Water

This section is based on information provided by the aquatic ecology specialist, Freshwater Consulting cc (refer to the Freshwater Ecology Impact Assessment, Appendix 11E).

6.7.1 Catchment Context

The study area lies in the Olifants-Doorn Water Management Area (WMA), which is planned to be incorporated into a larger Olifants-Berg WMA. Within this WMA, most of the study area falls within DWS's quaternary catchment F60E, comprising a large quaternary without any major rivers. The rivers in the WMA rise primarily in the north eastern part of the quaternary (approximately 20 km inland) and comprise relatively minor systems. They have been mapped in the national 1:50 000 river cover as "non-perennial" (i.e. ephemeral) rivers.

A few very short ephemeral rivers are also shown along the coastline in this quaternary (Figure 49 and Figure 50). These systems comprise short drainage lines through the coastal dunes, which may act as local recharge areas. The coastal zone near the study area is narrow and separated abruptly from the inland zone by steep dunes and rocky cliffs.

6.7.2 Ecoregion Context

Ecoregions are groups of rivers that share similar physiography, climate, geology, soils and (under natural conditions) natural vegetation. The National Ecoregional Classification of Kleynhans et al. (2005) classifies the study area as falling with Ecoregion 25: the Western Coastal Belt Ecoregion. This ecoregion is characterised by plains with low and moderate relief, an altitude between sea level and 700 m amsl and vegetation that comprises primarily Succulent Karoo types (Kleynhans et al. 2005). The ecoregion includes the Olifants, Doring, Sout, Groen, Buffalo and western section of the Orange Rivers. Although it lies within a winter rainfall area, mean annual precipitation is very low / arid (Mean Annual Rainfall = 200 mm) with a high to very high co-efficient of annual precipitation, indicating high inter-annual variability between months and seasons (Schulze et al. 1997). Drainage density (length of river channel per unit area) is low, suggesting relatively slow discharge of runoff at a catchment level after a rainfall event.

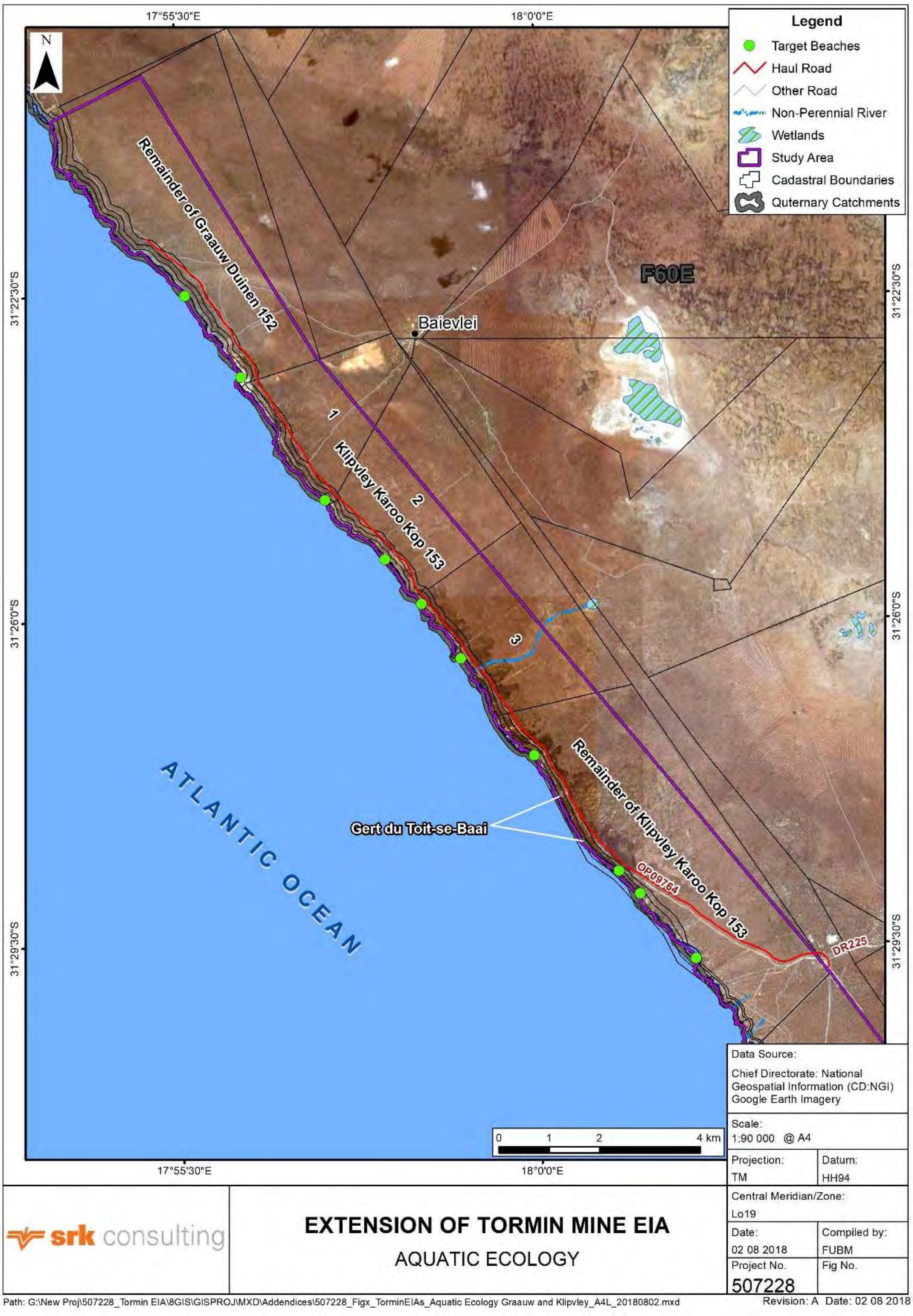


Figure 49: Surface water features in the study area – northern beaches

Source: NFEPA and Matzikama Fine Scale Planning Data

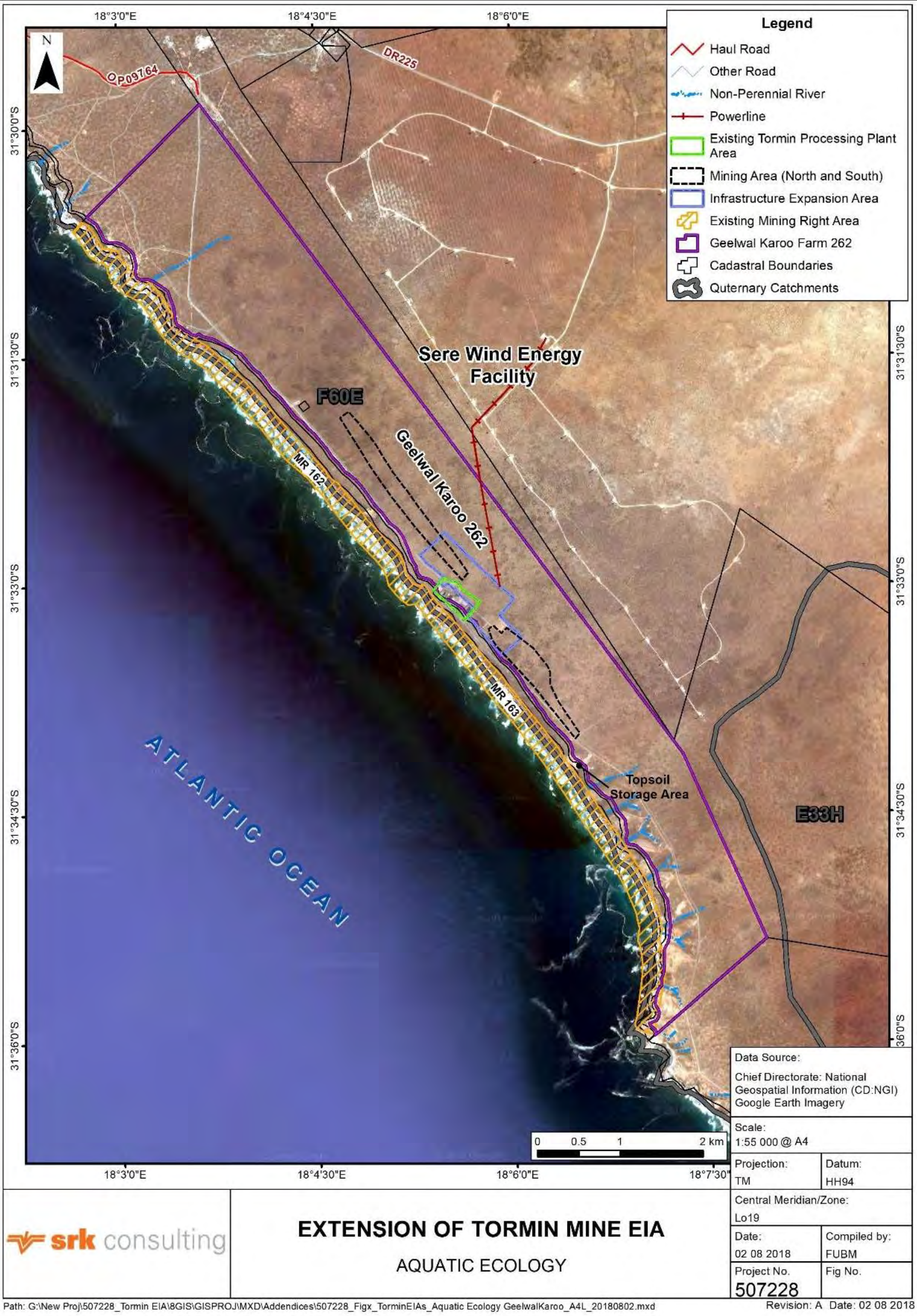


Figure 50: Surface water features in the study area – Farm Geelwal Karoo 262

Source: NFEPA and Matzikama Fine Scale Planning Data

6.7.3 Aquatic Ecosystems

All the rivers and wetlands in the study area comprise minor ephemeral systems (the Olifants River is outside the study area). This is not surprising, given the low rainfall and high rates of evaporation in this ecoregion. The high rates of evaporation in the area suggest that its ephemeral systems are likely to be characteristically mildly brack to saline. In agricultural areas, such systems are often least-impacted because of their marginal value as water supplies for irrigation or livestock (e.g. see Rountree et al. 2016). This notion is supported by data from the National Freshwater Water Ecosystem Priority Area (NFEPA) project for this area, which ascribe Present Ecological State (PES) or "condition" ratings of A/B and C to these systems, indicative of aquatic ecosystems that are in a natural or near-natural condition, to moderately impacted, respectively (Driver at al. 2011). Few of these data have however been ground-truthed and the condition of several of the systems are moreover listed as "unknown" or unassessed but disturbed (Category Z).

Wetlands in the surrounding area comprise mainly pans, which are classified by Ollis et al (2013) and identified in NFEPA data as "depressions". However, no wetlands occur in the study area.

Drainage lines in the study area are all considered highly ephemeral, and likely to be dry throughout most if not all of most years, flowing only intermittently after significant rainfall events. Ground-truthing of the mapped watercourses showed only clearly identifiable systems including a system north of Tormin Mine near Beach 1 (Figure 51) and a number of minor watercourses in Farm Geelwal Karoo 262. Locations of the identified watercourses are provided in Table 31.

Table 31: Locations of watercourses (drainage lines) identified within the study area

	Watercourse Location	Coordinates		Located in Project Footprint (Yes / No)	Potential Impact
		S	E		
1	Beach 1	31°29'31.76"	18° 2'38.61"	Yes	Crossed by northern haul road and Beach 1 access road alternative (refer to Figure 3, Appendix 5)
2	North of Processing Plant	31°30'51.00"	18° 3'32.78"	Yes	Crossed by existing haul road between northern beaches and processing plant
3	South of Processing Plant 1	31°34'26.47"	18° 6'55.89"	No	-
4	South of Processing Plant 2	31°35'10.25"	18° 7'23.91"	No	-

Source: Freshwater Consulting, 2018

The drainage line near Beach 1 (watercourse 1) seemingly dissipates into the sands following all but the most major of storm events, largely because of the high evaporation rate that characterizes this region (Schulze 2007) and it is assumed to derive its flow from surface rather than groundwater surfaces (refer to discussion on hydrogeology). The drainage line is not even associated with obvious riparian zones and it is assumed that flow occurs in this system too infrequently to sustain riparian species. Nevertheless, the drainage line near Beach 1 accords with the DWS definition of a watercourse, as "a natural channel in which water flows regularly or intermittently". The condition of the watercourse is coarsely assessed as PES Category C, based on the DWAF (2008) definitions of PES categories, with the main impact being fragmentation because of the passage of minor roads across the system, and low to moderate erosion, mainly in the vicinity of roads. The watercourse is considered of Low to Medium conservation importance but would have high sensitivity to changes in flows – particularly increases, and physical disturbance to the adjacent areas as a result of the passage of heavy vehicles through these areas. Its chief function as an aquatic ecosystem is the conveyance of water under episodic flood conditions.

Figure 51: Watercourse north of Tormin Mine near Beach 1, downslope of OP9764

Source: Freshwater Consulting Group, 2018

The coastline steepens adjacent to Farm Geelwal Karoo 262 and the minor watercourses along this area drop steeply down to the beach (Figure 52). Many of these systems are highly eroded, with the source of disturbance assumed in all cases to be runoff and diversions of flow from haul roads. Under natural conditions, these systems would also be driven by episodic surface runoff, and possibly seepage from adjacent dunes. It is likely that the systems flow only occasionally and that their water quality is rendered more saline by the influence of sea spray. This said, if they are linked to seepage water from dune areas, it is possible that they may have importance as sources of relatively fresh water along an otherwise arid, salt-dominated coast. No exploitable sources of freshwater have been identified in the study area.

Figure 52: Ephemeral watercourses in Farm Geelwal Karoo 262 - located south (left) and north of the processing plant (right)

Source: Freshwater Consulting Group, 2018

Watercourse condition is difficult to assess using the standard PES approach, given that these watercourses have no riparian component, and include instream habitat on a temporary basis only. However, with consideration of the definitions for PES categories, it is estimated, with low confidence, that these watercourses vary in condition from Category D for systems south of the Tormin processing plant, to Category C/D for a watercourse north of the processing plant. The main reason for these different categories appears to be the fact that the area south of the processing plant has, historically, been heavily mined.

Like the watercourses north of the Tormin Mine, the main role in the landscape of these watercourses is the conveyance of water from the coastal dunes / cliffs down to the sea. Given the arid conditions, likely high runoff rates in places and steep gradients of these areas, the watercourses have very high sensitivity to erosion caused by runoff.

6.8 Terrestrial Vegetation and Habitats

This section is based on information provided by the terrestrial ecology specialist, 3Foxes Biodiversity Solutions (refer to the Terrestrial Ecology Impact Assessment, Appendix 11F).

6.8.1 Regional Context

The study area is on the West Coast of South Africa within the Succulent Karoo Biome (Mucina and Rutherford 2006). The Succulent Karoo Biome extends from the West Coast of South Africa, northwards along the coast into southern Namibia and inland to Calvinia and almost as far as Port Elizabeth along the coast eastwards. The biome covers approximately 11 000 km, making it the fourth largest biome in South Africa (Mucina et al. 2006). The majority of the biome lies below 800 m and is generally flat to gently undulating. The Succulent Karoo is a recognised global biodiversity hotspot and is considered unique because of the dominance of dwarf leaf-succulent shrubs. Apart from flora, the region also forms the centre of endemism for groups such as mole-rats, lizards, tortoises and various invertebrates. The area is incredibly diverse and rich botanically, containing 6 356 plant species 26% of which are strict endemics and 14% near endemics. Of the species occurring within the biome, 17% are International Red Data species (Mucina and Rutherford 2006).

Mining has been identified as one of the major threats to the biodiversity of Namaqualand, especially along the West Coast, which has been heavily impacted by mining activities. As such, the vegetation types which occur along the coast, such as Namaqualand Seashore Vegetation, have been particularly affected due to cumulative habitat loss and disturbance. Transformation and disturbance along the coastline also threatens to disrupt the connectivity of the coastal strip for fauna endemic or restricted to this region. Fauna that are likely to be particularly vulnerable to mining activities include the various subterranean species which are associated with the coastal sands and dune systems. This includes the various endemic golden moles that are restricted to the coastal areas, as well as the subterranean skinks which occur in this area.

6.8.2 National Vegetation Types

Broad-scale Patterns

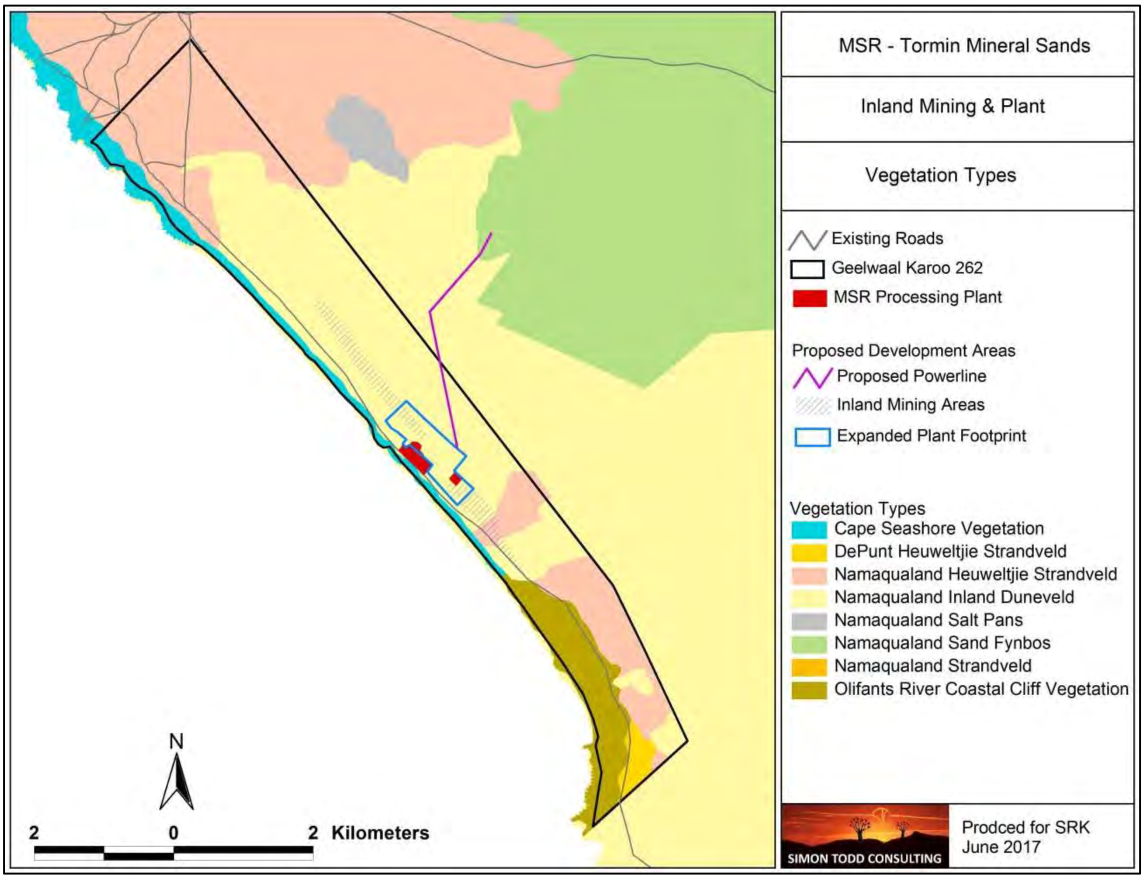
According to the national vegetation map (Mucina and Rutherford 2006, 2012), there are only two vegetation types within the study area - Namaqualand Seashore Vegetation along the seashore and Namaqualand Strandveld inland. This is, however, a very coarse depiction of the vegetation of the area and Skowno et al. (2009) provide a more realistic and detailed mapping of the vegetation of the area as part of a conservation assessment of the West Coast District Municipality (Figure 53). Skowno et al. (2009) recognised the following vegetation types in the area:

- Cape Seashore Vegetation;
- Namaqualand Heuweltjie Strandveld;
- Namaqualand Inland Duneveld; and
- Olifants River Coastal Cliff Vegetation.

Not all of these vegetation types are officially recognised vegetation types in the national vegetation map but were defined by Skowno et al. (2009). Namaqualand Heuweltjie Strandveld represents the ecotone vegetation between the Namaqualand Strandveld and Namaqualand Heuweltjieveld of Mucina and Rutherford (2006). The main driver here is soil texture, with typical Namaqualand Strandveld on sandy soils and the Namaqualand Strandveld of Skowno et al. associated with more compact, fine-textured soils. Olifants River Coastal Cliff Vegetation is not defined by Skowno et al. but represents a community of Cape Seashore Vegetation occurring on the steep seacliffs characteristic of this part of the coastline, especially in the vicinity of the Olifants River mouth.

Although the vegetation along the shore is classified in the National Vegetation Map as Namaqualand Seashore Vegetation, Skowno et al. define this vegetation as Cape Seashore Vegetation. It is not clear whether this is simply a naming convention or based on real information with regards to the composition of the vegetation of this area. However, given the aridity of the site and its features, the seashore vegetation clearly has greater affinity with Namaqualand and the Olifants River mouth is taken as the break between Cape and Namaqualand Seashore Vegetation.

The areas of Namaqualand Inland Duneveld which are mapped by Skowno et al. are based on their affinity with the areas of Namaqualand Inland Duneveld mapped under the National Vegetation Map. The site visit and field assessment, however, suggests that there are some obvious differences between these areas. The Namaqualand Inland Duneveld to the north and the areas classified as Namaqualand Inland Duneveld within Farm Geelwal Karoo 262 are, at best, transitional between typical Namaqualand Strandveld and Namaqualand Inland Duneveld, but certainly don't conform to the typical concept of Namaqualand Inland Duneveld. Although the naming of the units identified is therefore considered debateable, they are nevertheless considered useful in delineating Strandveld on deep sands from Strandveld on shallow or more finely-textured soils.



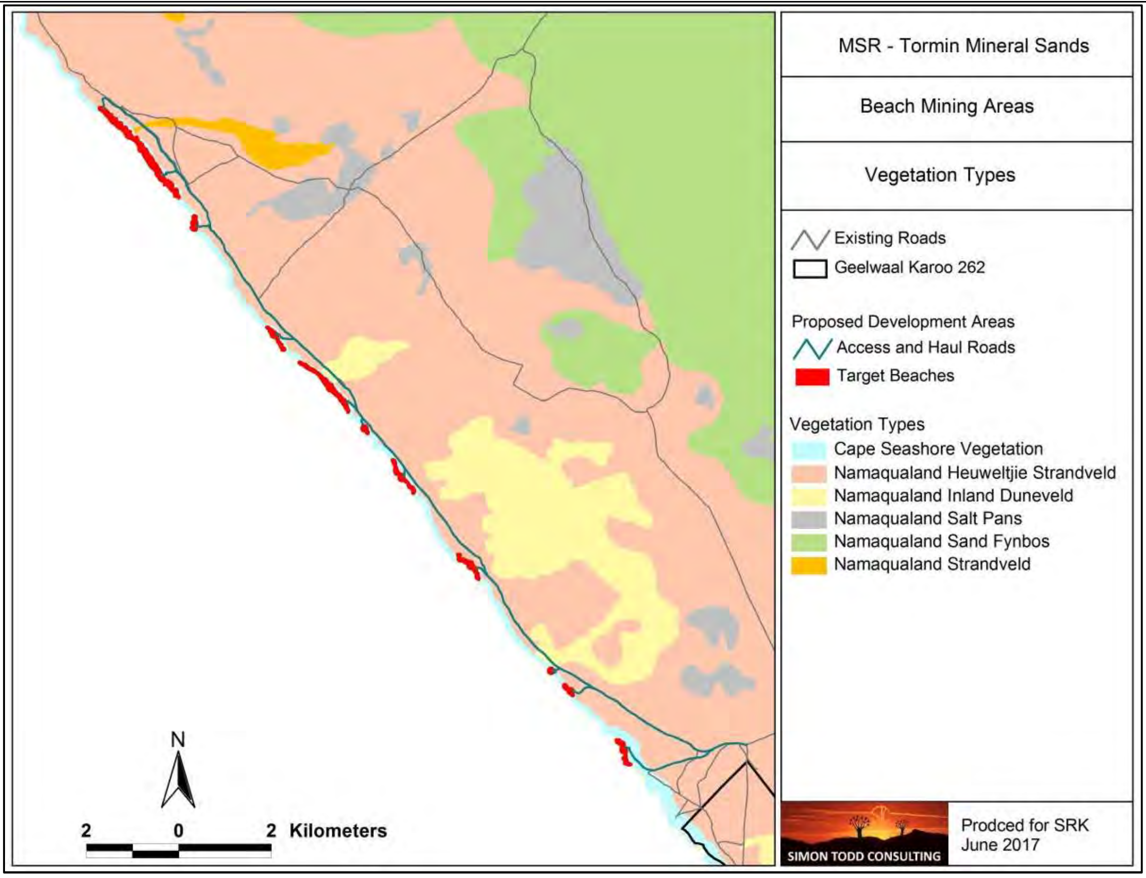


Figure 53: Vegetation maps of the area as described by Skowno et al (2009) for the WCDM

Source: 3Foxes Biodiversity Solutions, 2018

Description of Vegetation Units

Namaqualand Strandveld, which incorporates the areas mapped as Namaqualand Heuweltjie Strandveld by Skowno et al., occurs on the coastal peneplain, associated with deep stabilised aeolian yellowish-red dunes and deep sand overlying marine sediments and granite gneisses. The vegetation consists of low species-rich shrubland dominated by erect and creeping succulent shrubs as well as non-succulent shrubs (Mucina and Rutherford 2006). It has a rich component of annual and perennial flora, producing spectacular spring displays. Mucina and Rutherford (2006) list eight endemic species for this vegetation type (*Lampranthus suavissimus, Tylecodon decipiens, T. fragilis, Afrolimon sp., Gorteria sp. nov. Sutera multiramosa, Lachenalia valeriae* and *Romulea sinispinosensis*). This is likely an underestimate and there are certainly additional species of conservation concern present as undescribed species are regularly encountered in this vegetation unit as it has not been well investigated in the past.

Namaqualand Seashore Vegetation occurs in the Northern Cape, along a very narrow strip above the high tide zone of the Namaqualand coast from the Holgat River to just south of the Olifants River (Mucina and Rutherford 2006). This vegetation type occurs on slightly sloping beach, coastal rocky formations supporting sparse vegetation composed partly of succulent hummock-forming and spreading dwarf shrubs and herbs on the beach, in shell beds and on low dunes. The soils associated with this vegetation type are typically recent sandy marine sediments. The vegetation is under constant maritime influence from salt spray but is not directly influenced by sea tides. Biogeographically important taxa (West Coast endemics) include: *Drosanthemum luederitzii, Limonium sp., Arctotis scullyi, Salsola nollothensis* (Mucina and Rutherford 2006). Mucina and Rutherford (2006) list mining as the greatest threat to this vegetation type.

According to Mucina and Rutherford (2006), **Namaqualand Inland Duneveld** is distributed in the Northern Cape Province where it occurs in two patches: one between Kotzesrus northwards to the Groen River and the other between Wallekraal and Hondeklipbaai. However, as the vegetation mapping of Skowno et al. as well as others suggest, this unit has been under-mapped and it is more extensive than previously mapped. The vegetation occurs on coastal peneplains with mobile dunes and consists of tall shrubland dominated by non-succulent shrubs (*Berkheya, Eriocephalus, Euclea, Gloveria, Lycium* and others) as well as some grasses (Ehrharta) and restioids (Willdenowia). It occurs on Quaternary Aeolian deep, loose, red to yellowish sand. Although some of the areas inland of the beach mining sites were seen to correspond to this vegetation unit, the areas mapped as Namaqualand Inland Duneveld within Farm Geelwal Karoo 262 by Skowno et al. are more representative of Namaqualand Strandveld than this unit. Species typical of this and the other units are described below.

Plant Community Analysis within Farm Geelwal Karoo 262

Based on analysis of 33 sample plots on Farm Geelwal Karoo 262, three plant communities could be distinguished. There is a clear separation of the plots from the south of the study area which represent low and open (short) Strandveld on fine-textured soils from the other plots. The remaining plots consist of moderate Strandveld and tall Strandveld, which are not as easily distinguishable as the short Strandveld. The analysis also revealed that the vegetation of the affected area is not unique or well differentiated from adjacent areas. The field assessment confirms that, while there is a clear vegetation gradient from the ocean inland, the affected area is homogenous and similar to habitat in the broader area. The different communities identified in the analysis are described in the next section.

Short Strandveld

On fine-textured soils, usually underlain by hardpan, the vegetation is generally short and open and is characterised by the occasional presence of heuwetljies. This vegetation type corresponds with what Skowno et al. (2009) called Namaqualand Heuweltjie Strandveld. Common and dominant species include *Othonna cylindrica, Exomis microphylla var. axyrioides, Tetragonia fruticosa, Asparagus capensis, Cephalophyllum framesii, Psilocaulon dinteri, Vanzijlia annulata, Galenia fruticosa, Phyllobolus spinuliferus, Rushia sp., Leipoldtia schultzei, Berkhaya fruticosa, Didelta carnosa var carnosa, Euphorbia caput-medusae, Tripteris oppositifolia, Hypertelis angrae-pequenae* and *Zygophyllum morgsana*. The diversity of this plant community is quite high, but the only endemic species observed in this habitat and within the site was *Hermannia sp. nov*. (bungholensis), which also present in the other strandveld communities of the site. Although this is a relatively widespread community in the area and is prevalent to the south and north of Farm Geelwal Karoo 262, it has a relatively limited extent within the site itself and tends to be restricted to the southern end of the inland mining area (Figure 54). The firmer soils present here make it a preferred habitat of smaller burrow-dwelling fauna such as Meerkat which cannot maintain burrows in the sandier parts of the site.

Figure 54: Short Strandveld typical of the southern section of Farm Geelwal Karoo 262

Source: 3Foxes Biodiversity Solutions, 2018

Moderately Tall Strandveld

The majority of Farm Geelwal Karoo 262 consists of moderately tall Strandveld (Figure 55). Common and typical species associated with this habitat include *Stoeberia utilis, Zygophyllum morgsana, Othonna cylindrica, Pteronia onobromoides, Eriocephalus racemosus var. affinis, Exomis microphylla var. axyrioides, Tetragonia fruticosa, Senecio sarcoides, Ehrharta calycina, Asparagus capensis, Asparagus lignosus, Asparagus aethiopicus, Helichrysum hebelepis, Babiana thunbergii (Near Threatened), Boophone disticha (Declining), Pteronia divaricata, Lycium ferocissimum, Salvia africana-lutea, Euphorbia burmannii, Galenia fruticosa, Conicosia pugioniformis subsp pugioniformis, Rushia sp., Leipoldtia schultzei, Mesembryanthemum crystallinum, Hermannia sp. nov., Tripteris oppositifolia* and *Pelargonium gibbosum*. This community is widespread at the site and forms most of the affected area. Although there are some listed species present in this community, including *Babiana thunbergii* (*Near Threatened*) and *Boophone disticha* (*Declining*), the overall abundance of these species within the site is low and a high impact on listed plant species within this community is unlikely.

Figure 55: Moderately tall Strandveld typical of the majority of Farm Geelwal Karoo 262

Source: 3Foxes Biodiversity Solutions, 2018

Tall Strandveld

In areas of deep sand and in valleys between the dunes, the vegetation consists of tall Strandveld, dominated by many of the same species as the moderately tall Strandveld plant community, but growing to a larger size or at a higher density (Figure 56). This community is closest to what Skowno et al. (2009) have mapped as Namaqualand Inland Duneveld but is driven by moisture availability rather than mobile sands and is considered a fairly typical Strandveld community. Dominant and characteristic species include *Stoeberia utilis, Salvia africana-lutea, Searsia rigida, Zygophyllum morgsana, Lycium ferocissimum, Othonna cylindrica, Pteronia divaricata, Eriocephalus racemosus var. affinis, Tetragonia fruticosa, Senecio sarcoides, Ehrharta calycina, Asparagus aethiopicus, Melianthus elongatus, Helichrysum hebelepis, Tylecodon paniculatus, Euphorbia burmannii, Tripteris oppositifolia* and *Pelargonium gibbosum*. Although the abundance of listed plant species in this habitat is low, the higher density of vegetation cover in these areas makes them important for fauna, especially species preferring dense vegetation to hide in such as Duiker and many of the predators. The overall extent of this habitat within the development footprint is relatively low and most of the affected habitat occurs in the northern section of the inland mining area.

Figure 56: Tall Strandveld community occurring in wetter areas on deep sands

Source: 3Foxes Biodiversity Solutions, 2018

Plant Communities of the Beaches and Foredunes

Most of the larger target beaches are backed by semi-vegetated dunes which transition into Namaqualand Coastal vegetation and Strandveld (Figure 57). The dunes are usually dominated by either *Cladoraphis cyperoides* or *Sporobolus virginicus*, with shrubs in more stable areas and inland, with dominant species being *Lycium tetrandrum, Lycium ferocissimum, Asparagus capensis, Amphibolia laevis, Carpobrotus quadrifidus, Thesium spinosum, Zygophyllum morgsana, Zygophyllum cordifolium, Delosperma crassum, Othonna cylindrica, Psilocaulon dinteri, Vanzijlia annulata, Atriplex vestita, Tripteris oppositifolia, Galenia fruticosa* and *Hypertelis angrae-pequenae*.

Due to the relatively low vegetation cover and high winds along the coast, the dunes are vulnerable to disturbance and easily mobilised.

Figure 57: Dunes along Beach 10, showing the dominance of *Cladoraphis cyperoides*, with *Thesium spinosum*, *Othonna cylindrica* and *Amphibolia laevis*

Source: 3Foxes Biodiversity Solutions, 2018

Large stretches of the coastline have been disturbed by diamond mining activities and virtually all the beaches have been disturbed (Figure 58).

Figure 58: Large waste dumps at the high water mark have been partially recolonised by vegetation but will not fully recover

Source: 3Foxes Biodiversity Solutions, 2018

6.8.3 Vegetation Sensitivity

The CBAs map of the study area is illustrated below (Figure 59) and indicates that most of the area under application falls within CBAs. These areas have been designated as CBAs to promote coastal resource protection and to maintain ecological processes associated with the coastal strip, especially the ability of fauna to move along the coast. Although CBAs confer no rights and have no official conservation status in law, they provide an indication of ecological status (biodiversity).

The ecological sensitivity of the study area, as determined by the specialist following a site visit in the summer season, is depicted in Figure 60. A large proportion of Farm Geelwal Karoo 262 is of Medium-high sensitivity because of the sensitivity of the vegetation and likely presence of species of conservation concern. There are areas in the study area that have been affected by historic prospecting activities and overgrazing; however, much of the vegetation of the proposed footprint of the strand line can be considered mostly natural, although homogenous and no features of specific concern were identified. Large parts of the coastal forelands are of High sensitivity on account of the significance of these areas for fauna and their vulnerability to disturbance.

Within the proposed beach extension area north of Farm Geelwal Karoo 262, the strip immediately inland of the beaches is of High sensitivity because of the vulnerability to disturbance and the role as an ecological corridor along the coast, with a variety of species restricted to this habitat. The beaches themselves are Moderately sensitive as they are used by a variety of faunal species but do not appear to be critical for any of the observed fauna in the area. Areas of dense vegetation in low-lying areas and coastal valleys that are important movement corridors for fauna have been identified as having a higher sensitivity than the surrounding Strandveld.

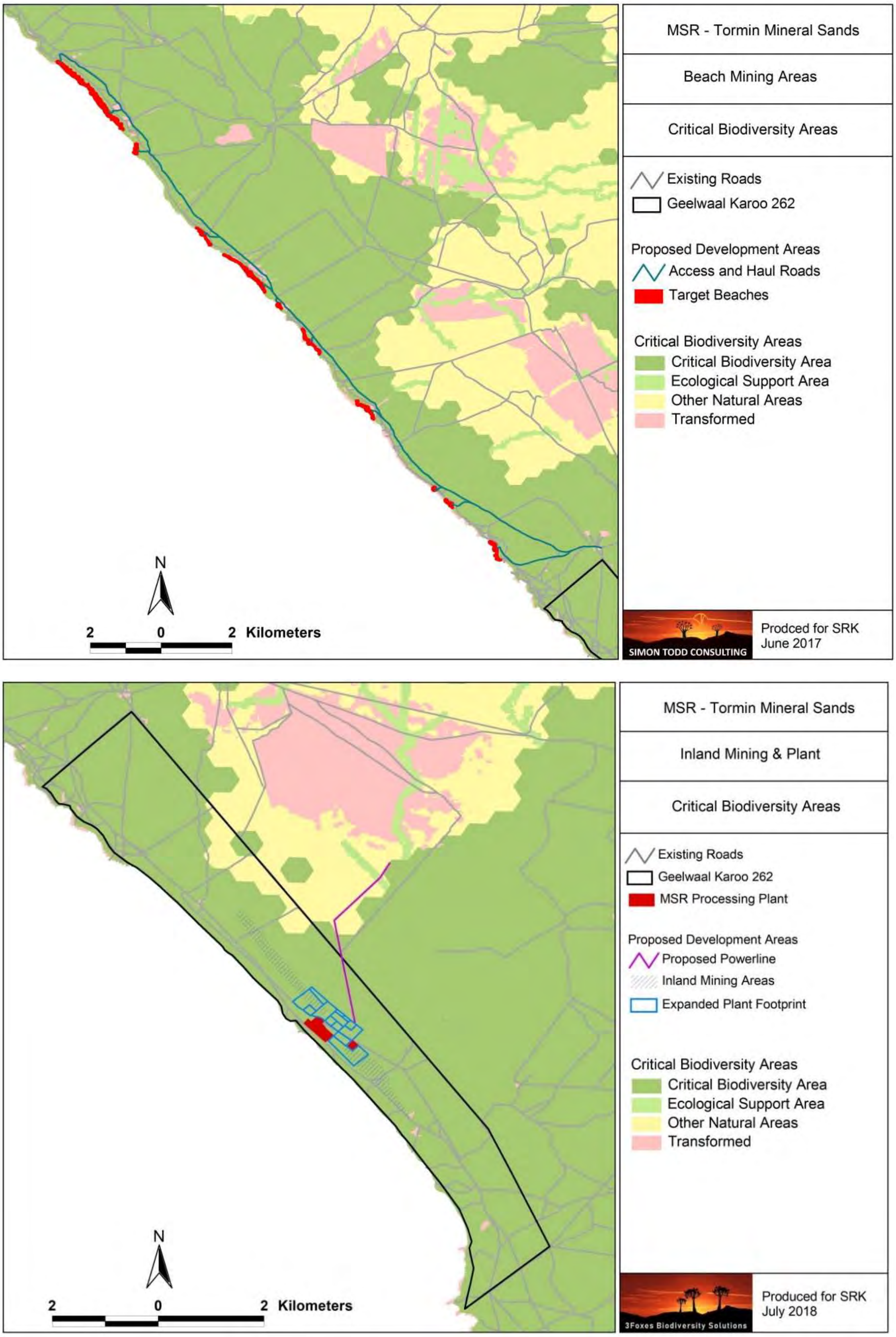


Figure 59: CBA maps of the study area

Source: 2017 Western Cape Biodiversity Spatial Plan in 3Foxes Biodiversity Solutions, 2018

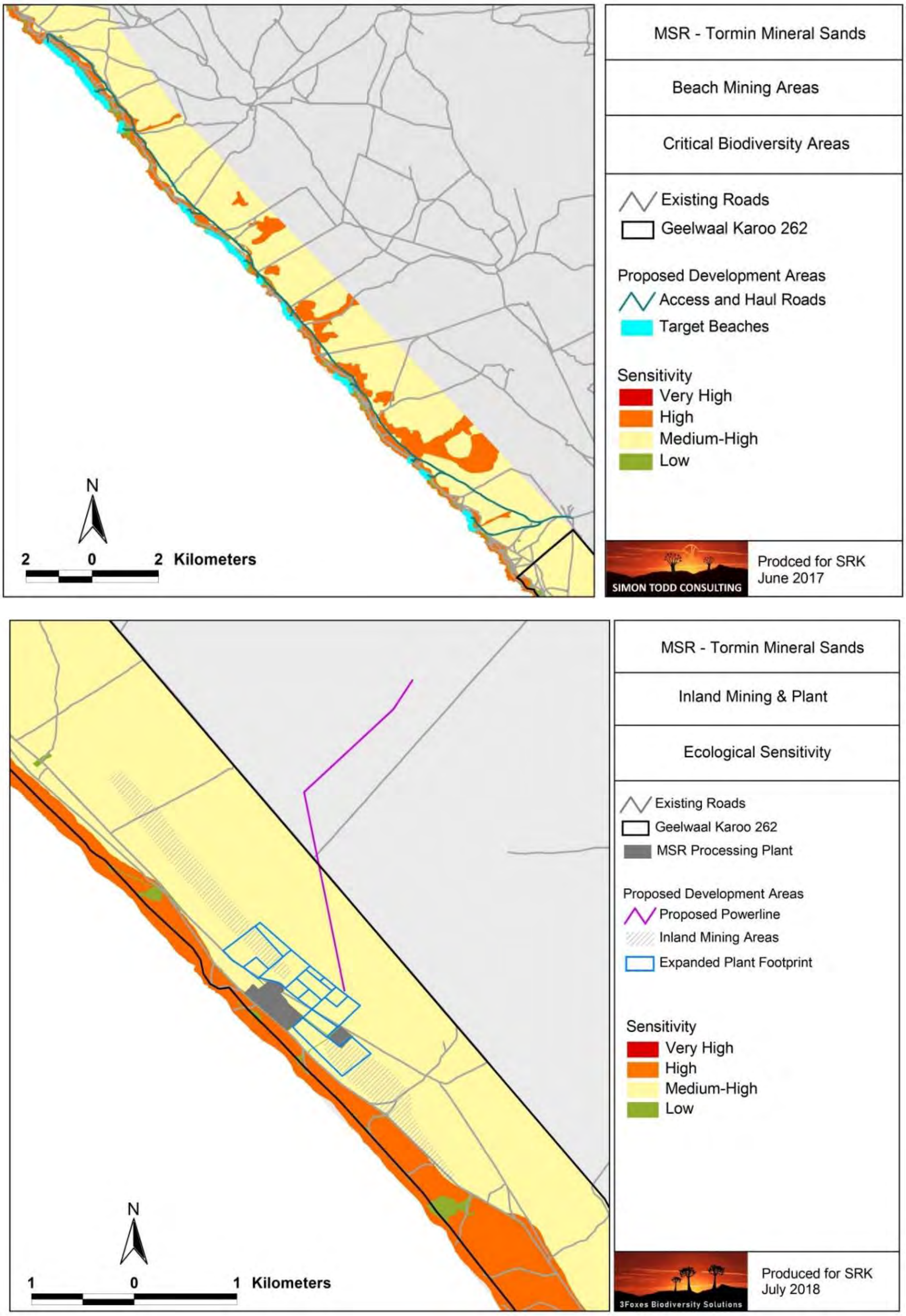


Figure 60: Ecological sensitivity maps of the study area

Source: 3Foxes Biodiversity Solutions, 2018