<table>
<thead>
<tr>
<th>I&amp;AP</th>
<th>ISSUE/CONCERN</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dirk Van Zyl</td>
<td>Is the pipeline going above or below the ground? It may result in cutting off the</td>
<td>The pipeline is above ground. A berth will be placed at regular intervals to make sure the animals can cross. There will be no fencing of the pipeline servitude.</td>
</tr>
<tr>
<td>I&amp;AP</td>
<td>ISSUE/CONCERN</td>
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<tr>
<td>Dirk Van Zyl</td>
<td>Will you negotiate with landowners prior to registering the servitude and get advice?</td>
<td>Yes.</td>
</tr>
</tbody>
</table>

**ADDITIONAL COMMENTS RECEIVED**

Cornelia Klak  

The Succulent Karoo has been identified as one of the 25 biodiversity hotspots in the world. The area, proposed for mining falls into this biodiversity hotspot. The Aizoaceae, where I am a leading expert, are one of the most diverse plant families found in the succulent Karoo (Snijman, 2013), with many being endemic to this area. Many Aizoaceae have very narrow distributions. Therefore, even the destruction of a fairly small area, could drive one or more species to extinction! A recent EIA study in the Garies area brought to light several new species, including two new species of Aizoaceae. One of them has been described so far, the other is in the process of being described. Two further new species were described from the Kamiesberg area in 2012, highlighting the incredible diversity of this area, which is still in the process of being described.

It is tragic that such a biodiversity hotspot should be subject to mining at all. The Red Data book, for which I was a major contributor, focused on areas which are currently under high threat due to extensive agriculture and urban expansion in the south western Cape. However, many species of Aizoaceae in the Succulent Karoo are naturally rare and we are very aware of the importance of the area from a botanical perspective, which is why we appointed Nick Helme to undertake the specialist work (have you seen his report?). Having discovered some new species, and some with very restricted distributions, we motivated to our client that Nick does further, surveys north and west of the site. As anticipated, he found additional specimens of all the new species, and identified suitable sites for possible biodiversity offsets. The fieldwork was undertaken from 1-12 August 2014, and the main focus species were Lachenalia sp. nov., Elegia sp. nov, Agathosma elata, Lampranthus procumbens and Leucoptera nodosa. During this survey all locations of these species were recorded, population sizes were recorded, and the areas were subsequently mapped. The EIA report and vegetation specialist study also makes sound recommendations for ecological corridors and other strategies to mitigate impacts. Unfortunately we cannot conserve areas without the financial resources to do so. And this has to come from the development process. In poor economies one sees almost no protected area, as the country simply cannot afford them. I have seen this in most Africa counties I have travelled to. How wish is therefore to find a balance between economic growth and resultant employment benefits, and environmental protection. The elusive goal of sustainable development. Please let us know if we can send you the reports, although they are available on our web page.
and were unfortunately never assessed, since this region has so far been fairly little impacted by human destruction. Thus, the Red Data book is incomplete and does not give the status of rarity for many species of Aizoaceae which occur in the Succulent Karoo. In this country, I believe that I am the only person, who can identify these plants correctly and determine how rare they are. For a proper EIA, I would expect that I should be involved in the identification of the specimen of Aizoaceae from the area earmarked for mining.

<table>
<thead>
<tr>
<th>I&amp;AP</th>
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<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vic Fitzmaurice</td>
<td>I wish to register as an IAP for this project.</td>
<td>Mr Fitzmaurice has been registered as requested.</td>
</tr>
<tr>
<td>Matthew Law</td>
<td>Please could you register me as an IAP for the Zirco Kamiesberg Project? My interest in the project relates to my involvement in environmental management of other mining operations in the region.</td>
<td>Mr Law has been registered as requested.</td>
</tr>
</tbody>
</table>
7. ALTERNATIVES

One of the objectives of an EIA is to investigate alternatives to the proposed project. There are two types of alternatives - Fundamental Alternatives and Incremental Alternatives.

7.1 FUNDAMENTAL ALTERNATIVES

Fundamental alternatives are developments that are totally different from the proposed project and usually involve a different type of development on the proposed site, or a different location for the proposed development. Since the core business of the project proponent is heavy mineral mining, the fundamental alternative of a development other than the proposed mine and associated infrastructure does not meet the general purpose and requirements of the proposed activity. Zirco holds the prospecting rights to the Roode Heuvel and Leeuvlei deposits, and is in the process of acquiring prospecting rights for the Sabies deposit immediately east of and adjacent to Roode Heuvel. Considerable effort has been expended in quantifying the size of the mineral resource in these areas, and no alternative locations for mining have been considered.

Accordingly no fundamental alternatives have been considered in this EIA, apart from maintaining the status quo (the No-Go option). Alternative locations for infrastructural components of the project that are not locality bound are, however, considered in section 7.2. The mine path is, of course, locality bound, as it is entirely dependent on the location of the resource being mined.

7.2 INCREMENTAL ALTERNATIVES

Incremental alternatives are modifications or variations to the design of a project that provide different options to reduce or minimise environmental impacts. There are several incremental alternatives that can be considered, including:

- The design or layout of the activity;
- The technology to be used in the activity;
- The operational aspects of the activity.

Various incremental alternatives have been considered throughout the EIA process. These include the following:

i. **Open Water vs Gully Seawater Intake**

Two types of sea water intake works have been proposed as a source of water for the mine, these include:
• Open water intake in Khnyp Bay or elsewhere as a stand-alone installation;
• Gully Intakes.

**Open Water Intake in Khnyp Bay or elsewhere as a stand-alone installation**

An open water intake would include the following components:

• **A beach crossing**: Stretching from the head works landward of the primary dune to approximately the low water line. The construction of this section would consist of an open dry excavation which would be protected by a cofferdam.

• **A surf zone crossing**: From the low water line to the limit of the breaker zone. There are two methods of construction for this section. The first consists of an open wet excavation between rock embankments in protected waters, while the second consists of a protected excavation inside a rock cofferdam with the seaward end closed off to exclude wave action inside the cofferdam.

• **An offshore zone pipeline**: From the breakwater zone to the intake structure. This section could be constructed without a cofferdam utilising times of calm sea conditions.

• **An intake structure**.

The above components are shown in the layout diagram in Figure 7.1.

The offshore environment is likely to be less sensitive than the inshore environment (lower biodiversity and lower density of fish and invertebrate larvae offshore). However, the impacts of building a pipeline that extends into the offshore environment would have a much higher impact in terms of disrupting water movement patterns (waves and currents) as well as natural sediment movement, and would also result in the loss of a much greater amount of marine habitat in the pipeline footprint. For this reason this alternative is considered to be not feasible as an option which will result in a lower impact (i.e. gully intake) is available.

**Gully Intake**

Due to the rocky nature of the coastline in the area of the proposed development, it is feasible to construct a gully type intake. In addition to this, according to the marine assessment, all impacts associated with the construction, operation and decommissioning of the proposed gully intake can be reduced to low significance with the implementation of appropriate mitigation measures.

Based on the analyses above the construction of a gully intake is the preferred option and thus the option of an open water intake will not be assessed further in the EIR.
ii. Alternatives Locations for a Gully Intake

Seven gullies were considered for the proposed gully intake; these are described in detail below and depicted on Figure 7.2. The proposed gully intake sites were divided into preferred sites and lesser preferred sites. This prioritisation was undertaken during the field survey in consultation with Bergstan Africa Development Engineers. The preferred sites from an engineering perspective included KMM1, KMM4 and KMM6. The lesser preferred sites included KMM2, KMM3 and KMM5. What follows is an analysis of the various options.

PARK 1

This site is located within the Namaqua National Park and the proposed Namaqua Marine Protected Area (MPA). Development at this site is in contravention of the law (the relevant sections are presented below) and thus this option was not assessed further in the EIA process.

Section 4 of the National Parks Act 57 of 1976:
“Object of a Park
The object of the constitution of a park is the establishment, preservation and study therein of wild animals, marine and plant life and objects of geological, archaeological, historical, ethnological, oceanographic, educational and other scientific interests and objects relating to the said life or the first-mentioned objects or to events in or the history of the park, in such a manner that the area which constitutes the park shall, as far as may be and for the benefit and enjoyment of visitors, be retained in its natural state.”
Section 43 of the Marine Living Resources Act:
“Marine protected areas
43. (1) The Minister may, by notice published in the Gazette, declare an area to be a marine protected area—
(a) For the protection of fauna and flora or a particular species of fauna or flora and the physical features on which they depend;
(b) To facilitate fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or
(c) To diminish any conflict that may arise from competing uses in that area.

(2) No person shall in any marine protected area, without permission in terms of subsection (3)—
(a) Fish or attempt to fish;
(b) Take or destroy any fauna and flora other than fish;
(c) Dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter, or in any way disturb, alter or destroy the natural environment;
(d) Construct or erect any building or other structure on or over any land or water within such a marine protected area; or
(e) Carry on any activity which may adversely impact on the ecosystems of that area.
(3) The Minister may, after consultation with the Forum, give permission in writing that any activity prohibited in terms of this section may be undertaken, where such activity is required for the proper management of the marine protected area.”

Proclamation of the Namaqualand MPA is on the Department of Environmental Affairs’ workplan agenda for 2014 (pers. comm. Dr. Kerry Sink, SANBI). Furthermore the Systematic Marine Biodiversity Plan for the West Coast of South Africa (Majiedt et al. 2013) shows that the proposed MPA falls within a high priority conservation area and is regarded as a Primary Focus Area for Protection. Further findings within this publication state that Namaqualand Inshore Reef, Inshore hard Grounds and Inshore Sandy areas are critically endangered habitat types. Selection of this site for a seawater intake is likely to invoke significant resistance from South African National Parks and the Department of Environmental Affairs and is therefore strongly discouraged.

**KMM1**

Gully KMM1 is a preferred (potentially impacted) site because it offers good protection from wave action. However, the maximum depth recorded during low tide was measured at only 1.3 m and an extensive rock shelf closes it off to open water during spring low tide, reducing it to a shallow pool. A significant amount of blasting would be required to deepen this gully and remove the rock barriers to ensure a constant supply of seawater. There is no adjacent sandy beach or sand dunes which would be impacted at this site.

**KMM2**

Gully KMM2 is a lesser preferred (control) site with maximum depth measured at 1.7 m at spring low tide. It is blocked off to the sea during spring low tide and reduced to a small puddle. Significant blasting would be required to both deepen it and to ensure a continuous flow of seawater for abstraction. There is no adjacent sandy beach or sand dunes which would be impacted at this site.

**KMM3**

Gully KMM3 is a lesser preferred (control) site with maximum depth measured at 1.5 m during spring low tide. A rocky barrier closes the mouth off to the sea during spring low tide and it too is reduced to a small puddle. Significant blasting would be required to both deepen it and to ensure a continuous flow of seawater for abstraction. Given the close proximity to KMM2, it also has no adjacent sandy beach or sand dunes likely to be impacted.

**KMM4**

Site KMM4 is a preferred (potentially impacted) site with a maximum depth of 2.4 m during spring low tide. This site is favoured because there are no rocky barriers which cut off flow to the open sea during spring low tide and therefore a good flow of seawater is maintained throughout the gully. It is also the deepest gully out of all the proposed sites and would be well suited for seawater abstraction. However, some blasting would be required towards the beach-end of the gully as there are some large rocks between the deepest part of the gully and the beach. A steep reflective beach is adjacent to the south and is largely composed of coarse sediment and dead mussel shells, an environment largely devoid of infauna.

**KMM5**

Gully KMM5 is a lesser preferred site with a maximum depth of 1.7 m recorded at spring low tide. It is well protected by an outer rock shelf behind which a deep extensive pool exists with
good supply of water from the open sea. Shoreward, this leads into a very shallow and well barricaded gully. The sheltered environment described above is echoed in the community structure of the intertidal biota – the open coast (exposed) survey site being more similar and clustering with the sheltered gully sites. Significant blasting would be required to run a pipeline through this gully to reach the deep outer pool. There is no adjacent sandy beach or sand dunes which would be impacted at this site.

**KMM6**

Gully KMM6 is a preferred site with a maximum depth of 1.6 m recorded at spring low tide. It is a shallow channel which runs inside of the point of the Namaqua Wreck. At spring low tide the channel dries out completely with only a small trickle connecting the two sides of the point. A sandy beach adjoins this proposed site where numerous holes indicate presence of the giant isopod, *Tylos*. Many species utilise this area; eight different species of bird in the vicinity of the Namaqua wreck and Cape fur seals hauling out on the rocks.

Taking into consideration the ecological sensitivity/significance of the various sites, the suitability of each site for construction of a seawater intake was scored from 10 (most suitable) to 1 (least suitable). Table 7.1 below summarises the results. It is concluded that site KMM4 is the most preferred, followed by sites 1, 2, 3 and 5, with the Park Site least favourable.

**Table 7.1: Ecological sensitivity / significance of candidate seawater intake sites**

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Ecological Score (Sensitivity/Significance)</th>
<th>Criteria</th>
</tr>
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</table>
| KMM1        | 6                                          | • Relatively low number of species  
• No adjacent sandy beach or sand dunes  
• Significant blasting required  
• Outside national park and proposed MPA |
| KMM2        | 6                                          | • Relatively low number of species  
• No adjacent sandy beach or sand dunes  
• Significant blasting required  
• Outside national park and proposed MPA |
| KMM3        | 6                                          | • Relatively low number of species  
• No adjacent sandy beach or sand dunes  
• Significant blasting required  
• Outside national park and proposed MPA |
| KMM4        | 8                                          | • Average species richness  
• No adjacent sandy beach or sand dunes  
• None/small amount of blasting required  
• Outside national park and proposed MPA |
| KMM5        | 5                                          | • High number of species  
• No adjacent sandy beach or sand dunes  
• Significant blasting required  
• Outside national park and proposed MPA |
| KMM6        | 3                                          | • Relatively high species richness  
• Eight different bird species utilising intertidal zone  
• Cape fur seals hauling out on the rock  
• Legal implications (wreck site)  
• Outside national park and proposed MPA |
Based on the above PARK1 and KMM6 were excluded from any further assessment in the EIR.

According to the Marine Assessment, it is recommended that the seawater intake pipe be installed at **gully site KMM4**, provided that the suggested mitigation procedures are followed. This gully was shown to be the deepest of all those surveyed and would therefore not require as much blasting as the other proposed sites. Furthermore, this site demonstrated good connectivity with the open sea during spring low tide, thus ensuring that seawater can be abstracted at the recommended velocity of 0.15 m/s without risk of drying the gully out. In addition to this the southern gully cluster, in which KMM4 is situated, does not have any adjacent sandy beaches or vegetated sand dunes likely to be impacted. However, based on the results of the field survey, it is apparent that the sheltered gully sites displayed significantly lower biodiversity and abundance of intertidal rocky shore biota in comparison to the open water (exposed) sites – which had significantly greater levels of biodiversity and abundance. Furthermore the benthic biota at these sites is not of great significance in terms of conservation status. This would suggest that perceived impacts of the construction and decommissioning phases of the intake point would be fairly low within any of the proposed gully sites (i.e. KMM1, KMM2, KMM3, KMM4, KMM5). The cost of the construction of the pipeline, however, varies significantly between KMM5 and the southern cluster (KMM1-4). Due to the fact that KKM5 is situated closer to the mine site, the cost of construction and operation (water pumped over shorter distance) is lower than that for KMM4, thus KKM5 is preferred from a financial point of view. Furthermore, the construction of KKM5 will also result in a reduction in disturbance of vegetation (due to its reduced length) and thus is also preferred from a terrestrial ecology perspective. KMM5 is thus the preferred option.

**iii. Transport of Product**

Three options were considered for the transport of product from the mining operation to the markets:

1. A combination of rail and road haulage.
2. Road transport only.

**Rail and Road Haulage**

The rail and road option will involve transporting product by road from the mine site to the rail siding at Bitterfontein, approximately 85 km to the south east of the mine site. From there product will be loaded into a silo loading facility, purpose built at the Bitterfontein siding. This will be used to load rail wagons and the product will be railed over a distance of 540 km to Saldanha Port for export to overseas markets. At Saldanha a storage facility to hold 2-3 months of production will be constructed together with loading infrastructure for shore to ship
loading. The construction of these bulk handling facilities presents challenges as the general goods terminal has no gantry or crane facilities.

In addition to this, transport by rail over a distance of 500 km is a significant operational cost and the preference would be to use the Sishen rail line, which reduces the distance to 240 km. Protracted negotiations to obtain permission to use the Sishen line are anticipated, as this line is dedicated to Iron Ore shipment and also caters for Namakwa Sands products.

Due to the extreme costs involved in this option as well as the fact that an additional storage facility will be required at Bitterfontein, increasing the development footprint, it has been deemed unfeasible and therefore will not be assessed further in the EIA.

Road Transport Only

The second option is to transport product by road (N7) all the way from the mine site to Saldanha Port, using a 37 tonne pay load horse plus 2 trailers. This will result in relatively large volumes of road traffic along the N7, estimated at 20 round trips per day.

This option has been chosen as it requires the least capital expenditure and offers the most flexibility. Once trucks have been loaded they can continue to Saldanha without the additional triple handling inherent in transferring material from truck to rail in Bitterfontein and back to truck in Saldanha. Existing contractors are already operating trucks for the same material with storage and loading facilities set up in Saldanha. Thus no additional loading and storage facilities would need to be built in Bitterfontein and specialist rail rolling stock would not need to be fabricated.

Marine Transport and Port Facilities

In this last option, the heavy minerals will be transported to the coast by truck or pumped there as a slurry, and then be pumped as a slurry directly to the ships hold, using a subsea pipeline and Single Point Mooring (SPM) buoy. Three pipes will be required for the subsea section of the piping network, although only two will be used simultaneously. The third pipe will function as a back-up in the case of a failure occurring. The return water pipe is a continuous pipeline from the ship to the mine. The pump station on the ship will be used to pump the water onshore and a booster station onshore will provide the required energy to pump the water the remaining distance to the mine. However based on cost analysis this alternative has been excluded and will not be assessed further in the EIR.

Based on the analyses above the use of road transport is the preferred option and thus the options of road/rail and marine transport were not assessed further in the EIR.

iv. Water Use

Even though a dry mining process is anticipated, the proposed operation will require large volumes of water, as a wet separation process is required to separate the HMC from the sand tails. Although water is recycled via the slimes thickener, a certain percentage of water remains tied up with the thickened slimes and sand tails in the backfill areas. Zirco estimates that up to 12 Gt (12 million m$^3$) of make-up water will be required per annum, translating to 33 000 m$^3$ per day. It is anticipated that seawater will be used for processing in the PCP (wet plant) as there is insufficient groundwater available for this purpose.

An estimated 690 000 m$^3$ per annum of freshwater will be required for human use, including for drinking, and also to remove salt from the HMC prior to it going into the MSP. There are currently two options for the provision of freshwater for HMC washing:
1. The use of groundwater resources. Preliminary groundwater investigations indicate that the ground water is brackish (total dissolved solids from 17 sampling points in the mining area range from 3 300 mg/l to 9 470 mg/l, with an average of 6 920 mg/l), and therefore will need to be desalinated before being used to wash the HMC prior to entering the MSP.

2. The use of sea water: Desalination of seawater to use for HMC washing is a second option, as the use of seawater has been successfully implemented at a number of heavy mineral mining operations worldwide.

To determine the availability of groundwater for the provision of freshwater required for the washing of HMC, pump tests were conducted on 3 boreholes in the concession area. Of these three boreholes the blow yield of ZIRCH03 (situated within the floodplain of the Groen River) – 10.9 l/sec - was higher than expected for the region, and a constant discharge test was carried out at a maximum pump discharge rate of 10 l/sec for 39 hours. During this test the drawdown of the groundwater level stabilised after 7 hours at approximately 30% (23.38m) of the available drawdown of 772m, and remained relatively static for the remainder of the test. On cessation of pumping, the borehole recovered to within 95% of the maximum drawdown within 2 hours. It is thus anticipated that borehole ZIRCH03 is able to sustain a yield of approximately 10 l/sec. In addition to this, the geometry of the river and the results of a resistivity survey of the Roode Heuvel block (which included four transects across the Groenrivier valley) indicate that it is likely that there may be an additional two areas in the Groenrivier valley from which similar yields may be expected from boreholes.

It is therefore possible that a total of approximately 30 l/sec of groundwater (approximately 950 000 m³/a) could be available for abstraction. This is more than the required volume of 690 000 m³/a, but it has not yet been definitely determined if this abstraction rate will be sustainable over the long term. It is therefore recommended that this option is excluded from further analysis until such time as it can be determined if high-volume and long-term abstraction will not result in significant drawdown, which may in turn affect local farmers in the region.

Based on the analyses above the use of seawater ONLY is the preferred option and thus no groundwater will be utilised for processing. As a result this impact was not assessed further in the EIR, and the focus was on an assessment of establishing a desalination plant on the mine, with seawater abstraction as described above.

v. **Location of the airstrip**

There were initially three possible locations for the airstrip (Figure 7.3). One option (Option 1) was recommended by the client and two options (Options 2 and 3) were recommended by the botanist. Option 1 for the airstrip was in an area degraded by agricultural activity. However, according to the botanist this area is in a vegetation type identified as Sand Fynbos, with a sensitivity rating of HIGH due to the high number of SCC occurring within this vegetation unit. This area has subsequently been incorporated into the suggested ecological corridor system and has been identified as one of the areas that could potentially function as a nursery for transplanted SCC identified during search and rescue prior to development. The establishment of an airstrip here has thus been excluded as an option.

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8 Blow yield: The volume of water per unit of time blown from the borehole during drilling – an indication of the rate at which groundwater can be abstracted from a borehole.
The two locations identified by the botanist (Options 2 and 3) were located within an area in the adjacent prospecting area referred to as Sabies. These locations are within and/or in close proximity to riverine areas and have subsequently also been incorporated into the proposed ecological corridor system. In addition it is currently uncertain as to when (or if) this area will be mined, and thus it is not ideal for any infrastructure to be located within this region.

As a result a fourth position was recommended for the location of the airstrip, just north of the Year 8 mine path, in an area of low to moderate sensitivity. This is considered to be the preferred option for the location of the airstrip.

Figure 7.3: Alternative locations for the proposed airstrip

vi. **Post-closure rehabilitation**

Various options were considered, based on the outcome of the specialist assessment for post-closure rehabilitation.

Option 1 was based on the soils and agricultural assessment, which recommended that the land should be rehabilitated back to agriculture to mitigate the impact of loss of agricultural land.

Option 2 was based on the ecological assessments (vegetation and fauna), which recommended that the area is rehabilitated back to its natural state for possible incorporation into the Namaqua National Park, which borders the proposed development in the north-west corner.

Based on the contradictory recommendations by the various specialist disciplines, it is the
recommendation of the EAP that a third option is considered. Option 3 consists of a combination of the two Options above. It is thus recommended that the prospecting area referred to as Roode Heuvel, which has been identified by the ecologists as an area of high sensitivity is continuously rehabilitated back to its natural state throughout the life of mine as the mine path progresses, and at post closure the land is offered to Namaqua National Park (NNP) for incorporation. This will tie in with the expansion strategy for the NNP as depicted in Figure 7.4 below, the intention of which is to include the western portion of Roode Heuvel into the NNP footprint. Should the NNP decline the offer of incorporating this area, a biodiversity offset in close proximity to the proposed development will need to be established. Under this scenario the land post-closure would be rehabilitated back to agricultural land.

In addition it is recommended that the prospecting areas identified as Sabies and Leeuvlei are rehabilitated back to agricultural land, as the majority of the area has been identified to be of low to moderate sensitivity. Areas of conservation concern within the borders of these prospecting areas have been incorporated into the proposed ecological corridor system and will not be impacted.

![Figure 7.4: Namaqua National Park buffer zone](image)

**Figure 7.4: Namaqua National Park buffer zone**

### 7.3 NO-GO ALTERNATIVE

The removal of vegetation during the mining process and the construction of associated infrastructure will cause the loss of important vegetation communities as well as habitat fragmentation. These are dynamic ecosystems that provide the habitats to support all forms of life. The study area, particularly the area referred to as Roode Heuvel and the north-eastern portion of Leeuvlei, is exceptionally rich in plant species.
However, it should be noted that the area consists of farms which focus on sheep and goat husbandry. The region has a low carrying capacity. In Namaqualand the carrying capacity is generally given as 1 small stock unit per 10 to 12 hectares. Certain farms, especially those with Sand Fynbos, also have fallow cereal fields. It seems that very few farmers still plant cereals, in spite of currently higher than average grain prices, and this is due to consistently lower rainfall than decades ago, when most of these fields were developed; however, the old lands are still clearly visible, as heavy livestock grazing has resulted in limited natural rehabilitation in these areas.

The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing is unlikely to have resulted in total loss of any plant SCC in the area. However, current land use has impacted on the isolated populations of SCC, and reduced the total population numbers of about 5 to 10 SCC. Overall no species or habitats are likely to have been lost, although degradation in certain areas (around stock kraals) has been intense. As a result current land use practices are having a moderate negative impact on biodiversity in general as well as on SCC.

Under the no-go option the land use of the area will remain as agriculture and based on the above information it is safe to assume that degradation of the SCC and vegetation communities will continue in the long term. In addition to this, for the no-go option, it is uncertain when/if this area will be incorporated into the NNP as per their expansion strategy. The proposed project, however, could assist in this regard upon closure of the mine.

In addition to this, the social and economic benefits provided by the project, such as, employment, skills development and local economic development will not accrue from the no-go option. The no-go option is therefore likely to have a high negative impact on social and economic development within the region.
8. KEY FINDINGS OF THE SPECIALIST STUDIES

In terms of section 31 (2) of the EIA regulations (2010), an environmental impact assessment report must include:

(j) A summary of the findings and recommendations of any specialist report or report on a specialised process

8.1 SOILS AND AGRICULTURAL ASSESSMENT

An agricultural impact assessment was undertaken to identify and assess the significance of potential impacts associated with the proposed activity on the agricultural potential and the current soil conditions of the affected land.

The proposed development’s primary impact on agricultural activities and soil conditions will involve the construction of the new Kamiesberg mineral sands mine site and associated infrastructure, as well as mining operations. The construction of the mine site and associated infrastructure will only influence a small area of the total local agricultural portion while mining activities will affect a large area over an extended timeframe (years).

The No-go alternative would mean abandoning the proposed development and as such there will be no negative impact on the environment as identified in Chapter 9 of this report. Furthermore it may also result in none of the positive impacts of commercial mining in terms of employment and skills development being realised from this area.

All the mitigation measures provided below are to be implemented in the Construction, Operation and Decommissioning Phases of the proposed Kamiesberg Project.

**Construction**

- The upper 30 cm of top soil must be stripped and stockpiled. It should be retained for re-spreading over disturbed surfaces during rehabilitation.
- An ECO should monitor all excavations to ensure backfilling with subsoil first and then topsoil afterwards takes place.
- An ECO should monitor depth and cover of topsoil spreading during rehabilitation to ensure a 30 cm depth.
- Rehabilitation of the affected landscape must start as soon as possible after mining to ensure a minimum amount of time allowed for soil/sand exposure.
- Ensure that the slopes and shape of the landscape conforms as far as possible to the pre-mining topography.
- Use only local sand to landscape the impacted areas during rehabilitation.

**Operation**

- Develop a Rehabilitation Plan that will ensure that the land can be utilised for agricultural purposes after closure and rehabilitation of the mining area.
- All run-off water must be collected, channelled and disposed of in an appropriate manner.
- The site must be visually monitored for occurrences of erosion, which must be recorded and immediately rectified.
- If erosion occurs the necessary changes to the surface drainage management system must be implemented.
• Ensure that all stockpiled material (subsoil and topsoil) are appropriately sited and shaped and protected (wetting, canvassing or netting down stockpiles, and the construction of wind break) to reduce wind-blown sand.
• The upper 30 cm of top soil must be stripped and stockpiled prior to commencement of the mining activity. It must be retained for re-spreading over disturbed surfaces during rehabilitation.
• Local seed mixes may be used to aid and speed up the rehabilitation process. These seed mixes must be approved by the ECO.

**Decommissioning**

• Develop and implement a Rehabilitation and Monitoring Plan to monitor rehabilitated areas.
• Implement measures such as wind-breaks, swales and watering to aid the initial growth of primary vegetation.

### 8.2 SURFACE AND GROUNDWATER ASSESSMENT

Potentially three activities may impact the groundwater conditions on site. These are the tailings storage facility and backfilling; groundwater abstraction and pollution by direct contact with contaminants. The impacts may be reduced to low negative associated with the latter two impacts and a moderate negative for the first impact if mitigation measures are adhered to.

Three potential impacts were identified to have a significant impact on the surface water of the proposed site and its surrounds. These impacts include activities associated with the tailings storage facility and backfill; abstraction from Groenrivier and infrastructure constructed to cross rivers. The potential impacts significance can be reduced to low negative after mitigation measures are implemented. The water crossing may potentially be reduced to a low negative from a moderate negative significance.

Operational impacts are expected to be of Low significance.

The following mitigation measures have been recommended to reduce the associated impacts on groundwater sources:

• Recover seawater from tailings via sumps in paddocks and recycle as process water.
• Optimise the use of slimes mixed with coarser material (co-disposal) to reduce the rate of infiltration and seepage.
• Continuously monitor the salinity of the groundwater in and around the mining area to confirm or otherwise the results of modelling, and continuously update the model to take account of the monitoring results and data from the weather station.
• If necessary, concomitant with the chosen form of post-mining land use, provide alternative sources of water for stockwatering if salinity levels exceed levels appropriate for animal consumption. New boreholes may need to be established outside the mining area to the east and west, and also on the south side of the Groenrivier.
• Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
• Continuously monitor groundwater levels via observation wells.
• All hydrocarbons of all types must be stored on impermeable surfaces with appropriately sized containment bunds and grease traps. Traps must be regularly
cleaned.

- All chemicals of all types must be stored on impermeable surfaces in secure and bunded designated storage areas.
- Cement must be stored on impermeable storage areas protected from the rain and mixed only in designated areas. Cement residue must be cleaned up immediately.
- Vehicle repairs, servicing, refuelling and washing must be done only in designated areas with impermeable surfaces with appropriately-sized containment bunds and grease traps.
- Where it is necessary to service, repair or refuel a vehicle or item of plant in the field drip trays must be used to catch drips, spills and leaks.
- Spill kits must be available at all locations where chemicals of hydrocarbons are stored, handled or used, and spills must be cleaned up immediately in accordance with an established protocol appropriate to the material in question.

The following mitigation measures have been recommended to reduce the associated impacts on surfacewater sources:

- Mitigation measures proposed for Impact 1 may result in a reduction of salinity levels of around 5 000 mg/l.
- A pre-mining baseline of the salinity levels in the estuary, together with the general biological state of the estuary, should be established, and monitored at regular intervals thereafter.
- Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
- If necessary provide an alternative source of water for stockwatering if abstractions for mining purposes prejudice the yield of existing wells and boreholes used by local population.
- Continuously monitor groundwater levels via observation wells.

Road crossing

- If it is necessary to construct a new crossing, not on the alignment of the existing drift, it should be sited to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- The conditions of the Water Use Licence (or General Authorisation) must be strictly adhered to.

Pipe crossing

- Site the crossing to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- As far as possible avoid the construction of structures below the level of the 100-year flood.
- Remove the pipe crossing after closure and decommissioning of the mine.
- The conditions of the Water Use Licence must be strictly adhered to.

8.3 VEGETATION IMPACT ASSESSMENT

The vegetation and habitat in the project area is generally in good condition, but the effects of stock and crop farming are evident in places, some land portions being significantly more overgrazed than others. In general the western parts are less heavily impacted by grazing than the eastern parts, and areas with goats are more heavily impacted than areas without. Most of the coastal section is in good condition, apart from old diamond camps and diggings, numerous tracks, and some kelp harvesting stockpile areas. Altogether some 23 plant Species of Conservation Concern (SCC) were recorded in the study area (17 in the mining
area), including 6 species not yet formally named or described, and large scale mining could thus have a significant negative impact on some of these species and the overall flora if adequate mitigation is not put in place.

The following mitigation measures are recommended:

- Mine construction phase planning should, as far as possible, be informed by the botanical sensitivity mapping, so as to minimize what could otherwise be very significant negative botanical impacts. Where possible, discretionary facilities (those that are not tied to any particular area) should be located in areas of lowest sensitivity.
- All Very High sensitivity areas (please refer to proposed corridor map in Chapter 11 of this report), with the exception of the small portion of Klipkop Shrubland that may be impacted upon by mining activities in the southern section of Leeuvlei, should be treated and managed as conservation areas and should not be subject to prospecting or mining.
- All High sensitivity areas that have been incorporated into the proposed ecological corridors, especially areas covered by northern Sand Fynbos, should be treated and managed as conservation areas and should not be subject to prospecting or mining.
- All Very High and High sensitivity areas not subject to mining (specifically on the Roode Heuwel Prospecting Area) should be offered to the Namaqua National Park, presumably after mining has ceased, but the northwestern areas (adjacent to the Park) should be offered as soon as possible. Areas of Very High and High sensitivity within the Leeuvlei and Sabies areas should also be offered to the NNP, if the land is acquired and mining proceeds at a later stage.
- Provided that the Namaqualand Strandveld and Namaqualand Heuweltjieveld areas within the total project area are treated and managed as conservation areas for the full Life of Mine no additional offset is required for these habitats, as significantly more than double the habitat area (for these two vegetation types) likely to be impacted by mining will be conserved within the project area.
- Suitable high quality areas of Namaqualand Sand Fynbos in the region, adjacent to the Namaqua National Park, have been identified. These could potentially be purchased by the applicant and donated to the appropriate national conservation authorities, or leased to them via contract. This would effectively be a biodiversity offset that would help reduce the significant residual botanical impacts remaining after all the above mitigation has been factored in (Moderate – High negative). Approximately 9000 ha of suitable land has been identified, made up of 11 cadastres, in three main areas. It is recommended that 2500 ha of this would be required to offset all biodiversity impacts to either moderate or low. It is recommended that consideration be given to purchasing suitable portions and donating them to the Park, within five years of project approval. Given that there are numerous factors that may impact on what land is actually purchased (including landowner willingness) no recommendation is made at this stage in terms of which portions have to be purchased, but it should be within either of these three target areas. If this quantum of land can be added to the National Park then the overall significance of the loss of Sand Fynbos for this project could be reduced to LOW negative.
• There must be a north-south corridor at least 300 m wide through the project area at all times. This corridor will be along the eastern side of Roode Heuvel during years 1-5 of mining and along the western edge of the project site once rehabilitation has been completed, for the remainder of the mine life. This corridor is particularly important in the case of the primary target habitat – Namaqualand Sand Fynbos. This vegetation type has a north – south regional distribution, through the western half of the study area (mainly on Roode Heuvel), and it is part of a largely continuous strip of habitat that runs from northeast of Hondeklipbaai in the north to the Olifants River in the south. Complete severance of this currently largely intact habitat through open cast mining across its width is not desirable from an ecological perspective (Desmet & Helme 2009). The corridors need to be of sufficient width to allow the potential natural movement of most faunal and plant species, and the wider the better in terms of functionality. The corridor will also function as a vital repository of rehabilitation material (seeds) for the post mining phase. This will significantly enhance rehabilitation success, and will also help limit wind erosion. A large part of the Sand Fynbos in the area also occurs on the property to the west of Roode Heuvel, owned by and currently being prospected by Exxaro, which suggests that mining may take place here at some stage in the future, severely compromising the corridor potential in the region. It is thus essential that both operations take corridors into account on their own land in order to avoid total loss of the north – south link in this area. The position, shape and extent of the corridor/s are fairly flexible, but need to be worked into mine planning.

• A significant buffer should be maintained along the part of the study area that borders the existing edge of the Namaqua National Park (northwestern corner of Roode Heuvel). Ideally this should be at least 5,000 m wide, and wider according to the Mining and Biodiversity Guidelines; but in reality this is not likely to be more than 3,200 m. This could serve a triple purpose as the main north – south ecological corridor, and would also conserve a large part of the northern Sand Fynbos area with at least 15 plant SCC.

• Primary processing takes place on or near site and involves washing with seawater. This will lead to a significant increase in the salinity of the soil returned to the areas requiring rehabilitation. This will compromise the rehabilitation potential of Namaqualand Sand Fynbos (Desmet & Helme 2003), which prefers acidic soils. Studies at Namakwa Sands have found that high soil salinity poses a challenge during rehabilitation (reducing species diversity), especially if rainfall is below average (and natural leaching is thus reduced). It is therefore recommended that topsoil of at least 300 mm depth (0.3 m) be set aside for rehabilitation purposes, as this will then retain its original pH, and will also include the bulk of the soil stored seedbank (including most of the bulbs, which are more deeply buried than most of the seeds). Furthermore, the top 2 metres of tailings returned to the surface after mining must be sand tailings only, as any clay will assist in the retention of salt.

• All livestock should be removed from the total authorized mining area and a 500 m buffer area around it (except where this is not feasible due to land ownership) from six months after any initial authorisation, throughout the life of the mine, and for at least ten (10) years after primary rehabilitation is completed on any particular block. Livestock preferentially eat the most tender flowering parts (including seeds), and also target annuals, such as grasses and herbs. The latter are often pioneers, which would normally be the first to stabilize a disturbed area and provide habitat for the longer lived shrubs. Thus, by removing livestock one maximizes the available seed bank, and hence the rehabilitation potential. It is the cheapest and easiest way of enhancing rehabilitation success.

• Livestock should, for the same reason, also be removed form the total project area (which will presumably be owned by the applicant) for the entire life of mine.
• The coastal seawater intake should be located at either Gulley Intakes 2, 6 or 7, which are of the lowest sensitivity and do not support any plant SCC. If neither of these is suitable for any reason there are also many potentially suitable gulleys with low sensitivity adjacent vegetation just north of Island Point (Gulley Intake Kmm5), and the botanist can advise on these. Intake site Kmm4 does support a population of a single plant SCC, but the area has good rehabilitation potential and could be considered for development. Intake sites 1 and 3 contain high sensitivity botanical elements and should not be further considered.

• The seawater pipeline should be an above ground pipeline if possible, as this entails significantly less disturbance than an underground pipeline. Frequent crossing zones should be incorporated to allow stock and wildlife movement. At this stage the exact route of the pipeline is not known and thus no further mitigation can be suggested.

• Botanical input into the mine EMP is required, and specifically in terms of site rehabilitation and management of the surrounding areas that will not be developed.

• All additional mitigation requirements (such as Search and Rescue for certain SCC, and alien invasive vegetation management) noted in the vegetation assessment should be considered mandatory, as they are considered reasonable and feasible, and have been factored into the assessments.

8.4 FAUNAL IMPACT ASSESSMENT

The project area as a whole is relatively pristine, but the effects of stock and crop farming are evident in places. Large tracts of Namaqualand, however, are still fairly intact in spite of general overgrazing. There are numerous birds, reptiles and mammal species which are either endemic to the project region or are of conservation concern. Of the 57 terrestrial mammal species which may occur on site, 10 are considered to be species of special concern (SCC). Fourteen (of a possible 33) avian SCC were recorded on site. Few species were recorded during the site visit but this does not necessarily mean that other species do not occur at the project site.

At this stage three features of particular sensitivity and of conservation concern have been identified in the project area. These features are:

• Drainage lines and rivers;
• Coastal Duneveld and Sandy Strandveld;
• Steep slopes, rocky areas and areas with shallow soils.

The Groen River and Bitter River occur on either side of the project areas. These river areas are identified as critical biodiversity areas and must be conserved and maintained as far as possible. As these water courses are not particularly close to the proposed footprint of the mine, they are not likely to be directly affected by it, and their functioning should remain relatively intact, provided that there is no abstraction from these catchments.

Several small drainage lines are present in the eastern section of Leeuvlei. These temporary wetland areas also constitute process areas even though they are seasonal, often dry, and do not have specific wetland vegetation. These areas need to be avoided, and will require adequate buffers.

Various components of developing and operating the mine site will cause faunal biodiversity loss directly or indirectly due to varied impacts. These include loss of vegetation that supply food or shelter, noise pollution, potential chemical pollution as well as loss and fragmentation of habitat. Many of the impacts assessed in the faunal report can be mitigated to a lesser significance. Noise pollution, however, is unlikely to be mitigated due to heavy and
continuous vehicle movements and plant machinery use. In addition, climate change is likely to have a major negative influence on the biodiversity of the Succulent Karoo, given the specialized habitat requirements of the numerous local plant endemics and may have a further negative impact on the faunal biodiversity.

The proposed transport linkages and associated infrastructure will all cause additional habitat loss and fragmentation, over and above the mining area. The greatest impact on habitat loss and fragmentation will be associated with the mining pit, internal access roads, the transport of product by road to the N7 and less so with the proposed pipelines. The location of the proposed infrastructure for the MSP lies in a region of intermixed sand fynbos and sandveld. Although relatively few terrestrial vertebrates are associated with this habitat, sand fynbos harbours many SCC as outlined in the faunal assessment.

Developments such as mines and their associated roads create suitable corridors for the introduction of alien species. The threat presented by alien invasive fauna is limited. The deliberate introduction of alien species should be prohibited, unless a full environmental assessment is undertaken and control methods for escapees detailed. Eradication programs of problem animals should be undertaken in consultation with conservation authorities.

Impacts of the proposed developments on the surviving fauna will vary for the different groups. Amphibian diversity may be impacted by possible small scale, localized changes in water flow dynamics due to storm water flow. However, most frogs in the region are widespread and have rapid colonizing abilities. The reptile fauna comprises some species relatively tolerant of agricultural development. All reptile and amphibian species are well protected elsewhere (e.g. Namaqua National Park) and need no further special treatment.

Birds are by far the most speciose vertebrate component in the region, but many species are tolerant of low to medium disturbance. The remaining mammal diversity in the region consists of small mammals. With the exception of introduced rodents and bats, most mammals in the region are poor colonizers and require protected habitats to maintain viable population levels. Due to disturbance resulting from habitat loss there will also be an increase in animal mortality as animals move away from the region.

No fatal flaws were identified in the faunal assessment. If current land use practices continue, there will be a moderate loss of faunal biodiversity and habitat. If this project goes ahead, it allows the opportunity to mitigate high and moderate impacts to that of moderate and low significance.

The following mitigation measures are recommended.

- Rocky outcrops in the northern Klipkop shrubland area should be avoided as this is a sensitive area for all reptile species.
- Avoid clearing or damaging drainage lines, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas. Limit the removal or damage to riparian vegetation surrounding the construction of the pipeline across the Groen River.
- Rivers and smaller drainage lines must be protected and/or rehabilitated if damaged.
- Maintenance of water quality and flow dynamics is required to prevent indirect impacts on drainage areas.
- All reptile and amphibian species are well protected elsewhere (e.g. Namaqua National Park) and need no further special treatment.
• Significant ecological corridors need to be maintained between all identified areas of High sensitivity, and this is particularly important in the case of the primary target habitat – Namaqualand Sand Fynbos. This vegetation type has a north – south distribution, through the western half of the study area, and it is part of a largely continuous strip of habitat that runs from Hondeklipbaai in the north to the Olifants River in the south. Complete severance of this currently largely intact habitat by means of open cast mining across its width is not desirable from an ecological perspective (Desmet & Helme 2003), and thus ecological corridors through this habitat (running mostly north to south) must be drawn up by the botanical specialist. The corridors need to be of sufficient width to allow the potential natural movement of faunal and plant species, and the wider the better in terms of functionality. These corridors can and will also function as vital repositories of rehabilitation material (seeds) for the post mining phase, thus significantly enhancing rehabilitation success, and they will also help limit wind erosion.

• A significant buffer (recommend at least 1-2000m wide) needs to be maintained along the part of the study area that borders the existing edge of the Namaqua National Park. This could serve a dual purpose as one of the main north – south ecological corridors (see Vegetation report).

• As far as possible, limit disturbance to areas of high faunal sensitivity.

• Ensure that representative areas of high and moderate ecological sensitivity remain intact, and that measures are put in place to manage the biodiversity of these “set aside” areas.

• Protect abiotic habitats, such as rock outcrops, which shelter many reptile species.

• Prohibit exploitation of SCC, e.g. tortoises and chameleons, by mine employees.

• Prohibit the trapping and killing of animals for the production of bush meat, by mine employees.

• Educate mine staff about the necessity of protecting snakes and other reptiles.

• Undertake habitat clearance in a systematic way to allow birds and other faunal groups to move to undisturbed areas.

• The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines.

• Road designs should incorporate, where possible, underpasses and culverts that allow the movement of animals.

• Where possible the road traffic on site should be limited after dark, as much of the surviving fauna is nocturnal, e.g. bats, most snakes, small rodents, amphibians, etc.

• Limit transport of product to and from project on the main provincial road as far as possible after dark.

• Vehicle speed should be limited to the lowest possible speed on site, and should not exceed 40km/h.

• Drivers should be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.

• All specific project actions associated with construction, access roads, borrow pits and cut-and-fill construction must avoid sensitive habitats as far as is practicable.

• Natural drainage should be maintained and the silt loads into rivers, streams and wetlands must stay within normal limits.

• Roads should be watered down or binders should be used during high wind conditions.

• Road speeds in sensitive regions e.g. near rivers, across drainage lines, and during extreme dry climatic conditions, should be limited to curtail dust production.

• Any material to be transported to and from project site should be done by covered trucks or containers to avoid contamination to the surrounding area.
8.5 ESTUARINE ASSESSMENT

The low-level road crossing, fences, agriculture and development in the floodplain has decreased the health of the Groen Estuary. The present ecological status is a 'B', however the estuary is in a protected area (Namaqua National Park) and should therefore be restored and maintained in the best possible state of health. The estuary should therefore be maintained in an 'A' or Best Attainable State. In order to maintain the estuary in its present state, Thresholds of Potential Concern need to be set. Should these thresholds not be met the health of the estuary due to hypersalinity will decline and the ecosystem services it provides to this harsh region will be impacted. There are three main issues of concern:

- The proposed mining activities upstream of the estuary could potentially lead to an increase in groundwater salinity. However, there is no evidence of any hydrological connection between the mining site and spring. In addition, any potential passage of contaminated water across the 10 km distance will exceed hundreds of years on a temporal scale, as well as being subject to long-term dilution effects (SWS, 2015). Consequently, any potential increase in salinity at the head of the estuary is unlikely, but in the event of any flux of such water, salinity will increase in the upper estuary, but probably not beyond threshold levels of estuarine organisms that could potentially occur there.

- Mapping of habitats suggests that the area of estuarine open water appears to have decreased over past decades (supported by anecdotal statements made by local residents). This may be related to borehole extraction of water, at least in part, by farming practices and for other purposes (see Bickerton, 1981 and van Niekerk & Turpie, 2012), potentially leading to reducing spring water discharge. An immediate and important management objective would be to protect the freshwater spring in the upper reaches (quality and quantity) and to ensure that salinity in the area remains around 10 ppt or less. Although reeds tolerate higher salinity values (up to ca 20 ppt), current levels provide a buffer protection zone. Of added concern is the prediction that rainfall will decrease along the west coast of South Africa (see CES, 2015) and that the Groen Estuary will become progressively drier and therefore more inhospitable to biota in the future.

- Thus, future changes of the Groen Estuary are potentially linked to both natural and anthropogenic influences.

As stated in the EIA report it is essential to conduct a pre-mining baseline assessment of salinity levels and the general biological state of the estuary, and to monitor these variables on a regular basis. The previous study (Bickerton, 1981) was conducted over 35 years ago and the present study was undertaken during an extreme hypersaline event. Different scenarios between a major flood (open mouth and freshwater dominated) and the present state (closed mouth and extreme hypersalinity) are lacking, primarily with respect to biotic response along the salinity continuum.

It is suggested that:

1. Permanent probes are deployed to continuously measure salinity in the upper reaches of the estuary.
2. Regular measurements of salinity and other physico-chemical characteristics are conducted along the length of the estuary (quarterly).
3. Vegetation mapping and biological surveys are needed to check for health of brackish wetlands and salt marshes (variable – linked to the rate of salinity change in the lower estuary).
4. Bird counts of the estuary should continue (quarterly).
5. With respect to the proposed mining operation, permanent salinity probes need to be deployed between the mining site and the head of the estuary to monitor any potential future change in groundwater salinity.
Points 1 to 4 should be the responsibility of SANParks, while Point 5 should be addressed by Zirco. To better understand the dynamic nature of the estuary and determine biotic response to salinity changes, it is essential that monitoring of the estuary be operational following the next flood. This will also establish the degree of estuary flushing and duration of various salinity conditions following mouth closure.

8.6 MARINE ASSESSMENT

The construction of a gully seawater intake system for the Kamiesberg Project at either of the gully sites proposed in the assessment will have a variety of impacts on the marine environment. These include the potential release of debris into the marine environment during and immediately following construction, the entrainment and impingement of organisms during the intake of seawater. The proposed mitigation procedures are well known and have been effectively applied in similar circumstances. If followed the overall effect of the perceived impacts will be significantly reduced.

Based on the results of the field survey, it is apparent that the sheltered gully sites displayed significantly lower biodiversity and abundance of intertidal rocky shore biota in comparison to the open water (exposed) sites – which had significantly greater levels of biodiversity and abundance. Furthermore the benthic biota at these sites is not of great significance in terms of conservation status. This would suggest that perceived impacts of the construction and decommissioning phases of the intake point would be fairly low within any of the proposed gully sites.

A complete analysis of the various alternatives is available in Chapter 7 of this report.

8.7 VISUAL IMPACT ASSESSMENT

The dry sand mining process to be employed in the project area, is a more visible type of mining than deep shaft mining and open pit mining. This is due to the fact that the surface of the mine area is cleared, and the mineralised sand to a depth of up to 20 meters is extracted for processing. This mining is spread out over a large area, whereas with shaft and pit mining it is concentrated to a small surface area (although these mining processes produce large unsightly waste rock dumps). The processed sand is filled in behind the mine path, but unless this is rehabilitated quickly and effectively, it can leave quite an obvious landscape scar. Also, the tall infrastructure that is required in order to separate the minerals via spirals will increase the visibility of the development. The vegetation of the area is very sparse, meaning that the screening effect of vegetation will be rather insignificant.

The most sensitive visual receptors identified, have been those associated with the Namaqua National Park: the accommodation camps and the 4x4 route. The Coastal Section of the Namaqua National Park, acquired in 2008, is located to the west of the mining license area, and actually borders it at one point. The location of the camp sites next to the ocean in all cases, and the 4x4 route which tends to run quite close to the coast, are at lower elevation. The location of the mining area on higher ground that is inland (approximately 150 masl) means that none of the camp sites (excluding Groen River camp site which is about 13 kilometres from the processing area ) will have any views of the mine. It is possible that a very small section of the 4x4 route will have views of a small amount of mine infrastructure, and this is only likely to be the Tailings Storage Facility when it reaches it’s maximum height of 27 meters. Some uninhabited areas on the western border of the park, will have views of up to 20% of mine infrastructure. It will also be necessary for the EIA to take cognisance of the DEA’s strategy for establishing buffer zones around parks. Although the strategy does not have the power to exclude development types, it does seek to promote decision making that will be beneficial to the park.
Some homesteads and non-park related accommodation in the project area will have views of up to 30% of infrastructure, although many will have no views. This is due to their location in the lower lying basins of the Groen, Outeep and Bitter rivers.

In conclusion, it can be said that the visual impact of the mine will not be high. Some surrounding landowners will certainly have views of the mine, but none of them have expressed unhappiness about this and they continue to be engaged via the EIA public participation process. Certain sections of the eastern border of the Coastal Section of the Namaqua Park will have views of the mine, but none of the camp sites (excluding Groen River) and only small sections of the 4x4 route.

The following mitigation measures are suggested:

- The construction contractor should clearly demarcate areas for roads, clearing and stockpiling so as to minimise site disturbance.
- To make space for stockpiles necessary during the construction phase, consider clearing areas for this purpose that will need to be cleared for mining activities during the operation phase.
- Treat roads to reduce dust emissions.
- Maintain as much natural vegetation as possible between the mine buildings and the edge of the mine area.
- Non-reflective paint should be used on all buildings and roofs of buildings. Galvanised steel structures should be darkened to prevent glare.
- Rehabilitate areas that have been cleared of vegetation during the construction phase.
- Light fixtures installed should not spill light beyond the mine area, where they are needed for 24 hour mine operation. Direct the light beams downwards, and use blinds as necessary.
- Use timer switches or motion detectors to provide light in areas where light is not needed continuously.

8.8 SOCIO-ECONOMIC IMPACT ASSESSMENT

From a community perspective, several small towns have been assessed as possible labour-sending communities. In general, the mine site is not in close proximity to any of these communities. Several interest groups are thus involved and will have different viewpoints and issues with the development in relation to how they will be affected. The interest groups include:

- The direct Project-Affected Farmers (PAFs) in and adjacent to the mine site,
- The direct PAFs falling within the pipeline’s servitude line; and
- The possible labour-sending communities.

The PAFs are directly affected by the project since their land will be acquired. Several issues and impacts have been identified in the social impact assessment and Chapter 9 of this report pertaining to the farm-owners who will lose their land. Most of these relate to land acquisitioning, which will affect the economic viability of remaining farm titles (should some farmers decide to remain on their land). As sheep farming is one of the major income sources for these farmers, many owners were concerned that the mine would reduce their income-earning capacity. This situation is compounded by the fact that many owners want to remain resident on their land, and do not see compensation as restoring their livelihoods. In mitigation, however, is the fact that the proponent will compensate landowners above the
land’s commercial value. It is therefore argued that, from an economic viability perspective, compensation should allow farmers to either invest in their remaining land, or buy alternative land. This is therefore seen as having a positive impact on affected farmers.

Many farm-owners’ land has been in their families for several decades. This reinforces their attachment to the land from a cultural and individual perspective. It is therefore not surprising that impacts related to altering owners’ sense of land attachment have been listed as highly significant. This is the most significant impact rated in the social impact assessment, as there are no mitigation measures for this impact. The reality is that land will be altered.

A different set of impacts have been recorded from a labour-sending community perspective. As these communities are relatively far from the proposed mine site, issues relate more to Local Economic Development (LED), employment provision and a concern over an influx of job-seekers and outside workers. The data reveals that the project is highly desired from employment benefits and community development perspectives. No community member was opposed to the project.

However, issues pertaining to an influx of job-seekers and outsider workers have been analysed closely, and influx and community expansion are listed as significant impacts. In particular, there is a concern amongst community members that social pathologies in the communities, such as substance-abuse, risky sexual behaviours, crime and intra-household violence might increase in response to community expansion and the influx of ‘outsiders’. These are major impacts for which several mitigation measures have been proposed. For example, it is recommended for the proponent to develop a Corporate Social Responsibility (CSR) Programme subsequent to a community needs analysis. Such a programme could include community projects, such as sports programmes or the upgrading of community playgrounds, for example.

In conclusion, the specialist is of the opinion that the project could ultimately uplift communities, which are in need of employment, skills transfer and learnership opportunities. Through the mine’s Social and Labour Plan (SLP), the KLM would also be supported with LED projects and possibly basic social service provision. With regard to the affected farm-owners, further discussion and engagements are needed to resolve further land acquisition issues, especially if one or more farmers desire to remain living on their land.

8.9 ECONOMIC ASSESSMENT

According to the Economic Assessment, it is considered most likely that the proposed project would achieve an overall positive impact provided the financial projections of the applicant prove reasonably accurate and provided adequate mitigation measures are instituted including rigorous rehabilitation. It would present a significant opportunity for increased economic activity and associated job creation in the local area and region.

The achievement of a net benefit at a local and sub-regional scale would be particularly dependent on extensive mitigation as the key societal risks of the project would be felt at these spatial scales. Significant attention will need to be paid to mitigating air quality, visual, noise, water, social and botanical impacts as these have the potential to result in highly significant economic impacts on tourism, surrounding land owners and on the provision of ecosystem services in general. An appropriate biodiversity offset which is integrated into the Namaqua National Park also has the potential to reduce impacts on ecosystem services including tourism.
8.10 HEALTH IMPACT ASSESSMENT

The proponent need to consider two major factors related to community health. The first is the existing health needs of the community. These existing health needs are present regardless of the proposed project and represent the current health status of the community. Second, the proposed project will need to consider the future health impacts that it (the proposed project) may exert on the community.

This health impact assessment outlines the significant changes on the health status of the local community that may be caused by the proposed project. An attempt has been made to give a comprehensive outlook of the baseline health status of the proposed project area (where possible) (available in Chapter 4 of this report) and also to understand and prioritise future project health impacts (available in Chapter 9 of this report), based on the available evidence. Mitigation and management measures have been recommended and it is advised that these measures are incorporated into the overall environmental and social management plan for the project.

8.11 PHASE 1 HERITAGE ASSESSMENT

The baseline heritage assessment has captured a good record of the archaeological heritage present in the Rood Heuvel and Leeuvlei application area. Sites of particular importance include rare wind deflated sites with stone implements, decorated pottery, marine shellfish and ostrich eggshell, all attributes of domestic campsites. Sites with similar decorated pottery (i.e. vertical incisions, or punctuations) appear in the archaeological record after 1300 years ago in the Knersvlakte and Richtersveld (Orton 2012; Webley 1997). Historical records show that Governor Simon van der Stel travelled to Namaqualand in 1685 and found the first Namaqua kraals north of the Groenrivier (Webley & Halkett 2012). It is tantalising to suggest that the Leeuvlei and Roode Heuvel encampments may be remnants of some of these Namaqua kraals.

It is maintained that outcroppings of quartz in the Leeuvlei application area were targeted by Stone Age people as a source of raw material. As such quartz quarries are considered significant (heritage) features in the landscape. Quarry sites provide evidence of stone tool transport and also raise questions about group size and organization of activity among hunter-gatherer groups. They cannot be seen in isolation from the (above) wind deflated sites/campsites which are the repository of the quarried stone and finished artefacts.

The heritage assessment has also recorded well preserved archaeological deposits at the coast (shell middens and scatters of shellfish). Most of these scatters are probably the remains of brief occupations, where small quantities of food debris were discarded, perhaps from one or two meals. Other sites may have been more substantial but have been ravaged by wind and blowing sand, leaving only a light scatter of weathered shell fragments (Orton 2007).

Large numbers of tools were also recorded in a wind deflated site south of the Groenrivier, in the pipeline route, while nearby outcroppings of nearby quartz were likely exploited by hunter-gatherers as a source of raw material.

The nature, type and distribution of archaeological sites in the study area reveal a dynamic use of pre-colonial landscapes by Later Stone Age hunter-gatherers and Herders.

The results of the heritage assessment indicate that the proposed activity (i.e. mining of mineral sands) and associated infrastructure (mineral separation and primary concentrator plant, tailings dam, airstrip, offices, workshops and stores, for example), will not have an
impact of great significance on the archaeological heritage, as these are expected to be limited.

The position of the gulley intake alternatives (Kmm4 & Kmm5), pump station and pipeline at the coast will impact negatively on archaeological heritage (shell scatters & shell middens).

The sea water intake pipeline (Kmm5) to the desalination plant on Roode Heuvel, will impact negatively on a wind deflated site (Site 136) and outcropping of quartz (Site 138) on the southern bank of the Groenrivier.

In archaeological terms, no fatal flaws have been identified and any sites that cannot be avoided could be easily mitigated if required. Mitigation also provides opportunities for better understanding pre-colonial land use patterns in this region of Namaqualand.

The following recommendations are made, which are subject to the approval of the South African Heritage Resources Agency (SAHRA).

**Roode Heuvel**

- Archaeological remains in wind deflated sites (Sites 328, 096, 097, 098, 086, 088, 090, 091 and 092, refer to Figure 11.3 for positions) must be mapped (on a grid system) prior to any mining or mining related activities commencing in that particular area. Sands should also be sieved for the presence of sub-surface material. The remains must be collected, curated and written up and a report presented to the South African Heritage Resources Agency (SAHRA). No archaeological material may be collected or damaged without a permit issued by SAHRA. It is acknowledged that some areas in which scatters of tools and organic remains occur (for example Site 096 on Brandkop) may not be mined at all, so archaeological mitigation will likely not be required.
- Should any unmarked human remains, or ostrich eggshell caches for example, be uncovered or exposed during mining or associated activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

**Leeuveli**

- Archaeological remains in wind deflated sites (Sites 025 and 050-055 refer to Figure 11.3 for positions) must be mapped on a grid system prior to any mining or mining related activities commencing in that particular area. Sands should also be sieved for the presence of sub-surface material. The remains must be collected, curated and written up and a report presented to SAHRA. No archaeological material may be collected or damaged without a permit issued by SAHRA. It is acknowledged that the above sites may not be mined (contingent on a final mine plan), so archaeological mitigation will therefore not be required.
- A Heritage Management Plan (HMP) must be implemented in order to protect important archaeological sites that fall within ‘non-mining areas’, during the Construction and Operational Phase of the project. The HMP must be included as part of the Environmental Management Plan (EMP) for the proposed project. The HMP must be submitted to SAHRA for approval.
- A buffer of 5m must be established around outcroppings of quartz (Sites 101, 033, 037, 041 and 088). Alternatively, these sites must be fenced off. Fencing must be done in consultation with and under the supervision of the archaeologist.
• Should any unmarked human remains or ostrich eggshell caches be uncovered or exposed during mining or mining related activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Att: Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

Proposed seawater intake, pump station and pipeline – Kmm5

• Shellfish deposits (Site 095) at the sea water intake must be sampled. This should take the form of a series of 1m x 1m excavations in order to test the significance and extent of the archaeological deposits. Shellfish and bone must also be collected for dating. Should significant sub-surface deposits be encountered during test excavations, a larger sample will need to be rescued.

• Scatters of shellfish (Sites 096-103 & Sites 105-115) in the pipeline route, and between the sea water intake and the pump station (Sites 277-279, Sites 283-286 and Site 296) must be sampled using a sampling strategy designed by Dr Jayson Orton for ephemeral sites of this nature. This will entail more detailed visual recording, sub-surface sampling (i.e. sieving), and collection of shellfish (for dating) and archaeological material. Such studies have shown an improved knowledge of pre-colonial landscapes.

• Scatter of tools (Site 136) in the wind deflated site in the pipeline route south of the Groenrivier must be mapped on a grid system. Sand must also be sieved for the presence of sub-surface material. All the remains must be collected, curated and written up and a report presented to SAHRA. No archaeological material may be collected or damaged without a permit issued by SAHRA. Alternatively, the pipeline must be moved to avoid this important site.

• Outcropping of quartz (sites 138 and 139) alongside the pipeline must be investigated. This will entail more detailed visual recording, mapping and collection. The material must be written up and a report presented to SAHRA. No archaeological material may be collected without a permit issued by SAHRA. Alternatively, the pipeline must be moved to avoid this important site.

• Should any unmarked human remains or ostrich eggshell caches be uncovered or exposed during excavations for the pump station for example, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resource Agency (Att: Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by a professional archaeologist.

Proposed seawater intake, pump station and pipeline – Kmm4

• Scatters of shellfish (Site 273, Sites 233, 236 and 237, Sites 244 and 245, Sites 250-255 and Site 261) in the pipeline route, and scatters of shellfish between the sea water intake and the pump station (Site 229 and Site 272) must be sampled using a sampling strategy designed by Dr Jayson Orton for ephemeral sites of this nature. This will entail more detailed visual recording, sub-surface sampling (i.e. sieving), and collection of shellfish (for dating) and archaeological material. Such studies have shown an improved knowledge of pre-colonial landscapes.

Sabies

If prospecting rights are approved, the area known as Sabies must be assessed for archaeological heritage ahead of any mining or development activity.
8.12 AIR QUALITY ASSESSMENT

From the baseline air quality assessment and atmospheric dispersion modelling the following conclusions were drawn:

- The dominant wind-field is from the south (south-westerly) with occasional flow from the northerly sector. Wind speeds are moderate to high with few calm periods.
- Baseline emission sources are likely to be fugitive predominantly from windblown dust, and from vehicle dust entrainment on unpaved roads.
- The proposed mining operations and processing plant are not likely to result in non-compliance with NAAQS for PM$_{2.5}$, SO$_2$ or NO$_2$ in the short-term.
- Exceedances of the daily PM$_{10}$ NAAQS (i.e. more than 4 days per year with average daily concentrations in excess of 75 μg/m$^3$) were simulated to be localized near the unpaved district road; however a watering programme or paving of the road surfaces will be effective in minimizing the area of impact.
- Dustfall rates are likely to exceed the National Dustfall Regulation standard for residential areas outside of the Prospecting Right boundary, even if emissions were mitigated through a watering programme, mainly as a result of vehicle entrainment. Further mitigation through paving the road surfaces is recommended.

8.13 WASTE ASSESSMENT

Based on the available project description and supplementary information sourced from a variety of sources, it was possible to assess the likely impacts associated with the management of waste streams from the proposed Kamiesberg Project in South Africa. The project locality is relatively very poor and the knowledge amongst local community members of the implementation of the National Waste Management Strategy (DEA, 2011) is expected to be limited. As such, the developer should employ measures to effectively manage the waste generated from the project in order not to contribute to poor waste management.

A total of 13 impacts were identified and of these, with mitigation, 11 were considered to be of LOW negative significance and one of MODERATE negative significance. One impact was considered beneficial and of Moderate significance with mitigation. However, due to the potential long-term nature of waste-related impacts, it is essential that the developer adhere to national legislative requirements and international best practice with regards the management of all waste streams. While a number of specific mitigation measures have been included in the document, further detailed guidance on the management of key waste streams is provided in the documents referenced in the waste assessment.

The following recommendations are included in the assessment:

- All waste streams should be managed according to the waste management hierarchy in accordance with NEM:WA No.59 of 2008 and the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, 3rd ed. (DWAF, 2005a). This specifies that wherever possible, production of wastes should be prevented or minimised at source. Where prevention or further minimization is not possible, wastes should be re-used, recycled and then disposed of responsibly so as to minimise impacts to the environment. Further guidance on the management of waste streams is provided in the IFC General EHS Guidelines (2007a) and the IFC EHS Guidelines for Mining (2007b). In the event that there are no national standards available, the proponent must comply with internationally recognised standards developed by international organisations such as the IFC. In the case where there are several standards available for use, the proponent must provide justification for the choice of use, other than the use of the most stringent.
Separate assessments, including groundwater and air quality assessment as well as engineering landfill design and specifications would be required for the construction and licensing of the landfill site. The landfill design would have to be in accordance with the Minimum Requirements for Waste Disposal by Landfill, 3rd ed. (DWAF, 2005b).

Due to the local situation as per the remote location of the project site and relevant legislation, it is recommended that the proponent establish a non-hazardous waste disposal facility on the site. Furthermore, practical options will need to be considered for the management and disposal of hazardous wastes. These would be to either develop a dedicated and specially-designed hazardous waste cell within the new on-site landfill or, alternatively, to construct a bunded and secure facility for temporary storage of hazardous waste on site until such time as it can be transported off-site for safe disposal.

**8.14 TRAFFIC AND TRANSPORT ASSESSMENT**

The risks and impacts related to project-generated traffic during construction and operation of the mine were identified as:

- Increased traffic on DR2938;
- Increased risk of vehicle collisions and personal injuries;
- Increased dust generation; and
- Increased traffic and disruption of traffic flows on the N7 highway, and on provincial roads between the N7 and the port at Saldanha.

An additional construction-phase impact was identified as the transport of large items of equipment requiring abnormally large vehicles.

The most significant impacts relate to project-related traffic using the DR2938 to access the mine site from the N7 highway, a distance of about 51 km. This road is currently unpaved, and is used to access farms and the coast at Groenriviermond. The impacts are most significant during the operational phase, when large volumes of mine product will be transported every day, by heavy, multi-axle vehicles, from the mine to the N7 en route to the port at Saldanha.

There will be traffic-related impacts on the N7 and the provincial roads, but these roads are designed for large volumes of traffic, and are already trafficked by heavy goods vehicles. Available data indicates that project-related traffic will not significantly affect existing traffic flows.

Two impacts (one for construction and one for operation) were rated as High without mitigation, and one (operation) was rated Very High without mitigation. With diligent and sustained implementation of mitigation measures all identified impacts can be reduced to Moderate or Low.

If the project does not proceed – the No-Go Alternative - there will be no increase in traffic on DR2938, the N7 highway or provincial roads between the port at Saldanha and the N7, and no project-related impacts in respect of traffic and transport.

With regard to cumulative impacts the Frontier Rare Earths mine at Zandkopsdrift, situated some 35 km south-east of the Kamiesburg project, is expected to commence production in 2015. The annual production from the mine, about 20 000 tonnes of mixed rare earth carbonate to be transported to a separation plant at Saldanha, is very small compared to the annual tonnage of product from Kamiesberg – approximately 570 000 tonnes - and the
cumulative impact of traffic from the two projects on the N7 and provincial roads is expected to be negligible.

Measures proposed to mitigate the identified impacts are summarised as follows:

**DR 2938**

- Develop and implement a Traffic Management Plan for construction and operation.
- Develop and implement an Emergency Preparedness and Response Plan for construction and operation, including provisions to deal with traffic accidents, particularly accidents involving personal injuries. All drivers must be made aware of the procedures to be followed.
- Establish and rigorously enforce a speed limit appropriate to the design and construction factors and characteristics of the road (such as width, horizontal and vertical alignment, grade, sightlines and surfacing material) for all project-related traffic.
- Erect speed limit signage at regular intervals along the road, and other appropriate warning signage, including at intersections with farm access and other roads.
- Prohibit heavy vehicle trips between 10pm and 6am unless it is absolutely unavoidable. Vehicle trips between 10pm and 6am should be minimised, concomitant with operational requirements.
- Schedule deliveries by heavy vehicles to avoid the formation of convoys. Sufficient distance must be maintained between heavy vehicles to allow light vehicles to overtake safely.
- Provide regular information to the local community and individuals on the volumes of traffic particularly heavy vehicles, anticipated on the road during construction and operation.

**N7 and provincial roads**

- Heavy vehicle deliveries and vehicle returns during construction should be scheduled to avoid, as far as possible, morning and evening periods where roads pass through urban areas, or other stretches known to carry large volumes of morning and evening traffic. (It is acknowledged that this will not be practicable during operation, when materials haulage will take place for 10 hours a day.)
- Extreme care must be exercised when travelling through urban areas (Piketburg on the N7; Moorreesburg and Hopefield on the provincial roads), especially during morning and evening peak hour traffic, and speed limits must be strictly observed.
- The formation of convoys must be avoided.
- Sufficient distances between heavy vehicles must be maintained to allow light vehicles to overtake safely.
- An Emergency Preparedness and Response Plan must be developed to deal with accidents and incidents en route.

**Abnormal loads**

- Arrangements must be made with the provincial traffic authorities – Western Cape and Northern Cape - for abnormal loads, and their requirements strictly adhered to.
- Speed limits must be strictly observed.
- As far as possible deliveries of abnormal loads should be scheduled to avoid periods when significant volumes of construction traffic are making deliveries to site.
Driver and vehicle management

- All drivers must be properly licensed for the class if vehicles they drive.
- All drivers must be made aware of the provisions in the Construction Emergency Preparedness and Response that deal with traffic accidents, particularly accidents involving personal injuries, of the procedures to be followed.
- All aspects of all vehicles must be in a good state of repair at all times, especially the exhaust system.
- Vehicle horns / hooters should be used only when absolutely necessary.
- A mechanism should be established, as part of the Stakeholder Engagement Plan, for recording traffic- and transport-related complaints from residents.

Road upgrades

- District Road DR2938 must be upgraded to ensure that it is wide enough to allow two heavy vehicles to pass safely. The carriageway may need to be widened in places, and realigned at sharp bends (particularly where the road crosses the Groenrivier). Construction work on the road upgrade must be done in such a way as to minimise disruption to local traffic.
- The upgrade of DR2938 must include measures to reduce the generation of fugitive dust, preferably by means of a bituminous sealing / wearing course, but otherwise by regular and frequent application of dust suppressant and/or water.
- To the extent practicable, concomitant with the requirements for durability and skid resistance, the surface of DR2938 should be designed to minimise rolling noise.
- The N7 at its intersection with DR2938 must be upgraded as required by SANRAL, which may include the construction of an auxiliary acceleration lane south from the intersection, and upgrading the DR2938 bellmouth entrance.

8.15 RADIATION ASSESSMENT

The purpose of the radiation specialist report was to present a preliminary qualitative radiation impact assessment as input into the ESIA process for the Kamiesberg Project.

In general, the way in which members of the public may be exposed to radioactivity from a specific operation, facility or activity, is evaluated through the development of site-specific public exposure conditions. Since the proposed project is still in early stages of planning, very little site-specific information is available that can be used as basis to define exposure conditions and assess the radiation safety. The scope of the assessment is therefore limited to a qualitative description of situations that could lead to public exposure conditions, in order to highlight those aspects that should be included in a comprehensive site-specific radiological public safety assessment. Consequently, unlike the other specialist studies, this specialist report does not include a detailed assessment, based on a standardised impact assessment methodology, of the specific radiation-related impacts potentially associated with the project radiation. Similarly, the identification and description of specific mitigation measures is also considered premature at this early stage. A comprehensive baseline radiation study and mitigation measures will, however, need to be included in the Authorisation Change Request (ACR) submission to the National Nuclear Regulator (NNR). Approval of this ACR will be required before operation of the mine or processing facility.
Based on the description of the development, the proposed mining and mineral processing operations will have the potential to alter the radiation background. Although specific information required for the characterisation of the sources or pathways (source-pathway-receptor analysis) is not yet available, one can assume that and water airborne radionuclides will be released from the operational facilities of the Kamiesberg Project into the environment through the atmospheric and groundwater pathway. Depending on the radioactivity concentrations of the material released, as well as the nearby human behavioural conditions, one can expect a radiological impact to members of the public. Although the focus of the study is the impact on humans, there is sufficient demonstrated evidence, which shows that by protecting humans against exposure to ionising radiation according to dose limits, non-human species are also provided adequate protection.

The impact through the atmospheric pathway is expected to be highest close to the facilities and generally decreases to insignificant levels at distances of 5 to 10 km from the site. The radiological impact through the groundwater pathway tends to be limited, mainly due to slow leaching and subsequent groundwater flow rates to receptor points. The potential radiological impact through the groundwater pathway tends to be visible during the post-closure period (hundreds of years after closure). It is expected that the contribution of the Kamiesberg Project to a total effective dose to members of the public will be below the dose constraint of 250 μSv per annum, which is well below the dose limit of 1,000 μSv per annum. Given that the Kamiesberg Project will be the only operating mine in the area, the dose limit in all likelihood will apply.

The regulatory framework defines criteria for the radiation protection of workers, which generally allows much higher level of radiation exposure than to members of the public. Within these criteria, workers are protected based on the activity that will be performed within specific work areas, and the associated total effective dose expected for that area. This allows for the classification of work areas into uncontrolled, supervised, controlled or restricted. Specific radiation control measures apply for each area classification. It was concluded that the mining area would in all likelihood be classified as an uncontrolled area, while the processing plant will be a supervised area. What is important to note as far as worker radiation exposure is concerned, is that workers will be exposed, but that the level of exposure can be controlled and managed to ensure compliance with regulatory limits for the protection of workers.

A comprehensive radiation baseline survey and site characterisation will have to be performed before operation commences and this, together with specific mitigation measures will need to be submitted to the NNR. It is recommended that the baseline be established at least a year before the operations commence. Continuous monitoring will be required during the operational phase.

8.16 NOISE ASSESSMENT

The impact of the noise pollution that can be expected during the operational phase will largely depend on the number of trucks that use the transport routes per day. Noise pollution is based on two main factors, namely the intensity of the noise and the number of occurrences per day.

The results indicate the following:

- The noise will increase along both transport routes (DR 2938 and N7).
- Community action can be expected if the trucks use the DR2938 during the night.
- The noise from the processing plants will not impact the residents in the noise sensitive areas along the DR2938 due to the distance from the processing plants.

The following is recommended:
a. All vehicles should be fitted with silencers and the use of exhaust brakes along the DR2938 of the transport route be severely curtailed.
b. The speed of the trucks should not exceed 60km/hr along DR2938 until it is upgraded and then should not exceed 80km/hr. This will reduce the noise impact even further.
c. The drivers should receive training in terms of sensitizing them to the noise issues.
d. It is highly recommended that Global Positioning System trackers be fitted to the vehicles in order to monitor vehicle speeds along the routes.
e. The hauling of final product along the DR2938 is curtailed to daylight hours only.

8.17 REHABILITATION ASSESSMENT

The recommended decision is to rehabilitate the entire site to natural vegetation. In doing so, recommendations made in the vegetation specialist report, and the need to establish ecological corridors are important considerations. The overall rehabilitation plan for the mine site is therefore to achieve an indigenous vegetation cover, and to focus the rehabilitation programme on re-establishing the type of vegetation that occurred before mining. The primary focus of the rehabilitation programme would therefore be focused on re-establishing Sand Fynbos. A secondary focus would be to re-establish Standveld in the eastern portions of the area to be affected by mining. The rehabilitation will be facilitated by the presence of various ecological corridors, as these areas will act as seed banks and a possible a source of plants which could be transplanted from these areas. They also support various faunal groups, which play an important role in pollination and seed dispersal.

The rehabilitation programme will need to be guided by the mine plan. Once an area has been mined out, rehabilitation can start shortly thereafter, since mining activities (essentially bulk earth works) will move onto the next parcel of land. Thus, a rolling rehabilitation process can take place, and at the end of the mine life, the area mined in year one will support vegetation close to 20 years old. The sequence of rehabilitation will need to closely follow the sequence of mining. Mining will be initiated in the south-western section of the Roode Heuvel deposit, and will then proceed south-west and then north-west. In the first year of mining a void will be created, as there is no area to backfill. The coarse tailings will be used to construct the walls of an off mine path tailings storage facility (TSF). In year 2 coarse tailings will continue to be used to construct the TSF, and hence there will be no or limited backfilling in years 1 and 2. It is only likely that rehabilitation could begin on the year 1 and 2 parcels (100 and 130ha respectively) after year 2, as sufficient space would be required for mining operations. Thus, it is anticipated that rehabilitation will lag 2 years behind excavation and mining.
9. IMPACT ASSESSMENT

9.1 BIOPHYSICAL IMPACTS

9.1.1 Planning and Design Phase Impacts

Activities associated with the design and pre-construction phase pertain mostly to exploration. As the project has an exploration license impacts associated with exploration and the mitigation of these impacts were included in the Exploration EMP compiled to obtain this license and will therefore not be repeated in this section. Other activities associated with the design and pre-construction phase will not have impacts on the biophysical environment as this phase consists of planning and design of the proposed development, and is done at a desktop level. In some cases site visits need to take place but the impact of these visits is negligible, if any, e.g. photographs, borehole pump testing, botanical and other field surveys, etc.

9.1.2 Impacts resulting from the existing land use / no-go options

i. Impacts on topography and geology

Existing impacts on the topography of the area consists of relatively minor excavations for agricultural purposes and secondary and tertiary roads. These are considered to be negligible. No existing impacts on geology have been identified.

ii. Impacts on soils and agriculture

Currently there are no existing impacts on soils and agriculture. The condition of the soils are pristine and un-impacted on. The only potential existing impact on agriculture is the current drought, however this is a natural feature and cannot be controlled or mitigated.

iii. Impacts on surface and groundwater resources

Surface water

The flow in the rivers in the project area is episodic, following rainfall on the upper parts of their catchments. As a result surface water resources are insufficiently reliable for them to be used to any significant extent in the area, either for domestic use or stockwatering.

The Groenrivier wetland is situated at the mouth of the river in the Namaqua National Park, which is relatively easily accessible from the N7 highway via District Road DR2938. As a result the wetland has been subjected to a number of impacts associated with the formation of a number of informal access routes for watching birds, as well as short hiking trails, all of which have increased the impact of erosion and sedimentation by providing preferential flow routes for surface water draining from the riparian zones into the wetland (Working for Wetlands 2014).

Groundwater

A hydrocensus in the project area identified a total of ten boreholes within the Roode Heuvel project area and within 1.2 km radius of the concession boundaries. All operational boreholes in the area are equipped with wind pumps, which deliver water to storage. Because groundwater is brackish (in general TDS values were between about 3 000 to 8 000 mg/l) most of the water is distributed to livestock watering positions, but some is used for domestic purposes such as washing and cleaning. All drinking water is obtained from rainwater harvesting from the roofs of the farmsteads.
Conclusion:
There are no current activities in the project area that could adversely affect the quality or quantity of surface or groundwater resources.

iv. Impacts on the marine environment

Included below is a list of the various existing impacts in the immediate vicinity of the proposed study site, including the approximate distance of each existing impact from the proposed Zirco gully seawater intake site. Please note that none of these occur within a 10 km radius of the proposed project site.

- Tronnox Namaqua Sands seawater intake - 46km
- Tronnox Namaqua sands outfall - 46km
- Abalone ranching at Kleinzee (Port Nolloth Sea Farms) - 140km
- Oyster farm (Quiryn) and Abalone Farm (De Beers) at Kleinzee - 150km
- Benguela Abalone (Abalone Farm at Port Nolloth) - 204km
- Septic tanks at National Parks rest camp at Groen Rivier - 15km
- Diamond mining (from Olifants River Mouth to Orange River Mouth - both historical and active mining activity).
- Recreational shore fishing (mostly Hottentot, Galjoen, and West Coast Rocklobster in proximity to recreational camping areas and holiday accommodation).

It is therefore unlikely that any of these will impact on the marine environment in the vicinity the proposed Zirco gully seawater intake site.

v. Impacts on flora

To contextualise the potential impacts of the proposed mining project the existing impacts (or status quo), associated with current ecological conditions need to be described in terms of vegetation patterns, structure and composition. This baseline or status quo should be used as the comparison against which project impacts are assessed. The main issues associated with the likely impacts are discussed below:

Issue 1: Loss of Vegetation Type

Impact 1.1: Loss and Degradation of Strandveld (Namaqualand Strandveld)

Cause and Comment

Strandveld is the dominant vegetation unit in the study area (but is only 40% of the mining area) and occurs all along the Groen River basin in the southern sections of Roode Heuvel and Sabies areas. It is also found scattered throughout Sabies, and extends into Leeuvlei. Strandveld merges with Sand Fynbos all along the boundary between the two vegetation types, and in places it can be difficult to distinguish a clear boundary. Degraded Strandveld (181 ha) occurs along the southern section of Roode Heuvel. The cause of degradation is overgrazing, resulting from water points and livestock pens (kraals) which occur along the road, and incidentally along the Groen River.

Significance Statement

The permanent loss of Strandveld (i.e. habitat transformation) is currently negligible, but there is ongoing degradation in places. The magnitude of this varies from place to place, and ranges from very low to moderate. Degradation is definitely occurring and has had a low to moderate, temporary to permanent impact (as removal of grazing pressure will often allow
vegetation recovery). The environmental significance of this unmitigated impact is LOW negative.

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<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
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**Impact 1.2: Loss of Sand Fynbos (Namaqualand Sand Fynbos)**

**Cause and Comment**

Sand Fynbos is the second largest vegetation unit in the project area, and it makes up about 60% of the mining area. It is the dominant vegetation on Roode Heuvel, but also extends into Sabies and Leeuvlei. Sand Fynbos occurs on slightly undulating plains and is often dominated by restios in the dune slacks (troughs), and asteraceous fynbos or restios on the dune ridges. The vegetation on the dune ridges often includes Strandveld elements.

**Significance Statement:**

The permanent loss of Sand Fynbos (i.e. habitat transformation) is currently negligible (although some has occurred in the past), but there is ongoing degradation in places. The magnitude of this varies from place to place, and ranges from very low to moderate. Degradation is definitely occurring and has had a low to moderate, temporary to permanent impact. The environmental significance of this unmitigated impact is LOW negative.

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<td>N/A</td>
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<td>N/A</td>
</tr>
</tbody>
</table>

**Impact 1.3: Loss of Heuweltjieveld (Namaqualand Heuweltjieveld)**

**Cause and Comment**

Heuweltjieveld may be found all along the eastern extent of Leeuvlei, and a large part of north eastern Sabies. It generally occurs on undulating topography of the Kamiesberg escarpment foothills, and comprises largely succulent dwarf shrubland communities amongst a mosaic of heuweltjie communities. Degraded Heuweltjieveld occurs in the south eastern sections of Sabies adjacent to alluvial corridors, where it has been both cultivated and heavily grazed. This vegetation type may be spectacular after good winter rains, when extensive displays of annuals, herbs and bulbs colour the landscape, and at that stage is capable of supporting a high diversity of insects, birds and other animals.

**Significance Statement**

The permanent loss of Heuweltjieveld (i.e. habitat transformation) is currently negligible (although some has occurred in the past), but there is ongoing degradation in places. The magnitude of this varies from place to place, and ranges from very low to moderate.
Degradation is definitely occurring and has had a low to moderate, temporary to permanent impact. The environmental significance of this unmitigated impact is LOW negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
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<td>N/A</td>
<td>N/A</td>
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</tr>
</tbody>
</table>

**Impact 1.4: Loss of Riparian Vegetation (Namaqualand Riviere)**

**Cause and Comment**

Riparian areas consist largely of alluvial corridors of the Groen River in the south and Bitter River in the north, but also include tributary alluvial drainage lines scattered largely in the eastern sections of Leeuvlei and Sabies, commencing in the Kamiesberg escarpment foothills and draining down to the larger river basins. The vegetation varies from Acacia thicket to alluvial halophytic shrublands. These areas serve as important corridors for bird species and are classified as areas of high sensitivity.

**Significance Statement**

The loss of the riparian vegetation has definitely occurred in the past, but does not appear to be ongoing, although degradation is ongoing (due to heavy grazing). Previous and current pressures have had a Moderate to Severe, temporary to permanent impact. The environmental significance of this unmitigated impact is MODERATE to HIGH negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
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</tr>
</tbody>
</table>

**Impact 1.5: Loss of Klipkop Shrubland (Namaqualand Klipkoppe Shrubland)**

**Cause and Comment**

Klipkop Shrubland vegetation occurs as scattered communities surrounding rocky outcrops of the Kamiesberg escarpment foothills. These can be found in central Leeuvlei and northern Sabies. No SCC is likely to occur within the limited extent of this unit in the study area, but the unit was not surveyed extensively, and various SCC are known from this unit nearby.

**Significance Statement**

No loss of the Klipkop Shrubland has occurred within the project area, but minor degradation (due to grazing) is ongoing. Most of this degradation is reversible, and is thus temporary. The environmental significance of this unmitigated impact is LOW negative.
Impact 1.6: Loss of Seashore Dunes

**Cause and Comment**

Seashore Dunes occur as a belt along the coastline, above the high tide water mark, and on the seaward side of the Coastal Duneveld. Essentially it consists of Namaqualand Seashore Vegetation, but also includes transition zones of seashore vegetation occurring on white dune sands, which have taller shrubs, but are not considered part of the Coastal Duneveld.

**Significance Statement**

No loss of the Seashore Dune vegetation has occurred within the project area, but some localised degradation has occurred and is ongoing (due to kelp harvesting and offroad vehicle tracks). Most of this degradation is reversible, and is thus temporary. The environmental significance of this unmitigated impact is LOW negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Study Area</td>
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</tr>
<tr>
<td>With Mitigation</td>
<td>N/A</td>
<td>N/A</td>
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</tr>
</tbody>
</table>

Impact 1.7: Loss of Coastal Duneveld

**Cause and Comment**

Coastal Duneveld is situated on the inland side of the Seashore Dunes, and gradually merges with Strandveld further inland. No SCC was recorded in this unit.

**Significance Statement**

There has been minor loss of the Coastal Duneveld (due to a few diamond exploration pits), but the unit does not appear to be experiencing any ongoing degradation. The severity of the impact is low, and the environmental significance of this unmitigated impact is LOW negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
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<td>Study Area</td>
<td>Low</td>
</tr>
<tr>
<td>With Mitigation</td>
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<td>N/A</td>
</tr>
</tbody>
</table>
**Issue 2: Loss of Biodiversity and Species of Conservation Concern**

**Impact 2.1: Loss of Biodiversity (general)**

**Cause and Comment**

The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing has resulted in a loss of biodiversity in the area. Overall no species or habitats are likely to have been lost, although degradation in certain areas (around stock kraals) has been intense.

**Significance Statement**

The current land use is probably having a moderately severe, long term impact on the biodiversity within the project area. The environmental significance of this unmitigated impact is MODERATE negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Temporal Scale: Long Term, Spatial Scale: Study Area, Severity of Impact: Moderately Severe</td>
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<td>MODERATE</td>
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<tr>
<td><strong>With Mitigation</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Impact 2.2: Loss of Species of Conservation Concern**

**Cause and Comment**

The clearing of relatively small areas of land for agriculture and for large scale use of the area for livestock grazing is unlikely to have resulted in total loss of any plant SCC in the area. However, land use has undoubtedly impacted on the isolated populations of SCC, and reduced the total population numbers of about 5-10 SCC.

**Significance Statement**

The current land use is probably having a moderately severe, long term impact on at least some of the SCC within the project area. The environmental significance of this unmitigated impact is MODERATE negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without Mitigation</strong></td>
<td>Temporal Scale: Long Term, Spatial Scale: Study Area, Severity of Impact: Moderately Severe</td>
<td>Probable</td>
<td>MODERATE</td>
</tr>
<tr>
<td><strong>With Mitigation</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Impact 2.3: Fragmentation of vegetation and edge effects**

**Cause and Comment**

Habitat fragmentation is one of the most important impacts on vegetation, especially when this creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. This impact usually occurs when large
areas are cleared for agriculture, development or mining. Fragmentation results in the isolation of functional ecosystems, and results in reduced biodiversity and reduced movement due to the absence of ecological corridors.

Habitat fragmentation is currently not a major feature of the study area, as most cultivation consists of narrow strips (<30 m wide) surrounded by natural vegetation. Most of the heavily disturbed areas are close to homesteads and livestock kraals, and are generally <10 ha in extent.  

**Significance Statement**

Habitat fragmentation is fairly likely to be an issue within the project area, but it is of low severity and has a long term impact. The environmental significance of this unmitigated impact is LOW negative.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Study Area</td>
<td>Low</td>
<td>Likely</td>
<td>LOW</td>
</tr>
<tr>
<td>With Mitigation</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**vi. Impacts on fauna**

**Issue 1: Loss of faunal biodiversity**

Historically, Namaqualand supported a large diversity of animals as noted by early travellers (Skead, 1980) and as recorded in present day place names (Acocks, 1979; Dean and Milton, 2003). A long list of small (e.g. steenbok, duiker) and large ungulates (e.g. gemsbok, eland) as well as mega-herbivores (such as elephant, black rhinoceros and hippopotamus) and predators (e.g. lion, hyena) were recorded in the region and reflect this diversity (Skead, 1980). However, the density of animals, as well as the extent of population fluctuations that would have occurred in Namaqualand prior to colonial settlement at the Cape, is harder to determine (Hoffman & Rhode 2006).

It appears that wildlife was not abundant in Namaqualand prior to colonialism, and large springbok ‘treks’ that are recorded in the eastern Karoo during the 19th century, were probably a rare event (Hoffman & Rhode 2006). Despite this, farmers regarded wildlife as vermin as they competed with their sheep for food, space and water, and thus shot as many springbok as they could, using the carcasses for dried spiced meat (Lovegrove 1993). This slaughter, along with habitat loss to fenced livestock farms and a rinderpest outbreak at the end of the 19th Century, reduced springbok numbers dramatically. Springbok are now, for the most part, farmed livestock and restricted to fenced enclosures (Kingdon 1997). Fortunately, fences do not limit birds or reptiles. Many granivorous birds migrate hundreds of kilometres to find food in the region after good rainfall events stimulate plant growth (Dean and Milton 1999).

Existing land use is primarily focused on agriculture, with livestock grazing as a dominant land use in the region. Cultivation is also practiced along the major perennial rivers, and in drier areas, where this largely depends on rainfall. According to Hoffman & Rhode (2006), the number of domestic livestock in Namaqualand spiked in 1957 largely as a result of an increase in the number of sheep. Numbers have fallen steadily since this peak. Crop production was absent from Namaqualand’s pre-colonial landscapes but increased to cover
Nearly 30,000 ha in the early 1970s. The area under cultivation has now declined by nearly two thirds, largely as a result of the large-scale abandonment of wheat farming in marginal environments.

Pastoralism is considered a major threat to the biodiversity of the region. In addition to pastoralism, alien invasive plants, mining, agriculture, and the collection of succulents and reptiles for the pet trade, also threaten the region's biodiversity (Lovegrove 1993, Lloyd 1999, Branch 2013).

**Impact 1.1: Existing land use impacts on fauna**

**Cause and Comment**

While many of the larger mammals were extirpated in historical times, present day impacts on fauna come in numerous forms. Predatory animals such as black-backed jackal (*Canis mesomelas*), caracal (*Felis caracal*) and leopard (*Panthera pardus*) have been known to effect stock numbers, thus impacting upon local livelihoods in the region. However, the hunting and trapping of predators can often lead to an increase in predator numbers because of the elimination of alpha males that restrict access of other predators within their territory (NDBSP 2008). Thus, common methods of predator control can have the opposite effect to that which is intended.

Fence lines along roads and between farm paddocks may restrict the movement of non-volant large animals across the landscape. The faunal impact depends on the size and structure of these linear barriers. Low electric fences, designed to restrict the moment of small predators, e.g. jackal, are particularly lethal to larger tortoises (Burger & Branch 1994). The use of poisoned carcasses by livestock farmers to kill "problem" animals such as black-backed jackal and caracal often results in poisoning of non-target raptors and other scavenging species (Lloyd 1999, Anderson 2000). Some species, like the martial (*Polemaetus bellicosus*) and black (*Aquila verreauxii*) eagles, perceived to prey on domestic livestock and poultry, may be deliberately targeted (Anderson 2000). Practices such as the use of gin traps are also problematic for local biodiversity, as it is an indiscriminate method that usually serves to eradicate more non-target animals, such as tortoises, aardvarks, etc, than it does the predator in question.

Drowning in farm reservoirs also account for a significant number of raptor mortalities in the Karoo (Anderson 2000), whilst pesticides used to control brown locust (*Locustana pardalina*) outbreaks also impact wildlife severely, with high concentrations being found at the top of the food chain, particularly lizards (Alexander et al. 2002) and raptors (Lovegrove 1993).

**Significance Statement**

Existing land use impacts on fauna in the project area results in a moderate negative impact in the medium to long-term in the study area. The environmental significance of this impact is MODERATE.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
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<td>Study Area</td>
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<td>Probable</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
**Issue 2: Habitat impacts**

The Succulent Karoo has been utilised extensively for livestock farming for many years (Allsopp 1999; Todd & Hoffman 1999), and the resultant problems of selective overgrazing, overstocking and trampling are therefore widespread (Hilton-Taylor & Le Roux 1989). The earliest evidence of livestock farming, a practise that was brought into the Succulent Karoo by the Khoikhoi, dates back as far as 2 100 years.

The livestock farming that is practiced on the communal areas has resulted in severe overgrazing of the veld, due to high stocking rates and limited opportunities for herd rotation (Todd & Hoffman 1999). On the other hand, private, commercial farms are fenced (such as those in the project area), and this allows some form of internal rotational grazing that may reduce the severity of overgrazing (Cowling & Pierce 1999).

Hoffman & Rhode (2006) describe three key eras in Namaqualand’s history, in terms of distinct phases of human intervention:

1. The **pastoral ecological revolution** that took place as a result of the introduction of domestic livestock and pastoral societies into the area approximately 2000 years ago and which, prior to this time was occupied by people with predominantly hunter-gatherer lifestyles.

2. The **colonial ecological revolution** which in Namaqualand first made itself felt through the rapid spread of smallpox from the Cape Colony after its outbreak there in 1713, decimating pastoral societies. From about 1750, and for the next two and half centuries, colonial settlers appropriated the mostly empty land for commercial livestock farming and mining, confining the original inhabitants to increasingly small communal reserves resulting in the formation of two distinct social, economic and ecological outcomes.

3. The **post-agrarian ecological revolution** includes the decline in commercial agriculture in the region, particularly cultivation, during the second half of the 20th century and the more recent transformation of the South African social economy after 1994. The influence of the latter has been accompanied by an end to agricultural subsidies, a major focus on land reform in the region, and the expansion of conservation areas such as the Richtersveld and Namaqua National Parks.

Removal of natural vegetation for cultivation destroys the natural habitat of many plants and animals. Where vegetation has been removed by cultivation, old fields take several years for vegetation to be restored, and may even fail to revert to natural vegetation for several decades (Allsopp 1999). Since the decline in commercial agriculture, most of the region is now rangeland for livestock grazing (Hoffman et al. 1999), and therefore still relatively intact. However, heavy grazing has left parts seriously degraded and has also transformed the plant spectrum in others (Lloyd 1999).

Mining is important in the region and also threatens the ecology, although in some cases, attempts are being made to rehabilitate historically mined areas (Lovegrove 1993) and current legislation enforces rehabilitation of mine sites. Mining activities result in loss of vegetation cover which may lead to wind erosion, whilst the creation of many access roads, tracks and borrow pits to service the mined areas and the processing plants and slime dams can generates significant secondary effects, e.g. increased mortality and barriers to migration (Jackelman & Moll 1989).
Impact 2.1: Habitat Loss

Cause and Comment

Large tracts of Namaqualand are still fairly intact in spite of general overgrazing. However, certain areas have also been converted for wheat agriculture. Land-use practices that will further threaten the regions biodiversity are listed below, in their probable order of importance (Cowling 2013).

- The increase of communally-owned land and accompanying small scale livestock use, may lead to overgrazing to desertification.
- Overgrazing of commercial (privately-owned) rangelands.
- Agriculture, especially in the valleys of perennial rivers.
- Mining for diamonds, heavy minerals, gypsum, limestone, marble, monazite, kaolin, ilmenite, and titanium. For example, 65% of the Namaqualand coastline is or has been mined at some level.
- Illegal and large scale collection of succulents and geophytes.
- In addition, climate change is likely to have a major negative influence on the biodiversity of the Succulent Karoo, given the specialized habitat requirements of the numerous local plant endemics (Rutherford et al 1999).

Significance Statement

Habitat loss through existing land use impacts in the project area has resulted in a moderate negative impact in the long-term in the study area. The environmental significance of this impact is MODERATE.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Long term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Probable</td>
<td>MODERATE</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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</tr>
</tbody>
</table>

vii. Visual impacts

The area surrounding the Zirco Kamiesberg project, is characterised by its remoteness and low level of development compared to most other parts of South Africa. It is part of the well-known greater Namaqualand. In this semi-desert environment, the screening effect of vegetation will be minimal as vegetation is very sparse, and there are virtually no tall trees. Most sensitive visual receptors identified within 20 km of the project area are those associated with the Namaqua National Park: the camping spots alongside the coast and the 4x4 route which runs adjacent to the coast and connects the camp sites. The homesteads of farmers within a 12 km radius of the edge of the prospecting areas are also considered to be sensitive receptors. There are two tourist accommodation facilities in the area: The Groenrivier Mond Akkomodasie and Sarri-Safari self-catering lodge. The Namaqua Flower Festival attracts large numbers of visitors to Namaqualand in the flower season. The Namaqua National Park establishes a temporary camp at the Groen River mouth during the flower season to accommodate extra guests visiting the park during this season. These factors combined lead to the conclusion that the Kamiesberg project area is a visually sensitive area. However, the topographical characteristics of the area mean that fixed mine infrastructure are only likely to be visible to a small number of sensitive receptors. Most camp sites are located adjacent to the ocean and are further than 12 km from the edge of the...
the project area. Mining activities will be in an area averaging 150 metres above sea level, meaning it will be mostly invisible to these camp sites. Most homesteads tend to be located along the lower lying drainage basins of the Groen, Bitter and Outeep rivers, which means many of them will also be protected from major visual impacts. Some homesteads however, will have views of fixed mine infrastructure. Not proceeding with the project will definitely contribute towards preserving the unique character of the area. However the project is expected to have only a low visual impact on surrounding sensitive receptors.

9.1.3 Impacts that may result from the construction phase

i. Impacts on topography and geology

Cause and Comment

The construction of the airstrip, landfill site, internal roads, etc. will require excavations in order to lay adequate foundations. Furthermore, minor excavations will be required for the upgrading of the existing access road.

Mitigation and Management

None required.

Significance statement

It is envisaged that only minor topographical manipulation will be required during the construction phase of the development. Topographical manipulation will not be required over the entire area but only within selected areas. In addition, large parts of the area are relatively flat, and therefore, impacts associated with topography of the area are considered to be of a low negative significance. There are no mitigation measures for this impact.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
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</tr>
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<td>N/A</td>
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</tr>
</tbody>
</table>

ii. Impacts on soils and agriculture

Issue 1: Soil profile disturbance and resultant decrease in soil capability

Soil capability of a specific area is determined by the collective influences of soil, terrain and climate features on that area. As this is a natural process, any unnatural interference such as excavations and mining activities will have a major effect on the soil capability, and may directly or indirectly lead to various issues such as ground water drainage, erosion and a decline in agricultural potential.

Impact 1.1: Large scale excavations that will disturb the soil profile.

Cause and Comment

Clearing and levelling of the site and excavations of soil during the construction of the mine and associated infrastructure will disturb the existing soil profile. If topsoil becomes buried, or
subsoil material that is less suitable for root growth remains at the surface, the agricultural suitability of the soil that will become available for agriculture again after rehabilitation of the mined areas will be reduced.

**Mitigation and Management**

- The upper 10cm of top soil must be stripped and stockpiled. It should be retained for re-spreading over disturbed surfaces during rehabilitation.
- An Environmental Control Officer (ECO) should monitor all excavations to ensure backfilling with subsoil first and subsequently topsoil spreading takes place.
- An ECO should monitor depth and cover of topsoil spreading during rehabilitation to ensure as close as possible to a depth of 10cm.

**Significance Statement**

This impact is considered to be short term, localised and severe and thus of MODERATE significance. With mitigation measures in place this impact can be reduced to LOW significance.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Temporal Scale</td>
<td>Spatial Scale</td>
<td>Severity of Impact</td>
</tr>
<tr>
<td></td>
<td>Short term</td>
<td>Localised</td>
<td>Severe</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Temporal Scale</td>
<td>Spatial Scale</td>
<td>Severity of Impact</td>
</tr>
<tr>
<td></td>
<td>Short term</td>
<td>Localised</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**Issue 2: Soil erosion through wind ablation as a result of vegetation clearing**

As the Kamiesberg Project area is situated on sand-dominated land the associated soils are considered as having high wind erosion susceptibility, as well as low to moderate water erosion susceptibility within the project area (AGIS, 2007). This effect will be severely enhanced with the removal of the protective top layer of vegetation

**Impact 2.1: Soil erosion through wind ablation.**

**Cause and Comment**

Mining of the site will result in large scale vegetation clearing. The vegetation layer in the Namaqualand serves an important role in acting as a buffer for aeolian sand movement in the area. Prompt rehabilitation will aid in reducing wind ablation and subsequently erosion of sand.

**Mitigation and Management**

- Rehabilitation of the affected landscape must commence as soon as possible after mining to minimise the period during which the soil surface is exposed;
- Use of wind breaks is recommended;
- Rehabilitation should, as far as possible, restore the pre-mining slopes and shape of the pre-mining landscape; and
- Only local sand should be used to landscape the impacted areas during rehabilitation.
**Significance Statement**

This impact is considered to be short term, severe and definite and thus of HIGH significance. With mitigation measures in place this impact can be reduced to MODERATE significance.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Long term</td>
<td>Study Area</td>
<td>Severe</td>
<td>Definite</td>
<td>HIGH</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Long term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Probable</td>
<td>MODERATE</td>
</tr>
</tbody>
</table>

**iii. Impacts on surface and groundwater resources**

**Impact 1: Impacts of groundwater abstraction**

**Cause and Comment**

The severity of the impacts is assessed on the assumption that it will probably be necessary to abstract groundwater from boreholes in the Groenrivier valley for construction purposes. Thus, impacts on groundwater levels may occur when groundwater is abstracted for construction purposes.

**Mitigation and Management**

- Restrict groundwater abstraction to the long-term sustainable yield of the well field to minimise lowering of groundwater table.
- If necessary provide an alternative source of water for stockwatering if abstractions for mining purposes prejudice the yield of existing wells and boreholes used by local population.
- Continuously monitor groundwater levels via observation wells.

**Significance Statement**

Although the likelihood of the impact occurring will be reduced by implementing mitigation measures, the overall severity of the impact for the construction phase will be LOW negative before and after mitigation.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Long term</td>
<td>Local</td>
<td>Moderate</td>
<td>Probable</td>
<td>LOW</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Long term</td>
<td>Local</td>
<td>Slight</td>
<td>Possible</td>
<td>LOW</td>
</tr>
</tbody>
</table>

**Impact 2: Impacts on groundwater of pollution by contaminants**

**Cause and Comment**

Groundwater may be polluted by a range of substances that, if not stored, handled and managed properly, may find their way into the aquifer underlying the mine site and permanently contaminate the water. The main contaminants during construction are
hydrocarbons such as fuel, oil and other lubricants, paints and solvents, which must be stored, handled and managed to prevent spills and leakage, and measures put in place to rectify incidents immediately they occur. Other contaminants such as cement must be properly managed to prevent spillage onto exposed soil surfaces.

**Mitigation and Management**

- All hydrocarbons of all types must be stored on impermeable surfaces with appropriately-sized containment bunds and grease traps. Traps must be regularly cleaned.
- All chemicals of all types must be stored on impermeable surfaces in secure and bunded designated storage areas.
- Cement must be stored on impermeable storage areas protected from the rain and mixed only in designated areas. Cement residue must be cleaned up immediately.
- Vehicle repairs, servicing, refuelling and washing must be done only in designated areas with impermeable surfaces with appropriately-sized containment bunds and grease traps.
- Where it is necessary to service, repair or refuel a vehicle or item of plant in the field drip trays must be used to catch drips, spills and leaks.
- Spill kits must be available at all locations where chemicals of hydrocarbons are stored, handled or used, and spills must be cleaned up immediately in accordance with an established protocol appropriate to the material in question.

**Significance Statement**

Without mitigation the impacts during the construction phase will be of MODERATE negative significance, which can be reduced to LOW negative by diligent and sustained implementation of mitigation control measures.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Probable</td>
<td>MODERATE</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Short Term</td>
<td>Study Area</td>
<td>Moderate</td>
<td>Possible</td>
<td>LOW</td>
</tr>
</tbody>
</table>

**Impact 3: Impact on surface water of groundwater abstraction from the Groenrivier valley**

**Cause and Comment**

The 2015 study by SWS indicates that there is negligible perennial flow in the Groenrivier system, either at the surface or in the shallow substrate or channel fill, and that the lagoon is sustained by discharge from the spring at the head of the estuary. The spring is fed by a shallow groundwater system in the riparian zone. The discharge from the spring was estimated to be 1 litre per second. The study also showed, by means of hydrochemical fingerprinting, that a direct hydrogeological connection between the general groundwater resources adjacent to the river at the site and the spring is highly unlikely. The river and estuary will only be affected in the unlikely event of water being abstracted from the shallow groundwater system in the riparian zone that feeds the spring. Since the discharge from the spring has been observed to be very low (around 1 litre per second in February 2015) compared to the estimated yield of the deeper groundwater system (possibly up to 30 litres per second), there is no intention to abstract water from the riparian groundwater system.
Provided no water is abstracted from the groundwater system that feeds the spring no impacts on the river or estuary are anticipated during construction or operation, or in the long-term after mine closure.

**Mitigation and Management**

- Ensure that water is not abstracted from the shallow groundwater system in the riparian zone

**Significance Statement**

No impact

**Impact 4: Impacts of river crossing infrastructure**

**Cause and Comment**

It will be necessary to upgrade (or possibly even to replace) the existing DR2938 road crossing over the Groenrivier to accommodate increased mine-related traffic. It will also be necessary to construct a pipeline across the river to convey mineral processing water from the seawater intake on the coast south of the mine site to the mine site. The construction of the road crossing and pipeline will necessitate working in and immediately adjacent to the river channel, and may require excavation in or alterations to the river bed and riparian zones.

The existing road crossing is a drift, with no culverts. The structure prevents subsurface flow, when it occurs, which backs up and flows over the road slab\(^9\). The road is impassable during the infrequent high-flow events. The upgraded / new crossing will not result in any impacts on the flow regime of the river that do not already occur. If the upgraded crossing is designed to include culverts it will not obstruct low flows up to the culvert capacity.

**Mitigation and Management**

**Road crossing**

- If it is necessary to construct a new crossing, not on the alignment of the existing drift, it should be sited to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- The conditions of the Water Use Licence (or General Authorisation) must be strictly adhered to.

**Pipe crossing**

- Site the crossing to avoid extensive excavation in the banks, and to avoid sensitive areas in the channel or riparian areas.
- As far as possible avoid the construction of structures below the level of the 100-year flood.
- Remove the crossing after closure and decommissioning of the mine.
- The conditions of the Water Use Licence must be strictly adhered to.

**Significance Statement**

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\(^9\) This is evident on the Google Earth images of the road crossing, which are dated 24th September 2013, two days after a flow rate of 1.7m\(^3\)/sec was recorded at the Swartdoring gauging station.
Without proper care in siting and constructing the crossings the bed and banks of the river could be damaged, resulting in impacts of MODERATE significance. Impacts can be reduced to LOW significance by adhering to the conditions in the Water Use Licence / General Authorisation.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Without Mitigation</th>
<th>With Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal Scale</strong></td>
<td>Short Term</td>
<td>Short Term</td>
</tr>
<tr>
<td><strong>Spatial Scale</strong></td>
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<td>Local</td>
</tr>
<tr>
<td><strong>Severity of Impact</strong></td>
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<td>Slight</td>
</tr>
<tr>
<td><strong>Risk or Likelihood</strong></td>
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<td>Possible</td>
</tr>
<tr>
<td><strong>Overall Significance</strong></td>
<td>MODERATE</td>
<td>LOW</td>
</tr>
</tbody>
</table>

**iv. Impacts on the marine environment**

**Impact 1: Direct losses of intertidal and infratidal biota in development footprint**

**Cause and Comment**

Constructing an intake pipeline across sub tidal reefs and the intertidal rocky shore will require permanently attaching the pipeline to the substratum in a manner that is sufficiently strong to resist the action of the sea. The use of concrete to cement the pipeline in place is the most feasible option. This will result in the death of all sessile (attached) biota along the pipeline path or in the areas where concrete is placed, disturbance of mobile fauna and habitat alteration.

**Mitigation and Management**

The impact is regarded as permanent, but may be mitigated to some extent by the choice of pipeline material, as some sessile rocky shore and reef organisms are predicted to recolonize the concrete and pipeline surface in time. Further mitigation measures include minimising the surface area impacted by cementing. Alternatively bolting the pipeline directly to the rocky substratum or to concrete bases would minimize the area impacted.

**Significance Statement**

The duration of the construction phase impacts will be Medium Term. The extent is Localised as it will only directly impact the area where the intake and pipeline will be constructed. The severity of the impact is expected to be MODERATE should mitigation measures not be employed. If they are, the impact is expected to be Slight. The likelihood of the impact occurring is Definite.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Without Mitigation</th>
<th>With Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal Scale</strong></td>
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<td>Localised</td>
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<tr>
<td><strong>Severity of Impact</strong></td>
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</tr>
<tr>
<td><strong>Risk or Likelihood</strong></td>
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<td>Definite</td>
</tr>
<tr>
<td><strong>Overall Significance</strong></td>
<td>MODERATE</td>
<td>LOW</td>
</tr>
</tbody>
</table>

**Impact 2: Barotrauma of marine fauna as a result of blasting**

**Cause and Comment**

The energy of detonating an explosive is released as physical, thermal and gaseous products. The thermal and detonation impacts associated with an explosion are only important to consider near the blast (3 m to 10 m) while the impacts of shockwaves, noise