# FAUNAL AND FLORAL ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS OF THE MINING RIGHT APPLICATION FOR THE PROPOSED MINING OF GYPSUM ON PORTION 0 OF THE FARM KANAKIES 332 AREA, NEAR LOERIESFONTEIN, NORTHERN CAPE

**Prepared for**

**Cabanga Environmental**

**July 2018**

## Section B: Floral Assessment


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# EXECUTIVE SUMMARY

**The field assessments and this report was confined to the focus area. Although the MRA was briefly visited during the field assessment, it formed part of all the background and desktop data in support of the field assessment and reports within the focus area. Three habitat units were identified within the focus area, namely Intact Vygieveld, Overgrazed Vygieveld and Transformed Areas.**

**From the assessment, it was found that the majority of the study area is comprised of Overgrazed Vygieveld, with an overall moderately low ecological sensitivity, mostly due to the current and historic anthropogenic activities that took place (grazing and farming). It is however important to note that portions of the study area, particularly in the northern and southwestern sections of the focus area remained largely intact and that the habitat type is considered well represented within the region surrounding the focus area. The proposed mining and placement of surface infrastructure within the focus area is not expected to significantly impact on floral conservation in the region. Although loss of SCC individuals will occur, the replacement or relocation of these species will function as a minimisation for the loss.**

**Several SCC were encountered during the field assessment within the Intact and Overgrazed Vygieveld. The relevant permits (nursery and harvesting) must be applied for at the relevant provincial authority, as indicated by the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) General Notice 19, Provincial Gazette No. 1589, dated 13 April 2012, Chapter 19. It is recommended that a nursery be constructed on site to grow and maintain indigenous vegetation and SCC while mining activities take place. As concurrent rehabilitation takes place within the phased mining process, these species maintained within the nursery can be replanted to reinstate the areas back to its original state prior to mining.**

**It is the opinion of the ecologists that this study provides the relevant information required in order to implement Integrated Environmental Management and to ensure that the best long-term use of the ecological resources in the focus areas will be made in support of the principle of sustainable development. With the implementation and management of the proposed mitigation measures, impacts associated with the mining activities on the floral community, and specifically the SCC and protected species, can be reduced to a lower significance rating.**

# MANAGEMENT MEASURES

Scientific Terrestrial Services (STS) was appointed to conduct a terrestrial ecological assessment as part of the environmental assessment and authorisation process for the proposed mining of natural gypsum (Gy) on the Portion 0 (remaining extent) of the farm Kanakies 332, near Loeriesfontein, Northern Cape, henceforth referred to as the Mining Right Area (MRA) The MRA is situated within the Hantam Local Municipality and within the Calvinia Magisterial District. The MRA is situated approximately 45 km east-south-east of the town of Loeriesfontein, and 40 km north-north-west of Niewhoudtville, and 53 km north-north-east of Nuwerus. The Doring River traverses the southwest corner of the MRA.

The extent of the MRA is approximately 7457.70 ha, while the concentrated gypsum deposit is approximately 689 ha in extent, while a further 9 ha will be affected by surface infrastructure. The deposit consists of 2 layers of gypsum i.e. a powder layer and nodular crystalline (clay) layer of gypsum. The area where the gypsum deposit is concentrated will henceforth be referred to as the “focus area”.

The field assessment and this report was confined to the focus area. Although the MRA was briefly investigated, it formed part of all the background and desktop data in support of the field assessment and reports within the focus area.

Specific outcomes required from this report include the following:

- To conduct a desktop study to gain background information on the physical habitat and potential floral biodiversity associated with the study area and surrounding region;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the study area;
- To provide inventories of floral species as encountered within the study area;
- To determine and describe habitat types, communities and the ecological state of the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To describe the spatial significance of the study area with regards to surrounding natural areas; and
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features.

To achieve the objectives of the report, the following assessment procedure/methodology was used:

- A desktop study to gain background information on the physical habitat, as well as generating potential floral biodiversity lists for the focus area and surrounding region;
- Aerial photographs and digital satellite imagery were consulted prior to the field assessment to guide priority areas for ground truthing;
- A field assessment that identified the dominant floral species that occur within the focus area;
- A description of the sensitivity of the project footprint;
- Data analyses and reporting of all findings; and
- An Impact statement was provided.

The following general summary is presented of the literature review and desktop analysis:

- According to the Mining Biodiversity Guidelines (2012) the southwestern corner of the MRA falls within an area considered to be of Highest Biodiversity Importance. The majority of the MRA is considered to be of Moderate Biodiversity Importance.
- According to the National List of Threatened Terrestrial Ecosystems (2011) the MRA is not located within a threatened terrestrial ecosystem;
- According to the SAPAD (2017) database, the MRA is situated immediately east of the Kalk Gat Private Nature Reserve (PNR), while the Knersvlakte Nature Reserve is situated ± 10km to the west. The SACAD (2017) and NPAES (2009) datasets does not indicate any protected or conservation areas within 10 km of the MRA. With reference to the comments concerning the Kalk Gat Private Reserve, although the western portion of the MRA does border the reserve, the actual focus area is located approximately 6km north-east of this reserve;
- According to the National Biodiversity Assessment (NBA; 2011) database, a portion of the MRA falling within the Northern Knersveld Vygieveld falls within an area that in currently not protected while the remaining portion is considered to be poorly protected;
- According to the Northern Cape Provincial Spatial Development Framework (PSDF; 2012), the MRA is situated within the Knersvlakte Centre (KVC) of Endemism. The south western corner of the MRA falls within a CBA 2; and
- The study area falls within the Succulent Karoo and Azonal Vegetation Biomes, the Knersvlakte and Inland Saline Vegetation Bioregions and within the Northern Knersvlakte Vygieveld, Knersvlakte Shale Vygieveld, and the Namaqualand Riviere vegetation type (Mucina & Rutherford, 2006). The study area is situated within the 3018DD and 3118BB Quarter Degree Square (QDS).

The following general conclusions were drawn upon completion of the field assessment:

- Three habitat units were identified within the focus area, namely Intact Knersvlakte Vygieveld, Overgrazed Knersvlakte Vygieveld and Transformed Areas;
- From the assessment, it was found that the majority of the study area is comprised of Overgrazed Knersvlakte Vygieveld, with an overall moderately low ecological sensitivity, mostly due to the current and historic anthropogenic activities that took place (grazing and farming). It is however important to note that portions of the study area, particularly in the northern and southwestern sections of the focus area remained intact and that the habitat type is considered well represented within the region surrounding the focus area;
- Several SCC were encountered during the summer field assessment within the Intact and Overgrazed Knersvlakte Vygieveld. These species include:
    - *Hoodia gordonii;*
    - *Mesembryanthum spp.;*
    - *Drosanthemum spp.;*
    - *Brownanthus spp.;*
    - *Lessertia frutescens;*
    - *Oxalis ambigua;*
    - *Oxalis luteola;*
    - *Lampranthus maximiliani;*
    - *Ornithogalum secundum;*
    - *Lapeirousia spinosa;*
    - *Tetragonia microptera*
    - *Malephora purpureo-corcea;*
    - *Ruschia robusta;*
    - *Gethyllis villosa;*
    - *Delosperma hisidium;*
    - *Bulbine torta;*
    - *Trachyandra falcata; and*
    - *Moraea collina.*
- The relevant permits (nursery and harvesting) must be applied for at the relevant provincial authority, as indicated by the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) General Notice 19, Provincial Gazette No. 1589, dated 13 April 2012, Chapter 19.
- It is recommended that a nursery be constructed on site to grow and maintain indigenous vegetation and SCC while mining activities take place. As concurrent rehabilitation takes place within the phased mining process, these species maintained within the nursery can be replanted to reinstate the areas back to its original state prior to mining. Indigenous species can also be sourced from local nurseries in the surrounding area.

Sensitivity

From an ecological perspective, habitat sensitivity is considered to be of an intermediate to low level. The table below indicates the sensitivity of the habitat units along with an associated conservation objective and implications for development.

**A summary of the sensitivity of each habitat unit and implications for mining.**

| Habitat Unit | Sensitivity | Conservation Objective | Development Implications |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | Intermediate | Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential. | This habitat unit is of intermediate ecological sensitivity. Although mining in this area is unlikely to have a significant impact on the receiving environment, the disturbance timeframes and footprint must be minimised, and care must be taken to limit edge effects on the surrounding sensitive wetland areas. |
| **Overgrazed Knersvlakte Vygieveld** | Moderately Low | Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects. | This habitat unit is of moderately low ecological importance and sensitivity. Activities within this habitat unit must be optimised and limited to the existing disturbance footprint. Care must be taken to limit edge effects on the surrounding sensitive wetland areas. |
| **Ephemeral Drainage Line** | Moderately Low | Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects. | This system is of moderately low importance and sensitivity. The phased mining activities have already taken the ephemeral drainage feature into consideration during the planning phase. No mining activities will take place within the ephemeral drainage lines. |
| **Transformed Areas** | Low | Optimise development potential. | This habitat unit is of low ecological sensitivity due to the current and historic practices. The placement of infrastructure and associated mining areas located within the transformed areas will have no significant impacts on this habitat unit, as the area has already been cleared of vegetation due to current and historic activities. It is however recommended that these transformed areas form part of the rehabilitation actions to reinstate these areas where possible and form a link between the intact and overgrazed Vygieveld. |

Impact Assessment

The tables below serve to summarise the findings of the impact study undertaken with reference to the perceived impacts stemming from the proposed mining activities of the Kanakies Mine. The tables below indicate the significance of the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post mitigation impact scores will increase. Due to the already highly degraded nature of the Transformed areas, this habitat was not included in the below impact assessment. All impacts associated with the Transformed habitat can be considered to be of very low significance throughout all phases of the proposed mining. Nonetheless, although the Transformed habitat is considered to already be in a

degraded state, it is imperative that all mitigation measures still be applied in order to minimise edge effects and impacts to the surrounding habitats.

**Mine Surface Infrastructure Areas**

**A summary of the impact significance on floral resources in the construction phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**A summary of the impact significance on floral resources in the operational phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**A summary of the impact significance on floral resources in the decommissioning/ rehabilitation phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Overgrazed Knersvlakte Vygieveld** | Impact on *floral* habitat and species diversity | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**Mining Areas**

**A summary of the impact significance on floral resources in the construction phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Ephemeral Drainage Lines** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**A summary of the impact significance on floral resources in the operational phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Ephemeral Drainage Lines** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**A summary of the impact significance on floral resources in the decommissioning/ rehabilitation phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium High | Low |
| **Ephemeral Drainage Lines** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

Probable latent Impacts

Even with extensive mitigation, significant latent impacts on the receiving floral ecological environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Continued loss of floral habitat and habitat for SCC associated with the mining footprint are, although such habitat are not unique to the mining footprint area;
- Where floral habitats have been disturbed, it is highly unlikely that these would be rehabilitated to pre-development conditions of ecological functioning. Should controlled, managed and monitoring of rehabilitation work not take place, the habitat and species diversity loss for this area will be significant;

- Alien and invasive plant proliferation in disturbed areas as well as edge effects from the mining footprint and activities. Alien vegetation will outcompete natural and indigenous species, leading to a further loss of species diversity in the centre of endemism and to the surrounding environment.; and
- The loss of SCC and / or protected floral species which could not be rescued and relocated. Protected species and SCC lost will further increase the pressure of the existence of these species in a natural environment. It is critical that all protected species be kept in a nursery or species must be sourced from local nurseries. The seedbank at the SANBI Kirstenbosch Botanical Garden in Cape Town can also be consulted to obtain seeds as part of the rehabilitation activities and process.

Cumulative Impacts

Even with the implementation of mitigation measures, cumulative impacts would still occur throughout the mining process to a lower significance level. The proposed infrastructure areas and open cast pits will result in clearance of indigenous vegetation within the demarcated focus area. The focus area is located within the Knersvlakte Centre of Endemism. Significant habitat loss has already occurred within the centre of endemism, largely due to small scale farming and to some extent mining. It is crucial that concurrent rehabilitation works take place within the mining area in order to reinstate the veld to the state of pre-mining within the Intact Knersvlakte Vygieveld. It is important to note that should rehabilitation measures not be implemented during and after mining, the potential of the habitat to be transformed as currently noted in the transformed habitat unit (large bare open soil areas), is high.

# DOCUMENT GUIDE

The table below provides the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) Regulations 2017 (as amended in 2014) for Specialist Reports and also the relevant sections in the reports where these requirements are addressed.

| **NEMA Regulations (2017) - Appendix 6** | **Relevant section in this report** |
|---|---|
| (1) A specialist report prepared in terms of these Regulations must contain - | |
| (a) details of - | |
| (i) the specialist who prepared the report; and | Section A - Appendix D |
| (ii) the expertise of that specialist to compile a specialist report, including a curriculum vitae; | Section A - Appendix D |
| (b) a declaration that the specialist is independent in a form as may be specified by the competent authority; | Section A - Appendix D |
| (c) an indication of the scope of, and the purpose for which, the report was prepared; | Section 2 |
| (cA) an indication of the quality and age of base data used for the specialist report; | Section A (Background Information) |
| (cB) a description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change; | Section 5 |
| (d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment; | Section 2 |
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used; | Appendix A |
| (f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying alternatives; | Section 4 |
| (g) an identification of any areas to be avoided, including buffers; | Section 4 |
| (h) a map superimposing the activity, including the associated structures and infrastructure on the environmental sensitivities of the site, including areas to be avoided, including buffers; | Section 4 |
| (i) a description of any assumptions made and any uncertainties or gaps in knowledge; | Section 1.2 |
| (j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment or activities; | Section 5 |
| (k) any mitigation measures for inclusion in the EMPr; | Section 5.2 |
| (l) any conditions for inclusion in the environmental authorisation; | Section 5.2 |
| (m) any monitoring requirements for inclusion in the EMPr or environmental authorisation; | Section 5.2 |
| (n) a reasoned opinion - | |
| (i) as to whether the proposed activity, activities or portions thereof should be authorised; | Section 7 |
| (iA) regarding the acceptability of the proposed activity or activities; and | Section 7 |
| (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; | Section 5.2 |
| (o) a description of any consultation process that was undertaken during the course of preparing the specialist report | Section 6 |
| (p) a summary and copies, if any, comments received during any consultation process and, where applicable all responses thereto; and | Section 6.1 |
| (q) any other information requested by the competent authority. | No further request |

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# ACRONYMS

| | |
|---|---|
| **CR** | Critically Endangered |
| **EAP** | Environmental Assessment Practitioner |
| **EIA** | Environmental Impact Assessment |
| **EIS** | Ecological Importance and Sensitivity |
| **EN** | Endangered |
| **EW** | Extinct in the Wild |
| **GIS** | Geographic Information System |
| **GPS** | Global Positioning System |
| **Gy** | **Gypsum** |
| **IEM** | Integrated Environmental Management |
| **IUCN** | International Union for Conservation of Nature and Natural Resources |
| **MRA** | Mining Right Area |
| **NCNCA** | Northern Cape Nature Conservation Act |
| **NC DENC** | Northern Cape Department of Environmental and Nature Conservation |
| **NT** | Near Threatened |
| **P** | Protected |
| **PES** | Present Ecological State |
| **POC** | Probability of Occurrence |
| **PPP** | Public Participation Process |
| **PRECIS** | Pretoria Computerised Information System |
| **QDS** | Quarter Degree Square |
| **RE** | Regionally Extinct |
| **SANBI** | South Africa National Biodiversity Institute |
| **SP** | Specially Protected |
| **STS** | Scientific Terrestrial Services |
| **SCC** | Species of Conservation Concern |
| **TOPS** | Threatened or Protected Species |
| **VU** | Vulnerable |

# 1 INTRODUCTION

## *1.1 Background*

Scientific Terrestrial Services (STS) was appointed to conduct a terrestrial ecological assessment as part of the environmental impact assessment and authorisation process for the proposed mining of natural Gypsum (Gy) on the Portion 0 (remaining extent) of the farm Kanakies 332, near Loeriesfontein, Northern Cape, henceforth referred to as the "Mining Right Area (MRA)" (Refer to Figure 1 & 2 within Section A). The MRA is situated within the Hantam Local Municipality and within the Calvinia Magisterial District. The MRA is situated approximately 45 km south-east of the town of Loeriesfontein, and 40 km north-west of Niewhoudtville, and 53 km north-east of Nuwerus. The Doring River traverses the southwest corner of the MRA.

The extent of the MRA is approximately 7457.70 ha, while the concentrated Gypsum deposit is approximately 689 ha, while a further 9 ha will be affected by surface infrastructure. The deposit consists of 2 layers of gypsum i.e. a powder layer and nodular crystalline (clay) layer of gypsum. The area where the gypsum deposit is concentrated, and the proposed surface infrastructure will henceforth be referred to as the "focus area".

The field assessment and this report was confined to the focus area. Although the MRA was briefly investigated, it formed part of all the background and desktop data in support of the specialist assessment for the mining right application.

The purpose of this report is to define the floral ecology of the focus area as well as mapping and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the focus area. It is the objective of this study:

- To provide inventories of floral and faunal species as encountered within the focus area;
- To determine and describe habitat types, communities and the ecological state of the focus area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the focus area; and

- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

## *1.2 Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- The floral field assessment is confined to the focus area and does not include the adjacent properties, nor the entire MRA; these were considered as part of the desktop assessment. The focus of the assessment is to investigate the habitat integrity and sensitivity of proposed areas to be disturbed as part of the mining activities;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral communities have been accurately assessed and considered and the information provided is considered sufficient to allow informed decision making to take place and facilitate integrated environmental management;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the focus area may therefore have been missed during the assessment; and
- The field assessment of the terrestrial ecology was undertaken during the summer season from 31$^{st}$ of January to the 2$^{nd}$ of February 2018 and during the winter season from the 18$^{th}$ – 20$^{th}$ of July 2018, to determine the ecological status of the focus area. Although the second field assessment was conducted during the flowering season, poor winter rainfall in the area was still a limiting factor for identification of annual floral and geophytes and determining species diversity within the focus area.

# 2 ASSESSMENT APPROACH

To accurately determine the ecological state of the focus area and capture comprehensive data with respect to the floral ecology, the following methodology was used:

- Maps and digital satellite images were consulted prior to the field assessments in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of this analysis were then used to focus the field work on specific areas of concern and to identify areas where target specific investigations were required;

- All relevant information as presented by SANBI's Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org), including the Northern Cape Critical Biodiversity Areas (2016), to gain background information on the physical habitat and potential floral and faunal biodiversity associated with the MRA;
- Field assessments were undertaken during the 31st of January to the 2nd of February 2018 (Summer Season) and during the 18th to 20th of July 2018 (Winter Season) in order to determine the ecological status of the focus area. A reconnaissance 'walkabout' was undertaken to determine the general habitat types found throughout the focus area, following this, specific study sites were selected that were considered representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support floral Species of Conservational Concern (SCC). These sites were further investigated on foot in order to identify the occurrence of the dominant plant species and habitat diversities. A detailed explanation of the method of assessment is provided in **Appendix A** of this report.

## *2.1 Sensitivity Mapping*

All the ecological features of the focus area were considered, and sensitive habitat areas were assessed. In addition, identified locations of protected species were marked by means of Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto aerial photographs. The sensitivity map should guide the finalisation of the design and layout of the proposed mining activities.

# 3 RESULTS OF FLORAL ASSESSMENT

The focus area falls within the Northern Knersvlakte Vygieveld vegetation type. The rainfall within the Knersvlakte varies between 100-200 mm per annum and the vegetation composition is low. The landscape is typified by very low, rolling hills, covered with small white quartzite that conceals unique vegetation. The Knersvlakte is dominated by extensive small-scale framing and mineral deposits, of which Gypsum is most important (le Roux, 2005). Many of the succulents are confined to the white quartz gravel, reflecting sunlight and cooling the soils and surrounding area.

Three habitat units were identified within the focus area, namely Intact Knersvlakte Vygieveld, Overgrazed Knersvlakte Vygieveld and Transformed Areas. These habitat units are described in sections 3.1 to 3.3 below and shown in Figure 2.

Numerous ephemeral[1] drainage lines were identified which are located within the southwestern portion of the focus area but are considered to not receive and retain sufficient water to support wetland or riparian characteristics (Figure 1) (such as facultative or obligate wetland vegetation; soils with prolonged and frequent saturation; and no indication of a saturated soil zone within 50 cm of the soil surface and no significant change in structure and composition of bankside vegetation). These drainage lines are connected to a tributary which forms an anabranching or braided tributary of the Doring River located southwest of the broader MRA. Since these features cannot be classified as a true watercourse with an associated riparian zone in the traditional sense due to the lack of saturated soils and wetland/riparian vegetation, it does still function as a waterway, through episodic conveyance of water, and therefore potentially enjoys protection in terms of the National Water Act, 1998 (Act 36 of 1998), if a floodline is applicable to these drainage lines. For further details on the systems, refer to the Freshwater Resource Report (SAS, 2018 – reference SAS217157).

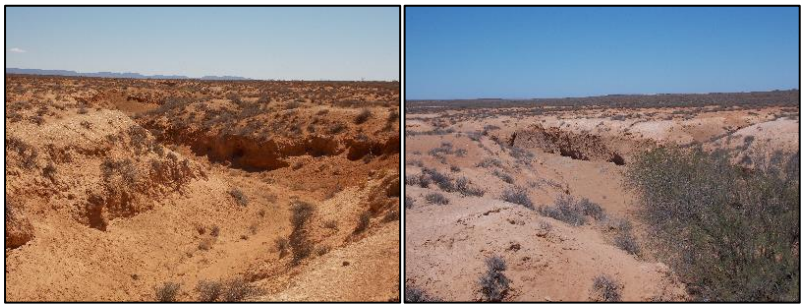


**Figure 1: The ephemeral drainage line located within the southwestern boundary of the focus area. Vegetation growth and species diversity was limited within this system.**

[1] "Ephemeral rivers flow for less time than they are dry. Flow or flood for short periods of most years in a five-year period, in response to unpredictable high rainfall events." (Rossouw *et. al*, 2006)

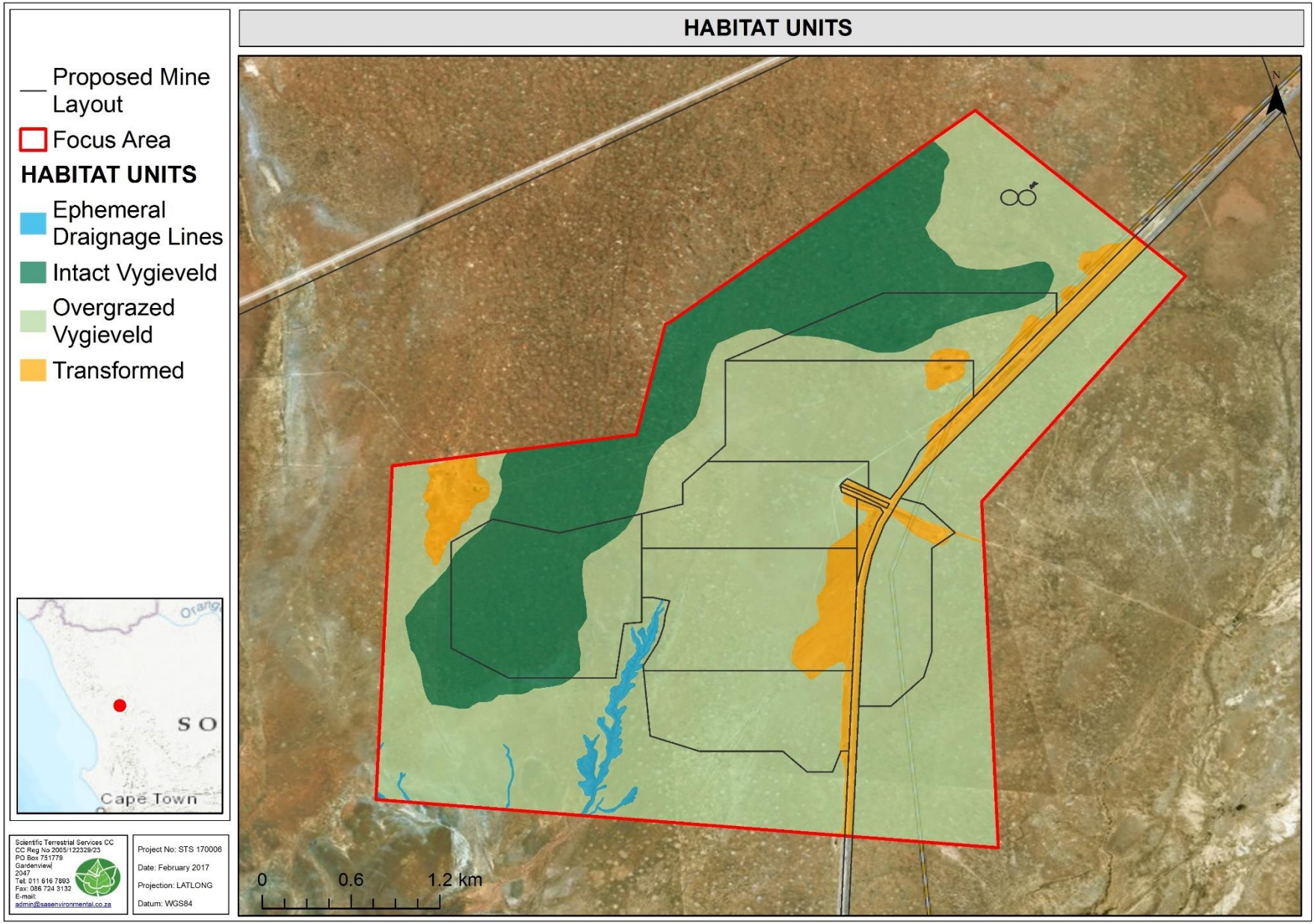



**Figure 2: Conceptual illustration of the habitat units within the focus area.**

## 3.1 Habitat Unit 1: Intact Knersvlakte Vygieveld

**Habitat Unit:**

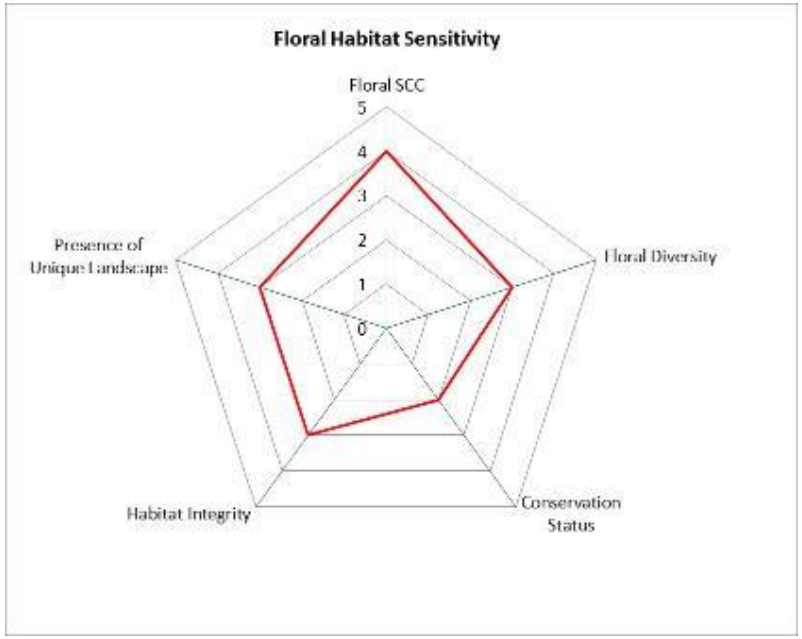
The northern and southwestern section of the focus area was more intact and species diverse due to less grazing activities within these areas.

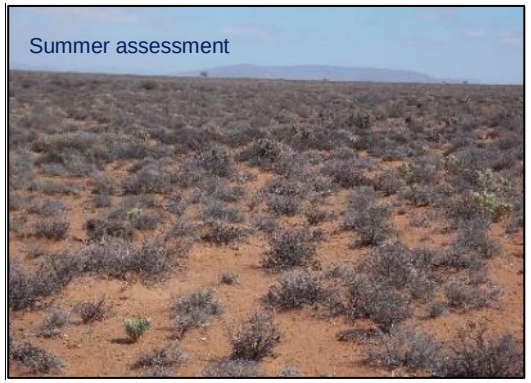
**Floral Habitat Sensitivity** **Intermediate**

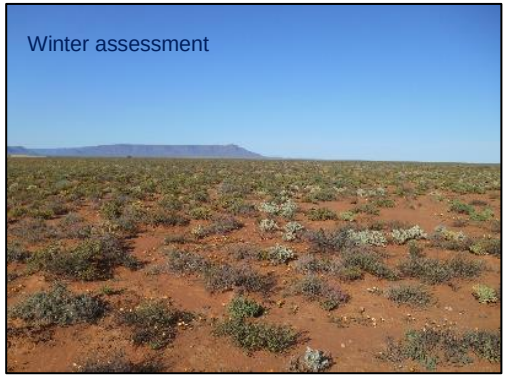
**Notes on Photograph:**

Top - Typical view of the Intact Knersvlakte Vygieveld habitat located in the northern section of the focus area during the summer and winter assessment.
Middel left – *Drosanthemum* hispidum
Middel right – *Lachenalia zebrina* (Kwaggaviooltjie)
Bottom left – *Augea capensis*
Bottom middle – *Ornithogalum secundum*
Bottom right – *Oxalis ambigua*

**Floral Habitat Sensitivity Graph:**




| | | | |
|---|---|---|---|
| **Floral Species of Conservation Concern (SCC)** | Several SCC were encountered during the field assessment within the Intact Knersvlakte Vygieveld.<br>➢ *Hoodia gordonii* (Ghobba) is protected under the Northern Cape Nature Conservation Act (NCNCA), 2009 (Act 9 of 2009) schedule 1 – specially protected species.<br>➢ Other SCC, such as *Mysembryanthemum* spp.; *Drosanthemum* spp. and *Brownanthus* spp. belonging to the family Aizoaceae is also protected under Northern Cape Nature Conservation Act (NCNCA), 2009 (Act 9 of 2009) schedule 2 – protected species.<br>➢ Lithops spp. also belonging to the Aizoaceae family was found within the MRA in outcrop areas east of the unnamed tributary of the Doring River (Refer to the Freshwater Assessment Report – Section for further detail on the freshwater features identified within the MRA). It is therefore possible that other *Lithops* spp. with similar habitat is located within the Intact Knersvlakte Vygieveld within the focus area.<br>➢ *Lessertia frutescens* (formally known as Sutherlandia frutescens) (Kankerbos) belong to the Fabaceae was found along the floodplain wetland systems within the MRA. *Lessertia frutescens* is also protected under Northern Cape Nature Conservation Act (NCNCA), 2009 (Act 9 of 2009) schedule 1 – specially protected species. This species was not noted during the two field assessments within the focus area.<br><br>It is recommended that permits for the removal or relocation of all floral SCC protected in terms of the Northern Cape Nature Conservation Act (NCNCA; Act 9 of 2009), be obtained prior to the commencement of mining / pit operations. |  <br>**Lithops spp. found within the MRA. Other *Lithops* spp. are likely to occur within the focus area.**<br>  <br>***Drosanthemum* spp. found within the focus area.**<br>  <br>***Hoodia gordonii* located within the upper reaches of the Intact Knersvlakte Vygieveld.**<br>  <br>***Lessertia frutescens* noted along the floodplain wetland within the MRA** | |
| **Floral Diversity** | The species diversity associated with the Intact Knersvlakte Vygieveld is relatively homogenous. Dominant species within this habitat type included *Augea capensis, Massonia depressa, lachenalia cornosa, Oxalis ambigua, Gazania lichtensteinii* and *Psilocaulon* spp. scattered throughout the extent of the northern section of the focus area. It was expected for the diversity of the area to be much higher than what was found during the summer field assessment, but due | **General comments:**<br><br>The species diversity found throughout the Intact Knersvlakte Vygieveld habitat unit was lower during the summer assessment compared to the winter assessment and what is typically found within the region. This is due to the prolonged drought in the area for the last 4 years. The winter assessment showed significant increase in the | **Business Case, Conclusion and Mitigation Requirements:**<br><br>This habitat unit is of intermediate ecological sensitivity. Although placement of infrastructure and mining activities in this area is unlikely to have a significant impact on the receiving environment on a regional scale, rescue and relocation |

| | | | |
|---|---|---|---|
| | to the intense and long drought the area has experienced, very few species could be positively identified to their species level. During the winter assessment, the diversity of species within this habitat unit was high. Numerous bulb and geophytes such as *Ornithogalum* sp. *Massonia depressa, Sarcocornia xerophila, Mesembryathemum guericheianum, Drosanthemum hispidum and Ruschia robusta* were present.<br><br>For a complete list of floral species observed, please refer to Appendix C. | recordings of species. The indicated diversity is likely to be more representative of that expected of the area. Floral SCC were found within the focus area and must form part of the permit application process. | programmes for indigenous flora and *SCC* will have to be implemented prior to any construction activity commencing. All protected species under NCNCA must be relocated to suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Northern Cape Department of Environmental and Nature Conservation (NC DENC). The specially protected species, *Hoodia gordonii* can be propagated by seed (Schmelzer & Gurib-Fakim, 2013), as the success rate from transplanting is very low. Relevant permits also need to be obtained from the NC DENC.<br><br>It is recommended that a nursery be constructed on site to grow and maintain indigenous vegetation while mining activities take place. As concurrent rehabilitation takes place within the phased mining process, these species maintained within the nursery can be replanted to reinstate the SCC composition of the area back to its original state prior to mining. |
| **Conservation Status of Vegetation Type/Ecosystem** | The vegetation type associated with the study area is listed as least threatened (Northern Knersvlakte Vygieveld and Knersvlakte Shale Vygieveld) (Mucina & Rutherford 2006). Due to impacts discussed in this section, the vegetation composition is only moderately representative of the vegetation type. | | |
| **Habitat integrity/Alien and Invasive species** | The intact habitat has been modified by historic livestock grazing activities and invasion by indigenous species such as *Psilocaulon spp and Atriplex lindleyi.* These species are known to occur in disturbed places throughout Namaqualand. | | |
| **Presence of Unique Landscapes** | The Knersvlakte is known for its diverse species, especially succulent shrubs and herbs. Rocky outcrop and quartzite areas within the focus area and MRA provide suitable habitat for indigenous floral vegetation and SCC. | | |

## 3.2 Habitat Unit 2: Overgrazed Knersvlakte Vygieveld

**Habitat Unit:**

Floral diversity and cover was low and dominated by species associated with disturbance. This is due to active grazing activities taking place within this habitat unit. The grass layer was poorly developed, hardly any shrubs or woody species and climbers were present during the field assessment.

Ephemeral drainage lines with no true watercourse characteristics located south of the focus area were noted.

| **Floral Habitat Sensitivity** | **Moderately Low** |
|---|---|

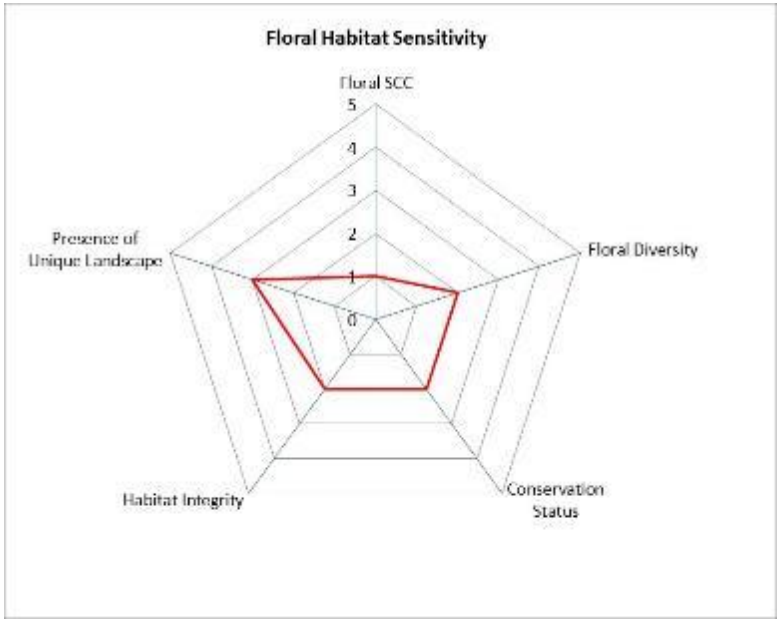
**Notes on Photograph:**

Top - A very low forb cover noted within the Overgrazed Knersvlakte Vygieveld. Dominant species within this habitat type included *Augea capensis* and *Psilocaulon* spp.

Bottom left – *Mesembryanthemum guerichianum*

Bottom right – *Zygophyllum cordifolium*

**Floral Habitat Sensitivity Graph:**




| | | | |
|---|---|---|---|
| **Floral Species of Conservation Concern (SCC)** | Although transformed through grazing activities, several SCC were encountered during the field assessment within the Overgrazed Knersvlakte Vygieveld<br><br>SCC, such as *Mysembryanthemum* spp.; *Drosanthemum* spp. and *Brownanthus* spp. belonging to the family Aizoaceae is also protected under Northern Cape Nature Conservation Act (NCNCA), 2009 (Act 9 of 2009) schedule 2 – protected species.<br><br>It is however recommended that permits for the removal or relocation of all floral SCC protected in terms of the Northern Cape Nature Conservation Act (NCNCA; Act 9 of 2009), be obtained. | | |
| **Floral Diversity** | Floral diversity and cover was low and dominated by species associated with disturbance. This is due to active grazing activities taking place within this habitat unit. Severe drought conditions over the last 4 years have also contributed towards the low shrub, succulent and forb cover. | **General comments:**<br><br>Although the Overgrazed Knersvlakte Vygieveld habitat unit provides very low floral diversity due to current and historical events, floral SCC was confirmed, and several others are likely to be present. | **Business Case, Conclusion and Mitigation Requirements:**<br><br>This habitat unit is of moderately low ecological sensitivity due to the current and historic agricultural practices.<br><br>The placement of surface infrastructure is within areas than have undergone disturbance. The phased mining activities have already taken the ephemeral drainage feature into consideration during the planning phase. No mining activities will take place within the ephemeral drainage lines.<br><br>Care must be taken to limit edge effects on the surrounding more Intact Knersvlakte Vygieveld habitat unit.<br><br>It is recommended that a nursery be constructed on site to grow and maintain indigenous vegetation and SCC while mining activities take place. As concurrent rehabilitation takes place within the phased mining process, these species maintained within the nursery can be replanted to reinstate the areas back to its original state prior to mining. |
| **Conservation Status of Vegetation Type/Ecosystem** | The vegetation type associated with the study area is listed as least threatened (Northern Knersvlakte Vygieveld and Knersvlakte Shale Vygieveld) (Mucina & Rutherford 2006). Due to impacts discussed in this section, the vegetation composition is only moderately representative of the vegetation type. | | |
| **Habitat integrity/Alien and Invasive species** | The overgrazed habitat has been modified by historic livestock grazing activities and invasion by indigenous species such as *Psilocaulon spp.* and *Atriplex lindleyi*. These species are known to occur in disturbed places throughout Namaqualand. | | |
| **Presence of Unique Landscapes** | The Knersvlakte is known for its diverse species, especially succulent shrubs and herbs. Watercourses located within the MRA provide suitable habitat for indigenous floral species. | | |

## 3.3 Habitat Unit 3: Transformed Areas

**Habitat Unit:**

Floral diversity and cover was very low due to soil disturbance (clearing) for grazing camps, roads and historical use of old borrow pits used during the construction of the road and railway line.

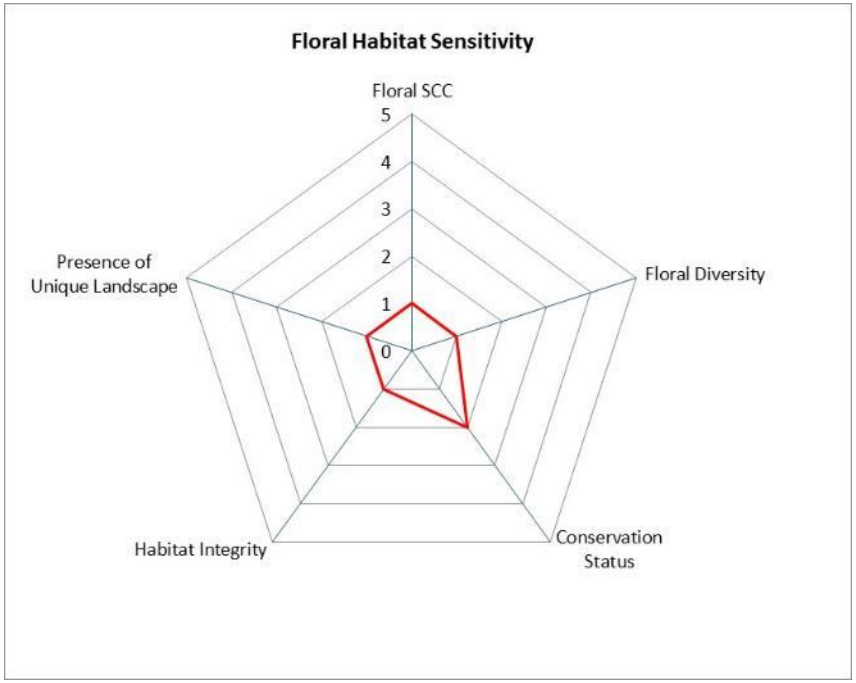
| **Floral Habitat Sensitivity** | **Low** |
|---|---|

**Notes on Photograph:**

Top - Historic soil and vegetation transformation observed at the old burrow pits used during the construction of the road and railway line

Bottom – Grazing camps used for farming during the summer and winter assessment.

**Floral Habitat Sensitivity Graph:**




| | | | |
|---|---|---|---|
| **Floral Species of Conservation Concern (SCC)** | No SCC were encountered during the field assessment within the transformed areas. Vegetation clearance and soil disturbance took place within the grazing camps, areas associated with the use of the main service road for the railway line and historic use of borrow pits.<br><br>It is however recommended that should any SCC be found within this habitat unit, permits for the removal or relocation of all floral SCC protected in terms of the Northern Cape Nature Conservation Act (NCNCA; Act 9 of 2009), be obtained. | | |
| **Floral Diversity** | Floral diversity and cover was very low and dominated by species associated with disturbance. This is due to active grazing activities and soil disturbance and clearing activities associated with historic infrastructure placement taking place within this habitat unit. | **General comments:**<br><br>The Transformed Areas provided very low floral diversity due to current and historical events, no floral SCC was confirmed, and not likely to be present. | **Business Case, Conclusion and Mitigation Requirements:**<br><br>This habitat unit is of low ecological sensitivity due to the current and historic practices.<br><br>The placement of infrastructure and associated mining areas located within the transformed areas will have no significant impacts on this habitat unit, as the area has already been cleared of vegetation due to current and historic activities.<br><br>It is important to note that should rehabilitation measures not be implemented during and after mining, the potential of the habitat to be transformed as currently noted in this habitat unit is high.<br><br>It is however recommended that these transformed areas form part of the rehabilitation actions to reinstate these areas where possible and form a link between the intact and overgrazed Vygieveld. |
| **Conservation Status of Vegetation Type/Ecosystem** | The vegetation type associated with the study area is listed as least threatened (Northern Knersvlakte Vygieveld and Knersvlakte Shale Vygieveld) (Mucina & Rutherford 2006). Due to impacts discussed in this section, the vegetation composition is only poorly representative of the vegetation type. | | |
| **Habitat integrity/Alien and Invasive species** | The transformed areas have been modified by historic livestock grazing activities, soil and vegetation clearance for the construction and use of service infrastructure and invasion by indigenous species such as *Psilocaulon spp.* These species are known to occur in disturbed places throughout Namaqualand. | | |
| **Presence of Unique Landscapes** | The Knersvlakte is known for its diverse species, especially succulent shrubs and herbs. | | |

## 3.4 Floral Species of Conservation Concern Assessment

Threatened/protected species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species. Furthermore, SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining.

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken. The SANBI PRECIS Red Data Listed plants were acquired for the Quarter Degree Square (QDS) 3018DD and 3118BB. Also taken into consideration was the Threatened or Protected Species (TOPS) Regulations (GN 255 of 2015) under Section 56 (1) of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) and the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009).

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken.

All species listed under PRECIS categorised as per the list below, assessed as part of the Probability of Occurrence (POC) calculations. Species listed under NEMBA TOPS that has a high likelihood to occur within the surrounding area and habitat was used to calculate the POC of SCC or protected species. Species as listed by the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) under Schedule 1 and 2 assessed as part of the POC calculations.

**Table 1: Protected floral species potentially occurring within the QDS's (Raimondo et al., 2009; SANBI, www.sanbi.org), NEMBA TOPS and NCNCA.**

| FAMILY | SPECIES | THREAT STATUS | HABITAT | POC (%) within the focus area |
|---|---|---|---|---|
| **SANBI SCC Floral Species** | | | | |
| **OXALIDACEAE** | ***Oxalis senecta*** | **NT** | **Sandy banks of dry watercourses** | **60%** |
| EUPHORBIACEAE | *Euphorbia fasciculata* | VU | Succulent karoo, occurs among short bushes on sandy flats and sparsely vegetated quartz-strewn flats | 20% |
| IRIDACEAE | *Babiana sambucina* subsp. *longibracteata* | EN | Bokkeveld Sandstone Fynbos, in deep sandy soils on flats and gentle slopes | 20% |
| **MESEMBRYANTHEMACEAE** | ***Phyllobolus chrysophthalmus*** | **Rare** | **Stony soils in Knersvlakte Quartz Vygieveld, growing in bushes, 180-350 m** | **60%** |
| PORTULACACEAE | *Anacampseros comptonii* | VU | Moss pads on seasonally moist sandstone pavements | 30% |
| **NEMBA TOPS Species** | | | | |
| AIZOACEAE | *Cheiridopsis peculiaris* | CR | Gravels and shale derived from metamorphic rocks of the Namaqualand Complex | 60% |

| FAMILY | SPECIES | THREAT STATUS | HABITAT | POC (%) within the focus area |
|---|---|---|---|---|
| **AIZOACEAE** | ***Conophytum herreanthus subsp. Herreanthus*** | **CR** | **Quartz patches** | **60%** |
| ASPHODELACEAE | *Aloidendron pillansii* | EN | Succulent Karoo shrubland on dry, rocky dolomite and gneiss hillsides. | 30% |
| AMARYLLIDACEAE | *Haemanthus granitcus* | EN | Namaqualand Klipkoppe Shrubland or Namaqualand Granite Renosterveld. | 20% |
| **AIZOACEAE** | ***Lithops dorotheae*** | **EN** | **Fine-grained, sheared, feldspathic quartzite** | **60%** |
| ASPHODELACEAE | *Aloidendron dichotomum* | VU | On north-facing rocky slopes (particularly dolomite) in the south of its range. Any slopes and sandy flats in the central and northern parts of range. | 30% |
| AMARYLLIDACEAE | *Brunsvigia herrei* | VU | Succulent Karoo Shrubland, granitic soils on flats and sometimes in deposits of fairly large stones. | 30% |
| **AIZOACEAE** | ***Conophytum bachelorum*** | **VU** | **Rocky outcrops** | **60%** |
| **AIZOACEAE** | ***Conophytum ratum*** | **VU** | **Spongy quartz soil.** | **60%** |
| AMARYLLIDACEAE | *Gethyllis grandiflora* | VU | Sandy and or stony soils in arid karroid shrubland. | 10% |
| AMARYLLIDACEAE | *Brunsvigia josephinae* | VU | Heavy clay soils. | 20% |
| ASPHODELACEAE | *Aloe krapohliana* | P | Occurs in the extremely arid northern regions of the Succulent Karoo, on clay, stony (mostly quarzitic) and sandy soils on flats and slopes. | 20% |
| AIZOACEAE | *Sceletium tortuosum* | P | Quartz patches and is usually found growing under shrubs in partial shade. | 30% |
| PEDALIACEAE | *Harpagophytum procumbens* | P | Well drained sandy habitats in open savanna and woodlands. | 30% |
| **Northern Cape Nature Conservation Act – Schedule 1 & 2** | | | | |
| **AMARYLLIDACEAE** | ***Gethyllis villosa*** | **P** | **Sand or clay on flats or south-facing slopes** | **100%** |
| **APOCYNACEAE** | ***Hoodia gordonii*** | **SP** | **Deep Kalahari sands, on dry stony slopes or flats and under the protection of xerophytic bushes** | **100%** |
| **AIZOACEAE** | ***All Mesembryanthum spp*** | **P** | **Found on a wide range of soil types, from well-drained sandy soils (including sand dunes), to loamy and clay soils. It can tolerate nutritionally poor or saline soils** | **100%** |
| | ***All Drosanthemum spp*** | **P** | **Found on a wide range of soil types** | **100%** |
| | ***All Brownanthus spp*** | **P** | **Shallow soil and in crevices and share the habitat with succulent plant** | **100%** |
| | ***All Phyllobolus spp*** | **P** | **Stony soils in Knersvlakte Quartz Vygie Veld** | **60%** |
| | ***Lampranthus maximiliani*** | **P** | **Well-drained, poor soils** | **100%** |
| | ***Tetragonia microptera*** | **P** | **Terrestrial** | **100%** |
| | ***Ruschia robusta*** | **P** | **Rocky hillsides** | **100%** |
| | ***Delosperma hisidium*** | **P** | **Shallow, poor soils** | **100%** |
| **ASPHODELACEAE** | ***Bulbine torta*** | **P** | **Dry sandstone slabs** | **100%** |

| FAMILY | SPECIES | THREAT STATUS | HABITAT | POC (%) within the focus area |
|---|---|---|---|---|
| | *Trachyandra falcata* | P | Sandy to clay flats and slopes and karroid scrub | 100% |
| CRASSULACEAE | *All species* | P | | 60% |
| OXALIDACEAE | *Oxalis senecta* | P | Sandy banks of dry watercourses | 60% |
| | *Oxalis ambigua* | P | Sandy soils | 100% |
| | *Oxalis luteola* | P | Sandy soils | 100% |
| FABACEAE | *Lessertia frutescens* | P | Dry part of South Africa | 100% |
| HYACINTHACEAE | *Ornithogalum secundum* | P | Stony, clayey flats and slopes | 100% |
| IRIDACEAE | *Lapeirousia spinosa* | P | Semi-arid habitats | 100% |
| | *Moraea collina* | P | Lower slopes and flats of Fynbos | 100% |
| MESEMBRYANTHEMACEAE | *Malephora purpureo-corcea* | P | Knersvlakte | 100% |

**CR= Critically Endangered, NT = Near Threatened, EN= Endangered, VU= Vulnerable, SP = Specially protected, P= Protected**

From this list, numerous species were encountered within the focus area. Suitable habitat is variable within the MRA for these species to also occur.

### 3.4.1 SANBI SCC Floral

Of the SANBI floral SCC listed for in the table above, none were recorded during the summer or winter assessment. Suitable habitat is available for *Phyllobolus* species to occur, increasing the likelihood of *Phyllobolus chrysophthalmus* to be present. The same is for *Oxalis senecta*, and two other *Oxalis* spp. were found during the winter assessment throughout the focus area. This will be verified during the winter assessment.

### 3.4.2 NEMBA TOPS

None of the species listed under Section 56 (1) of the National Environmental Management: Biodiversity Act (Act 10 of 2004): Threatened or Protected Species (TOPS) Regulations (GN 255 of 2015) and published under the Publication of Lists of Species that are Threatened or Protected, Activities that are Prohibited and Exempted from Restriction (GN 256 of 2015), were encountered within the focus area. Species such as *Conophytum herreanthus* subsp. *herreanthus, Conophytum bachelorum* and *Conophytum ratum* were, however calculated to have a POC of 60%. It is likely that suitable habitat for these species are available within the focus area, especially within the Intact Knersvlakte Vygieveld habitat unit. *Lithops* spp. also belonging to the Aizoaceae family, was found within the MRA in outcrop areas east of the freshwater features. It is therefore possible that other *Lithops* spp. with similar habitat is located within the Intact Knersvlakte Vygieveld within the focus area.

### 3.4.3 Northern Cape Nature Conservation Act – Schedule 1 & 2

In addition to SANBI SCC and NEMBA TOPS species, other floral SCC encountered within the focus area include species as being specially protected and protected under the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009). The following species were encountered within the focus area during the summer and winter assessment:

- *Hoodia gordonii;*
- *Mesembryanthum* spp.;
- *Drosanthemum* spp.;
- *Brownanthus* spp.;
- *Lessertia frutescens;*
- *Oxalis ambigua;*
- *Oxalis luteola;*
- *Lampranthus maximiliani;*
- *Ornithogalum secundum;*
- *Lapeirousia spinosa;*
- *Tetragonia microptera*
- *Malephora purpureo-corcea;*
- *Ruschia robusta;*
- *Gethyllis villosa;*
- *Delosperma hisidium;*
- *Bulbine torta;*
- *Trachyandra falcata; and*
- *Moraea collina.*

From the list above, these species protected under NCNCA will be directly impacted by the mining activities. The relevant permits (nursery and harvesting) must be applied for at the relevant provincial authority, as indicated by the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) General Notice 19, Provincial Gazette No. 1589, dated 13 April 2012, Chapter 19. It is recommended that a nursery be constructed on site to grow and maintain indigenous vegetation and SCC while mining activities take place. As concurrent rehabilitation takes place within the phased mining process, these species maintained within the nursery can be replanted to reinstate the areas back to its original state prior to mining. Specialist input will be required for the success of rehabilitation of the indigenous species.

## 3.5 Alien and Invasive Plant Species

Alien and invasive floral species are floral species that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural “check” mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. Therefore, they are often the most dominant and noticeable within an area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

Very few alien and invasive vegetation was noted within the focus area. Mesquite or Suidwesdoring (*Prosopis glandulosa*), Mexican poppy (*Argemone ochroleuca*) and Lindley's saltbush (*Atriplex lindleyi*) are problematic in dry river beds and need to be monitored and controlled. Alien species located in the study area need to be removed on a regular basis as part of maintenance activities according to the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, GN R598 of 2014.

## 3.6 Medicinal Floral Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The table below presents a list of dominant plant species with traditional medicinal value, plant parts traditionally used and their main applications, which were identified during the field assessment. These medicinal species are all commonly occurring species and are not confined to the focus area. However, several of the species below are protected by the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009)

(refer to Section 3.4.3 above). Thus, activities that are to encroach upon the Intact and Overgrazed Vygieveld habitat units, a rescue and relocation plan must be implemented by a suitably qualified ecologist in the correct flowering season for the abovementioned species after obtaining the relevant permits from the NC DENC. Furthermore, care must be taken to limit edge effects on the surrounding natural areas, and mitigation measures specified within Section 5 must be strictly adhered to in order to minimise the spatial scale of potential impacts associated with the mining activities.

**Table 2: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009).**

| Species | Name | Plant parts used | Medicinal uses |
|---|---|---|---|
| ***Hoodia gordonii*** | Bitterghaap | Whole plant | Eaten fresh as food and is used as an appetite-suppressant by shepherd's, paradoxically it can be used as an appetite-stimulant, and it is eaten for abdominal pain suggestive of peptic ulceration. |
| ***Mesembryanthemum spp.*** | | Leaves | Juice of leaves are used for various skin conditions. |
| ***Lessertia frutescens*** | Kankerbos | Leaves | Old Cape remedy for stomach cramps problems and internal cancers. |

# 4 SENSITIVITY MAPPING

The figure below conceptually illustrates the areas considered to be of increased ecological sensitivity with the mining layout and surface infrastructure overlaid. The areas are depicted according to their sensitivity in terms of the presence or potential for floral SCC, habitat integrity and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. Although numerous protected floral species were located throughout the focus area, and where the family of numerous species are protected, only *Hoodia gordonii* was illustrated on the map below. The rest of the proposed family and species were scattered throughout the focus area and difficult to present in the map.

The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

**Table 3: A summary of the sensitivity of each habitat unit and implications for mining.**

| Habitat Unit | Sensitivity | Conservation Objective | Development Implications |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | Intermediate | Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential. | This habitat unit is of intermediate ecological sensitivity. Although mining in this area is unlikely to have a significant impact on the receiving environment, the disturbance timeframes and footprint must be minimised, and care must be taken to limit edge effects on the surrounding sensitive wetland areas. |
| **Overgrazed Knersvlakte Vygieveld** | Moderately Low | Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects. | This habitat unit is of moderately low ecological importance and sensitivity. Activities within this habitat unit must be optimised and limited to the existing disturbance footprint. Care must be taken to limit edge effects on the surrounding sensitive wetland areas. |
| **Ephemeral Drainage Line** | Moderately Low | Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects. | This system is of moderately low importance and sensitivity. The phased mining activities have already taken the ephemeral drainage feature into consideration during the planning phase. No mining activities will take place within the ephemeral drainage lines. |
| **Transformed Areas** | Low | Optimise development potential. | This habitat unit is of low ecological sensitivity due to the current and historic practices. The placement of infrastructure and associated mining areas located within the transformed areas will have no significant impacts on this habitat unit, as the area has already been cleared of vegetation due to current and historic activities. It is however recommended that these transformed areas form part of the rehabilitation actions to reinstate these areas where possible and form a link between the intact and overgrazed Vygieveld. |

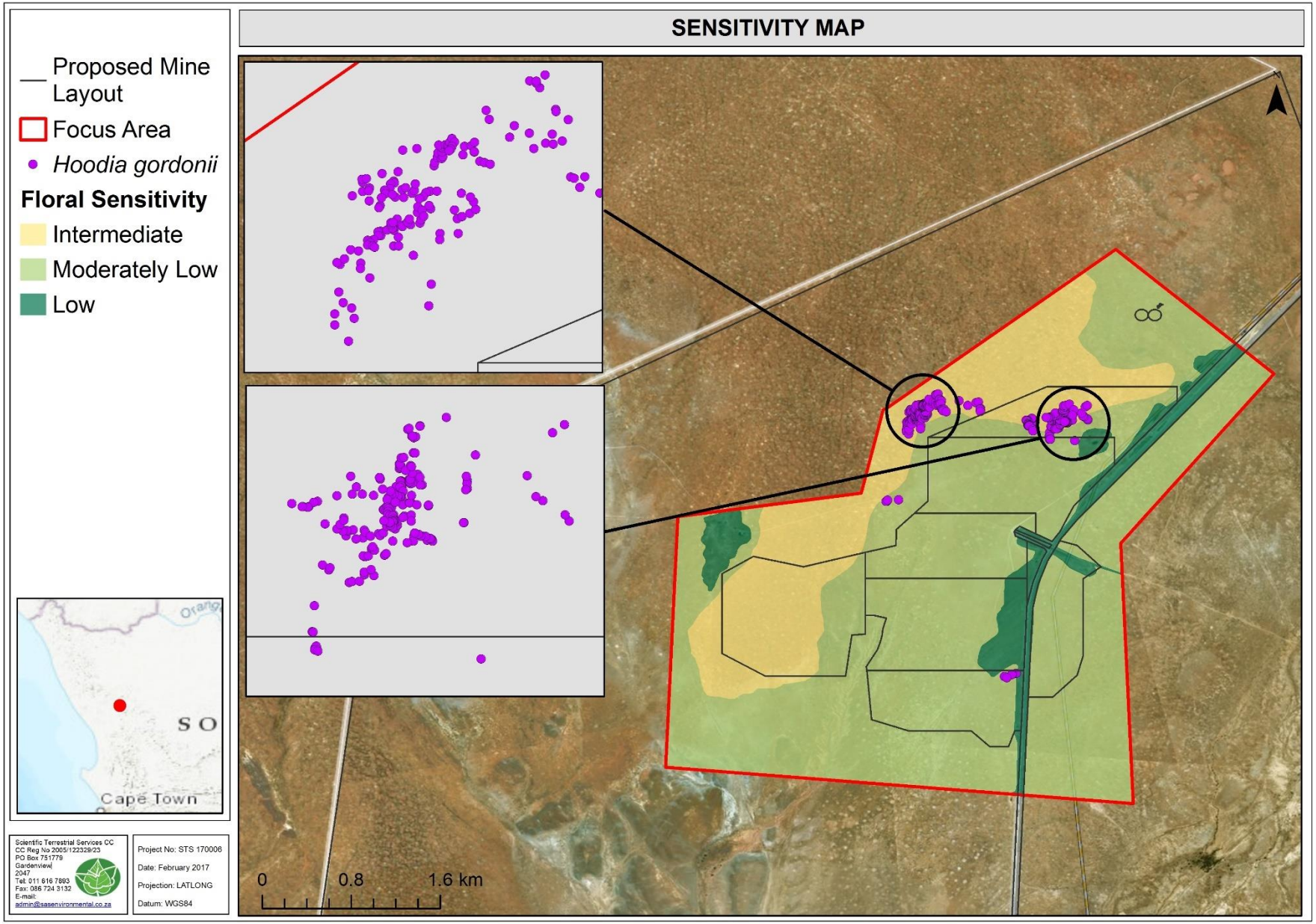



**Figure 3: Sensitivity map for the focus area with the mining and surface infrastructure footprint overlaid.**

# 5 IMPACT ASSESSMENT

The extent of the concentrated Gypsum deposit is approximately 689 ha, while a further 9 ha will be affected by surface infrastructure. The region in which the focus area is located falls within the Knersvlakte Centre of Endemism and is most pronounced among succulents, especially Mesembryanthemaceae. The Knersvlakte is dominated by extensive small-scale framing and mineral deposits, of which Gypsum is most important, leading to a lost in habitat and diversity of floral species. As part of the rehabilitation actions, all disturbed and mined areas must be rehabilitated (concurrently) in accordance to the habitat unit of pre-mining conditions.

**Impact on Floral Diversity and Habitat**

A portion of the proposed mining blocks (northern and western block) are located within the Intact Knersvlakte Vygieveld. This habitat unit is considered to have an intermediate sensitivity due to the presence of floral SCC, where biodiversity needs to be preserved, where possible. Where disturbance are to take place within this habitat unit, implementation of a concurrent rehabilitation plan must be implemented, managed and monitored in order to re-instate the biodiversity of the region post mining. The remainder of the proposed mining blocks and surface infrastructure is located within the Overgrazed Knersvlakte Vygieveld, considered to be of moderately low sensitivity. It is proposed that the surface infrastructure is not expected to have a significant impact on the overall floral diversity of the area, since habitat disturbance and loss of species diversity has already taken place in these areas due to grazing from small-scale farming activities. The propose mining activities within the Overgrazed Knersvlakte Vygieveld is also not likely to have a significant impact within the focus area. It is however imperative that mitigation measures are implemented to ensure no further loss of species habitat and diversity occur outside of the mining footprint area. Furthermore, concurrent rehabilitation and habitat reinstatement is crucial in order to ensure that displaced species are able to recolonise areas post mining activities. All edge effects, erosion and stormwater runoff are to be managed notably in the vicinity of the ephemeral drainage lines in order to ensure that downstream impacts to the freshwater systems does not occur.

### Impacts on Floral SCC

Several floral species are associated with the focus area, where surface infrastructure will be constructed, and mining activities will occur. Therefore, the clearance of vegetation during the construction / operation phase of the mine will result in a loss of floral SCC. Species that will be directly impacts upon as a result of the mining activities include:

- *Hoodia gordonii;*
- *Mesembryanthum* spp.;
- *Drosanthemum* spp.;
- *Brownanthus* spp.;
- *Lessertia frutescens*

The above listed species are specifically at risk from vegetation clearance and the loss of habitat within the Overgrazed and Intact Knersvlakte Vygieveld.

The following table indicates the perceived risks to floral species associated with the activities pertaining to the mining activities, access roads and infrastructure area.

**Table 4: Aspects and Activities register considering floral resources.**

| Pre-Construction | Construction | Operational | Decommissioning and Closure |
|---|---|---|---|
| Potential poor planning leading to excessive or unnecessary clearing of vegetation outside of the demarcated infrastructure areas, mining footprint and access roads | Clearing of vegetation leading to loss of habitat, floral species and floral SCC | Potential erosion stemming from bare soil areas leading to sedimentation of downslope floral habitat | Potential ineffective rehabilitation will lead to the proliferation of alien and invasive plant species and further floral habitat and species loss |
| | Excavation of soils leading to increased runoff and sedimentation of downslope habitat | Additional pressure on floral habitat by increased human populations associated with the proposed mine leading to a loss of floral habitat | Bare soil areas, if not rehabilitated will lead to increased runoff, erosion and the sedimentation of downslope habitats |
| | Dust generation during construction leading to a loss of floral habitat | Footprint creep resulting in additional floral habitat loss | Potential continued loss of habitat due to poor rehabilitation measures will result in a further loss of floral SCC |
| | Runoff/disposal of concrete or other hazardous and construction materials from the infrastructure areas into the surrounding habitat leading to surface hardening, decreased vegetation growth and loss of floral habitat | Dust generation during operational activities leading to a loss of floral habitat | |

| Pre-Construction | Construction | Operational | Decommissioning and Closure |
|---|---|---|---|
| | Loss of floral diversity through invasion of alien species in disturbed areas | Increased fire frequency during operation leading to a loss of sensitive floral habitat | |
| | Movement of construction vehicles and access roads other than existing and what was planned | | |
| | Compaction of soils outside of the mining footprint area, reducing the efficiency of floral re-establishment | | |
| | Increased fire frequency during construction leading to a loss of sensitive floral habitat | | |

## 5.1 Assessment Summary

The tables below serve to summarise the findings of the impact study undertaken with reference to the perceived impacts stemming from the proposed mining activities of the Kanakies Mine as found in Appendix E. The tables below indicate the significance of the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post mitigation impact scores will increase. Due to the already highly degraded nature of the Transformed areas, this habitat was not included in the below impact assessment. All impacts associated with the Transformed habitat can be considered to be of very low significance throughout all phases of the proposed mining. Nonetheless, although the Transformed habitat is considered to already be in a degraded state, it is imperative that all mitigation measures still be applied in order to minimise edge effects and impacts to the surrounding habitats.

**Mine Surface Infrastructure Areas**

The following tables represent the findings of the impact assessment pertaining to the proposed surface infrastructure areas, which consist of:

- Mobile crushing and high frequency screening plant;
- Shipping container type office block and ablution facility, with a high roof shed;
- Vehicle parking area and fuel storage area;
- Product stockpile area;

- Run of Mine stockpile; and
- Access Roads.

**Table 5: A summary of the impact significance on floral resources in the construction phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**Table 6: A summary of the impact significance on floral resources in the operational phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**Table 7: A summary of the impact significance on floral resources in the decommissioning/ rehabilitation phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Overgrazed Knersvlakte Vygieveld** | Impact on *floral* habitat and species diversity | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

### Mining Areas

The following tables represent the findings of the impact assessment pertaining to the proposed mining activities. The deposit will be harvested by means of roll-over trench mining and the depth of the trench will vary between 1.4 and 2.5m. The following steps will be undertaken:

- Removal of overburden material;
- Mining of powder layer;
- Mining of crystal-containing clay layer;
- Screening of powder layer to remove foreign materials;
- The clay layer will be roll-crushed and screened; and
- Material will be sold from the stockpile or blended to optimise quality.

**Table 8: A summary of the impact significance on floral resources in the construction phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Ephemeral Drainage Lines** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**Table 9: A summary of the impact significance on floral resources in the operational phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Ephemeral Drainage Lines** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

**Table 10: A summary of the impact significance on floral resources in the decommissioning/ rehabilitation phase.**

| Site | Impact | Unmanaged | Mitigated |
|---|---|---|---|
| **Intact Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium High | Medium Low |
| | *Impact on floral SCC* | Medium High | Medium Low |
| **Overgrazed Knersvlakte Vygieveld** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium High | Low |
| **Ephemeral Drainage Lines** | *Impact on floral habitat and species diversity* | Medium Low | Low |
| | *Impact on floral SCC* | Medium Low | Low |

## *5.2 Integrated Impact Mitigation*

The table below highlights the key integrated mitigation measures that are applicable to the infrastructure layout and mining areas as well as the access roads in order to suitably manage and mitigate the ecological impacts that are associated with the construction and operation phases of the proposed activities. Provided that all the management and mitigation measures as stipulated in this report are implemented the overall risk to floral diversity, habitat and floral SCC can be adequately mitigated and minimised.

**Table 11: A summary of the mitigatory requirements for floral resources**

| | |
|---|---|
| **Project phase** | *Construction Phase* |
| **Impact Summary** | *Loss of floral habitat, species and floral SCC* |
| **Management Measures** | ***Proposed mitigation and management measures:*** |
| | - Vegetation outside of planned footprints is not to be cleared;<br>- It is recommended that site clearing take place in a phased manner to reduce the impact of bare soils, erosion and sedimentation of areas downgradient;<br>- As far as possible the infrastructure areas and open cast areas should be accessed through the existing road network;<br>- Vegetation clearance and commencement of construction activities should be controlled and managed in a phased manner. Stormwater controls during winter rainfall periods must be established at the start of construction and dust suppression implemented;<br>- Excavated topsoil must be stored with associated native vegetation debris for subsequent use in rehabilitation;<br>- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect surrounding floral habitat, need to be strictly managed in adjacent natural areas;<br>- All soils compacted as a result of construction activities falling outside of development footprint areas should be lightly ripped and profiled;<br>- Initiate an alien and invasive plant control plan;<br>- No collection of floral SCC or medicinal floral species must be allowed by construction or mining personnel;<br>- Development of a nursery may be considered where indigenous/endemic plant species must be propagated with focus on rehabilitation in conjunction with a suitably qualified specialist;<br>- Rehabilitation trials must be continuously undertaken from the commencement of construction in order to determine the efficiency of rehabilitation methods and the suitability of flora propagated in the nursery for rehabilitation;<br>- A floral SCC rescue, relocation, monitoring and management plan must be designed and implemented by a suitably qualified specialist and should address all species which can be successfully rescued and relocated;<br>- During the surveying and site-pegging phase of surface infrastructure, all floral SCC that will be affected by surface infrastructure must be marked and where possible, relocated to suitable habitat surrounding the disturbance footprint. The relevant permits must be applied for within the relevant province as indicated in the baseline floral assessment, prior to the construction phase; |

| | |
|---|---|
| | - The number of floral SCC removed for construction of the infrastructure should be kept to a minimum and no plants should be needlessly destroyed;<br>- Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a suitably qualified botanist;<br>- Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area;<br>- Spills and /or leaks from mine equipment must be immediately remedied and cleaned up so as to ensure that these chemicals/hydrocarbons do not contaminate the soils; and<br>- No informal fires by construction personnel are allowed. |
| **Project phase** | *Operational and Closure Phase* |
| **Impact Summary** | *Loss of floral habitat, species and floral SCC* |
| **Management Measures** | **Proposed mitigation and management measures:** |
| | - When accessing the mining areas vehicles are to utilise the existing roads;<br>- Continually monitor the operational areas and ensure that further disturbance of the surrounding habitat is not occurring;<br>- Ensure adequate dust suppression is taking place;<br>- Ensure that no unnecessary clearing of habitat occurs;<br>- No informal fires by construction personnel are allowed;<br>- Following heavy rains, access roads and areas of disturbance are to be inspected for signs of erosion, which if found must be immediately rectified through appropriate erosion control measures;<br>- Permits required for protected floral species needs to be removed or applied for as the phased mining takes place;<br>- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a suitable specialist. This rehabilitation plan should consider all development phases of the project indicating rehabilitation actions to be undertaken during and once construction has been completed, ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during closure;<br>- As much vegetation growth as possible should be promoted within the rehabilitated areas in order to protect the soils;<br>- Monitor the success of rehabilitation efforts of open cast mining areas and access roads seasonally; and<br>- Continue with and update the alien and invasive plant control plan accordingly. |

## *5.3 Probable Latent Impacts*

Even with extensive mitigation, significant latent impacts on the receiving floral ecological environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Continued loss of floral habitat and habitat for SCC associated with the mining footprint are, although such habitat are not unique to the mining footprint area;
- Where floral habitats have been disturbed, it is highly unlikely that these would be rehabilitated to pre-development conditions of ecological functioning. Should controlled, managed and monitoring of rehabilitation work not take place, the habitat and species diversity loss for this area will be significant;
- Alien and invasive plant proliferation in disturbed areas as well as edge effects from the mining footprint and activities. Alien vegetation will outcompete natural and

indigenous species, leading to a further loss of species diversity in the centre of endemism and to the surrounding environment.; and

- The loss of SCC and / or protected floral species which could not be rescued and relocated. Protected species and SCC lost will further increase the pressure of the existence of these species in a natural environment. It is critical that all protected species be kept in a nursery or species must be sourced from local nurseries. The seedbank at the SANBI Kirstenbosch Botanical Garden in Cape Town can also be consulted to obtain seeds as part of the rehabilitation activities and process

## *5.4 Cumulative Impacts*

Even with the implementation of mitigation measures, cumulative impacts would still occur throughout the mining process to a lower significance level. The proposed infrastructure areas and open cast pits will result in clearance of indigenous vegetation within the demarcated focus area. The focus area is located within the Knersvlakte Centre of Endemism. Significant habitat loss has already occurred within the centre of endemism, largely due to small scale farming and to some extent mining. It is crucial that concurrent rehabilitation works take place within the mining area in order to reinstate the veld to the state of pre-mining within the Intact Knersvlakte Vygieveld. It is important to note that should rehabilitation measures not be implemented during and after mining, the potential of the habitat to be transformed as currently noted in the transformed habitat unit (large bare open soil areas), is high.

# 6 PUBLIC PARTICIPATION

A meeting was held on the 9th of February 2018 as part of the Scoping Phase of the EIA and a legal requirement. The Scoping Report was made available for public review between the 27th of March – 29th of April 2018, at which time Interested and Affected Parties (I&APs) were allowed to comment on the proposed project. A second Public Meeting is scheduled for the 29th of August 2018 to summarise the findings from the specialist studies for I&APs, which will be held concurrently with the public review of the EIA EMP report. Any comments received during the second round of public review will be addressed as part of the public participation process.

## 6.1 Brief Summary of Concerns and Issues Raised By I&APs

The following table summarises the issues raised by I&AP's during the Scoping phase public consultation on the relevant specialist report.

| Comment received by I&AP's during Scoping Phase | Response |
|---|---|
| Proximity of the Kalk Gat Reserve to the proposed operations. This is a protected area. Appropriate buffer zones must be recommended and established | With reference to the comments concerning the Kalk Gat Private Reserve, although the western portion of the MRA does border the reserve, the actual focus area is located approximately 6km north-east of this reserve, and as such mining activities, provided mitigation measure are suitable implemented, are unlikely to impact upon the reserve. According to the NEMA Regulations 2017, "buffer" means an area extending 5km from the proclaimed boundary of nature reserve or that defined as such for a biosphere. |
| Certain areas have been mapped as areas of biodiversity importance appropriate ecological buffers should be recommended by the specialists and implemented | Refer to Section 4.2.2 for requirements on the buffer zones. |
| Plant species of concern must be relocated in the Loeriesfontein area | All SCC and protected plant species, where possible must be rescued and relocated to an onsite nursery or to suitable habitat outside of the mining footprint area, but within the MRA. Where rescue and relocation is not possible, Protected species destroyed must be propagated in a nursery at a ratio of 1:5. |
| Waste generation and management | Refer to Section 5.5.3. for mitigation on contamination management. |

# 7 CONCLUSION

Scientific Terrestrial Services (STS) was appointed to conduct a terrestrial ecological assessment as part of the environmental impact assessment and authorisation process for the proposed mining of natural gypsum (Gy) on the Portion 0 (remaining extent) of the farm Kanakies 332, near Loeriesfontein, Northern Cape, henceforth referred to as the Mining Right Area (MRA). The extent of the MRA is approximately 7457.70 ha, while the concentrated gypsum deposit is approximately 689 ha, while a further 9 ha will be affected by surface infrastructure. The deposit consists of 2 layers of gypsum i.e. a powder layer and nodular crystalline (clay) layer of gypsum. The area where the gypsum deposit is concentrated will henceforth be referred to as the "focus area". The field assessment and this report was confined to the focus area.

A portion of the proposed mining blocks (northern and western block) are located within the Intact Knersvlakte Vygieveld. This habitat unit is considered to have an intermediate sensitivity due to the presence of floral SCC, where biodiversity needs to be preserved, where possible.

The remainder of the proposed mining blocks and surface infrastructure is located within the Overgrazed Knersvlakte Vygieveld, considered to be of moderately low sensitivity. It is proposed that the surface infrastructure is not expected to have a significant impact on the overall floral diversity of the area, since habitat disturbance and loss of species diversity has already taken place in these areas due to grazing from small-scale farming activities. The mining activities are likely to have an impacts on the floral habitat as this will be unavoidable.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement Integrated Environmental Management and to ensure that the best long-term use of the ecological resources in the focus areas will be made in support of the principle of sustainable development. With the implementation and management of the proposed mitigation measures, impacts associated with the mining activities on the floral community, and specifically the SCC and protected species, can be reduced to a lower significance rating. Concurrent rehabilitation must be implemented to ensure that post construction objectives are met, and that surrounding habitat is supported and remain in a functional state.

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# APPENDIX A: Floral method of Assessment

## *Floral Species of Conservational Concern Assessment*

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from SANBI for the Quarter Degree Square in which the study area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC was determined using the following calculations wherein the distribution range for the species, specific habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Each factor contributes an equal value to the calculation.

| **Distribution** | | | | | | |
|---|---|---|---|---|---|---|
| | **Outside of known distribution range** | | | | | **Inside known distribution range** |
| **Site score** | | | | | | |
| **EVC 1 score** | 0 | 1 | 2 | 3 | 4 | 5 |
| **Habitat availability** | | | | | | |
| | **No habitat available** | | | | | **Habitat available** |
| **Site score** | | | | | | |
| **EVC 1 score** | 0 | 1 | 2 | 3 | 4 | 5 |
| **Habitat disturbance** | | | | | | |
| | **0** | **Very low** | **Low** | **Moderate** | **High** | **Very high** |
| **Site score** | | | | | | |
| **EVC 1 score** | 5 | 4 | 3 | 2 | 1 | 0 |

[Distribution + Habitat availability + Habitat disturbance] / 15 x 100 = POC%

## *Floral Habitat Sensitivity*

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the floral habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in question. In order to present the results use is made of spider diagrams to depict the significance of

each aspect of floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

**Table A1: Floral habitat sensitivity rankings and associated land-use objectives.**

| Score | Rating significance | Conservation objective |
|---|---|---|
| 1> and <2 | Low | Optimise development potential. |
| 2> and <3 | Moderately low | Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects. |
| 3> and <4 | Intermediate | Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential. |
| 4> and <5 | Moderately high | Preserve and enhance the biodiversity of the habitat unit limit development and disturbance. |
| 5 | High | Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered. |

# APPENDIX B: Impact Assessment Methodology

## *Ecological Impact Assessment Method*

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[2]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table D1. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary[3].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

[2] The definition has been aligned with that used in the ISO 14001 Standard.

[3] Some risks/impacts that have low significance will however still require mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

**Table B1: Criteria for assessing significance of impacts**

**LIKELIHOOD DESCRIPTORS**

| **Probability of impact** | **RATING** |
|---|---|
| Highly unlikely | 1 |
| Possible | 2 |
| Likely | 3 |
| Highly likely | 4 |
| Definite | 5 |
| **Sensitivity of receiving environment** | **RATING** |
| Ecology not sensitive/important | 1 |
| Ecology with limited sensitivity/importance | 2 |
| Ecology moderately sensitive/ /important | 3 |
| Ecology highly sensitive /important | 4 |
| Ecology critically sensitive /important | 5 |

**CONSEQUENCE DESCRIPTORS**

| **Severity of impact** | **RATING** |
|---|---|
| Insignificant / ecosystem structure and function unchanged | 1 |
| Small / ecosystem structure and function largely unchanged | 2 |
| Significant / ecosystem structure and function moderately altered | 3 |
| Great / harmful/ ecosystem structure and function largely altered | 4 |
| Disastrous / ecosystem structure and function seriously to critically altered | 5 |
| **Spatial scope of impact** | **RATING** |
| Activity specific/ < 5 ha impacted / Linear developments affected < 100m | 1 |
| Development specific/ within the site boundary / < 100ha impacted / Linear developments affected < 100m | 2 |
| Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear developments affected < 1000m | 3 |
| Regional within 5 km of the site boundary / < 2000ha impacted / Linear developments affected < 3000m | 4 |
| Entire habitat unit / Entire system/ > 2000ha impacted / Linear developments affected > 3000m | 5 |
| **Duration of impact** | **RATING** |
| One day to one month | 1 |
| One month to one year | 2 |
| One year to five years | 3 |
| Life of operation or less than 20 years | 4 |
| Permanent | 5 |

**Table B2: Significance Rating Matrix.**

| LIKELIHOOD (Frequency of activity + Frequency of impact) | CONSEQUENCE (Severity + Spatial Scope + Duration) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 |
| | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 | 56 | 60 |
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |
| | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 66 | 72 | 78 | 84 | 90 |
| | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 84 | 91 | 98 | 105 |
| | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 | 88 | 96 | 104 | 112 | 120 |
| | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 90 | 99 | 108 | 117 | 126 | 135 |
| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |

**Table B3: Positive/Negative Mitigation Ratings.**

| Significance Rating | Value | Negative Impact Management Recommendation | Positive Impact Management Recommendation |
|---|---|---|---|
| Very high | 126-150 | Critically consider the viability of proposed projects<br>Improve current management of existing projects significantly and immediately | Maintain current management |
| High | 101-125 | Comprehensively consider the viability of proposed projects<br>Improve current management of existing projects significantly | Maintain current management |
| Medium-high | 76-100 | Consider the viability of proposed projects<br>Improve current management of existing projects | Maintain current management |
| Medium-low | 51-75 | Actively seek mechanisms to minimise impacts in line with the mitigation hierarchy | Maintain current management and/or proposed project criteria and strive for continuous improvement |
| Low | 26-50 | Where deemed necessary seek mechanisms to minimise impacts in line with the mitigation hierarchy | Maintain current management and/or proposed project criteria and strive for continuous improvement |
| Very low | 1-25 | Maintain current management and/or proposed project criteria and strive for continuous improvement | Maintain current management and/or proposed project criteria and strive for continuous improvement |

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction; and
  - Operation.
- If applicable, transboundary or global effects were assessed.
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

## *Mitigation measure development*

According to the DEA *et al.,* (2013) “Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fibre; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands”.

According to the DEA *et al.,* (2013) Ecosystem services can be divided into 4 main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fibre, medicine, and fresh water;
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment;
- Regulating services are the benefits obtained from an ecosystem’s control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards; and
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods. The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA, 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.

Sustainable development is enshrined in South Africa’s Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act), and is fundamental to the notion of sustainable development. In addition, International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DEA *et al.,* 2013).

The primary environmental objective of the Mineral and Petroleum Resources Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that “any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations”.

Pressures on biodiversity are numerous and increasing. According to the DEA *et al.,* (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[4]:

- Cultivation and grazing activities;
- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DEA *et al.,* 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from riverine resources;
- **Indirect impacts:** are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;

[4] Limpopo Province Environment Outlook. A Report on the State of the Environment, 2002. Chapter 4.

- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries; and
- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted the definition of a clear mitigation strategy for biodiversity impacts.

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other land use. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et al.,* 2013):

- **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases, if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
- **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
- **Rehabilitate impact:** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation tool as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
  - **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
  - **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the focus area supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
  - **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
  - **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.
- **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[5]

In light of the above discussion the following points present the key concepts considered in the development of mitigation measures for the proposed development.

- Mitigation and performance improvement measures and actions that address the risks and impacts[6] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation wherever possible.

## *Recommendations*

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

[5] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.

[6] Mitigation measures should address both positive and negative impacts

# APPENDIX C: Floral SCC

**Table C1: Protected floral species potentially occurring within the QDS's (Raimondo et al., 2009; SANBI, www.sanbi.org), NEMBA TOPS and NCNCA. Species with a POC of higher than 60% or was found on site during the two field assessments, were highlighted in Bold.**

| FAMILY | SPECIES | THREAT STATUS | HABITAT | POC (%) within the focus area |
|---|---|---|---|---|
| **SANBI SCC Floral Species** | | | | |
| **OXALIDACEAE** | ***Oxalis senecta*** | **NT** | **Sandy banks of dry watercourses** | **60%** |
| EUPHORBIACEAE | *Euphorbia fasciculata* | VU | Succulent karoo, occurs among short bushes on sandy flats and sparsely vegetated quartz-strewn flats | 20% |
| IRIDACEAE | *Babiana sambucina* subsp. *longibracteata* | EN | Bokkeveld Sandstone Fynbos, in deep sandy soils on flats and gentle slopes | 20% |
| **MESEMBRYANTHEMACEAE** | ***Phyllobolus chrysophthalmus*** | **Rare** | **Stony soils in Knersvlakte Quartz Vygie Veld, growing in bushes, 180-350 m** | **60%** |
| PORTULACACEAE | *Anacampseros comptonii* | VU | Moss pads on seasonally moist sandstone pavements | 30% |
| **NEMBA TOPS Species** | | | | |
| AIZOACEAE | *Cheiridopsis peculiaris* | CR | Gravels and shale derived from metamorphic rocks of the Namaqualand Complex | 60% |
| **AIZOACEAE** | ***Conophytum herreanthus subsp. Herreanthus*** | **CR** | **Quartz patches** | **60%** |
| ASPHODELACEAE | *Aloidendron pillansii* | EN | Succulent Karoo shrubland on dry, rocky dolomite and gneiss hillsides. | 30% |
| AMARYLLIDACEAE | *Haemanthus granitcus* | EN | Namaqualand Klipkoppe Shrubland or Namaqualand Granite Renosterveld. | 20% |
| **AIZOACEAE** | ***Lithops dorotheae*** | **EN** | **Fine-grained, sheared, feldspathic quartzite** | **60%** |
| ASPHODELACEAE | *Aloidendron dichotomum* | VU | On north-facing rocky slopes (particularly dolomite) in the south of its range. Any slopes and sandy flats in the central and northern parts of range. | 30% |
| AMARYLLIDACEAE | *Brunsvigia herrei* | VU | Succulent Karoo Shrubland, granitic soils on flats and sometimes in deposits of fairly large stones. | 30% |
| **AIZOACEAE** | ***Conophytum bachelorum*** | **VU** | **Rocky outcrops** | **60%** |
| **AIZOACEAE** | ***Conophytum ratum*** | **VU** | **Spongy quartz soil.** | **60%** |
| AMARYLLIDACEAE | *Gethyllis grandiflora* | VU | Sandy and or stony soils in arid karroid shrubland. | 10% |
| AMARYLLIDACEAE | *Brunsvigia josephinae* | VU | Heavy clay soils. | 20% |
| ASPHODELACEAE | *Aloe krapohliana* | P | Occurs in the extremely arid northern regions of the Succulent Karoo, on clay, stony (mostly quarzitic) and sandy soils on flats and slopes. | 20% |
| AIZOACEAE | *Sceletium tortuosum* | P | Quartz patches and is usually found growing under shrubs in partial shade. | 30% |
| PEDALIACEAE | *Harpagophytum procumbens* | P | Well drained sandy habitats in open savanna and woodlands. | 30% |

| FAMILY | SPECIES | THREAT STATUS | HABITAT | POC (%) within the focus area |
|---|---|---|---|---|
| | | | | |
| Northern Cape Nature Conservation Act – Schedule 1 & 2 | | | | |
| APOCYNACEAE | *Hoodia gordonii* | SP | Deep Kalahari sands, on dry stony slopes or flats and under the protection of xerophytic bushes | 100% |
| AIZOACEAE | *All Mesembryanthum spp* | P | Found on a wide range of soil types, from well-drained sandy soils (including sand dunes), to loamy and clay soils. It can tolerate nutritionally poor or saline soils | 100% |
| | *All Drosanthemum spp* | P | Found on a wide range of soil types | 100% |
| | *All Brownanthus spp* | P | Shallow soil and in crevices and share the habitat with succulent plant | 100% |
| | *All Phyllobolus spp* | P | Stony soils in Knersvlakte Quartz Vygie Veld | 60% |
| FABACEAE | *Lessertia frutescens* | P | Dry part of South Africa | 100% |
| CRASSULACEAE | *All species* | P | | 60% |
| OXALIDACEAE | *Oxalis senecta* | P | Sandy banks of dry watercourses | 60% |

# APPENDIX D: Floral Species List

**Table D1: Dominant floral species encountered in the focus area during the summer and winter assessment. Alien species are indicated with an asterisk (*). Protected species as indicated in Bold.**

| Species | Intact Knersvlakte Vygieveld | Overgrazed Knersvlakte Vygieveld | Ephemeral Drainage Line |
|---|---|---|---|
| ***Hoodia gordonii*** | *X* | *X* | |
| *Augea capensis* | *X* | X | |
| **Atriplex lindleyi* | | *X* | X |
| *Deverra denudate* | X | | |
| ***Mesembryanthemum spp*** | *X* | X | |
| ***Brownanthus spp*** | *X* | | |
| *Psilocaulon spp* | | X | |
| ***Lithops spp***[7] | | | |
| *Arenifera stylosa* | *X* | *X* | |
| **Prosopis glandulosa (3)* | | | X |
| ***Drosanthemum spp*** | *X* | X | |
| *Massonia depressa* | X | X | |
| *Lachenalia cornosa* | X | | |
| ***Oxalis ambigua*** | X | X | |
| ***Lessertia frutescens***[8] | | | |
| ***Oxalis luteola*** | X | X | |
| ***Lampranthus maximiliani*** | X | X | |
| *Androcymbium scabromorginatum* | X | | |
| *Zaluzianskya affinis* | X | | |
| *Lyperia spp* | | X | |
| *Gazania lichtensteinii* | X | X | |
| *Amellus tridactylus* | X | | |
| ***Ornithogalum secundum*** | X | | |
| ***Lapeirousia spinosa*** | X | X | |
| *Sarcocornia xerophila* | X | | |
| ***Tetragonia microptera*** | X | X | |
| ***Mesembryanthemum guerichianum*** | X | X | |
| ***Drosanthemum hispidum*** | X | | |
| ***Malephora purpureo-corcea*** | | | |
| *Zygophyllum cordifolium* | X | | |
| ***Ruschia robusta*** | X | X | |
| *Augea capensis* | X | X | |
| ***Gethyllis villosa*** | X | | |
| ***Delosperma hisidium*** | X | X | |
| *Panicum natalense* | X | X | X |
| *Schizachyrium sanguineum* | X | | |
| *Trachypogon spicatus* | X | X | |
| ***Bulbine torta*** | X | X | |
| *Albuca suaveolens* | X | X | |
| *Chlorophytum undulatum* | X | X | |
| *Dimorphotheca sinuata* | X | | |
| ***Trachyandra falcata*** | | X | |
| *Lachenalia zebrina* | X | X | |
| ***Moraea collina*** | X | | |
| *Lapeirousia spp.* | X | | |
| *Amellus tridactylus* | X | X | |

**3: Category 3** – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

[7] *Lithops* spp. also belonging to the Aizoaceae family was found within the MRA in outcrop areas east of the freshwater features.
[8] Lessertia frutescens was found within the MRA close to the freshwater features.

# APPENDIX E: Floral Impact Assessment Tables

## E1. Impact assessment pertaining to the proposed infrastructure areas

The following tables highlight the perceived impact pertaining to the relevant habitats affected by the proposed mining infrastructure areas, namely the Overgrazed Vygieveld Habitat.

**Table 12: Impact on floral habitat and species diversity of the Overgrazed Vygieveld**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 3 | 2 | 3 | 8 | 8 | 64 (Medium Low) |
| Operational phase | 5 | 3 | 3 | 2 | 4 | 8 | 9 | 72 (Medium Low) |
| Decommissioning and Closure | 3 | 3 | 3 | 2 | 5 | 6 | 11 | 66 (Medium Low) |
| **Managed** | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 2 | 1 | 2 | 8 | 5 | 40 (Low) |
| Operational phase | 3 | 3 | 2 | 1 | 4 | 6 | 7 | 42 (Low) |
| Decommissioning and Closure | 2 | 3 | 2 | 1 | 3 | 5 | 6 | 30 (Low) |

**Table 13: Impact on floral SCC in the Overgrazed Vygieveld**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 3 | 2 | 3 | 8 | 8 | 64 (Medium Low) |
| Operational phase | 5 | 3 | 3 | 2 | 4 | 8 | 9 | 72 (Medium Low) |
| Decommissioning and Closure | 4 | 3 | 3 | 2 | 5 | 7 | 10 | 70 (Medium Low) |
| **Managed** | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 2 | 1 | 2 | 8 | 5 | 45 (Low) |
| Operational phase | 4 | 3 | 2 | 1 | 4 | 7 | 7 | 49 (Low) |
| Decommissioning and Closure | 3 | 3 | 2 | 1 | 3 | 6 | 6 | 36 (Low) |

## E2. Impact assessment pertaining to the proposed mining activities

The following tables highlight the perceived impacts pertaining to the relevant habitats affected by the planned open cast mining activities, namely the Overgrazed and Intact Vygieveld Habitats.

**Table 14: Impact on floral habitat and species diversity of the Intact Vygieveld**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 4 | 4 | 4 | 3 | 9 | 11 | 99 (Medium High) |
| Operational phase | 5 | 4 | 4 | 3 | 4 | 9 | 11 | 99 (Medium High) |
| Decommissioning and Closure | 4 | 4 | 3 | 4 | 5 | 8 | 12 | 96 (Medium High) |
| Managed | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 4 | 3 | 3 | 2 | 9 | 8 | 72 (Medium Low) |
| Operational phase | 3 | 4 | 3 | 3 | 3 | 7 | 9 | 63 (Medium Low) |
| Decommissioning and Closure | 3 | 4 | 3 | 2 | 3 | 7 | 8 | 56 (Medium Low) |

**Table 15: Impact on floral SCC in the Intact Vygieveld**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 4 | 4 | 4 | 3 | 9 | 11 | 99 (Medium High) |
| Operational phase | 5 | 4 | 4 | 3 | 4 | 9 | 11 | 99 (Medium High) |
| Decommissioning and Closure | 3 | 4 | 3 | 4 | 5 | 7 | 12 | 84 (Medium High) |
| Managed | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 4 | 3 | 3 | 2 | 9 | 8 | 72 (Medium Low) |
| Operational phase | 3 | 4 | 3 | 3 | 3 | 7 | 9 | 63 (Medium Low) |
| Decommissioning and Closure | 3 | 4 | 3 | 2 | 3 | 7 | 7 | 56 (Medium Low) |

**Table 16: Impact on floral habitat and species diversity of the Overgrazed Vygieveld**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 3 | 4 | 3 | 8 | 10 | 80 (Medium High) |
| Operational phase | 5 | 3 | 3 | 3 | 4 | 8 | 10 | 80 (Medium High) |
| Decommissioning and Closure | 3 | 3 | 3 | 4 | 5 | 6 | 12 | 72 (Medium Low) |
| **Managed** | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 2 | 3 | 3 | 8 | 8 | 64 (Medium Low) |
| Operational phase | 3 | 3 | 2 | 2 | 4 | 6 | 8 | 48 (Low) |
| Decommissioning and Closure | 2 | 3 | 2 | 2 | 3 | 5 | 7 | 35 (Low) |

**Table 17: Impact on floral SCC in the Overgrazed Vygieveld**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 4 | 4 | 3 | 8 | 11 | 88 (Medium High) |
| Operational phase | 5 | 3 | 4 | 3 | 4 | 8 | 11 | 88 (Medium High) |
| Decommissioning and Closure | 4 | 3 | 3 | 4 | 5 | 7 | 12 | 84 (Medium High) |
| **Managed** | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 3 | 3 | 3 | 8 | 9 | 72 (Medium Low) |
| Operational phase | 4 | 3 | 3 | 2 | 4 | 7 | 9 | 63 (Medium Low) |
| Decommissioning and Closure | 3 | 3 | 2 | 2 | 3 | 6 | 7 | 42 (Low) |

**Table 18: Impact on floral habitat and species diversity of the Ephemeral Drainage Lines**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 3 | 2 | 3 | 8 | 8 | 64 (Medium Low) |
| Operational phase | 5 | 3 | 3 | 2 | 4 | 8 | 9 | 72 (Medium Low) |
| Decommissioning and Closure | 3 | 3 | 3 | 2 | 5 | 6 | 11 | 66 (Medium Low) |
| **Managed** | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 2 | 1 | 2 | 8 | 5 | 40 (Low) |
| Operational phase | 3 | 3 | 2 | 1 | 4 | 6 | 7 | 42 (Low) |
| Decommissioning and Closure | 2 | 3 | 2 | 1 | 3 | 5 | 6 | 30 (Low) |

**Table 19: Impact on floral SCC in the Ephemeral Drainage Lines**

| Unmanaged | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 3 | 2 | 3 | 8 | 8 | 64 (Medium Low) |
| Operational phase | 5 | 3 | 3 | 2 | 4 | 8 | 9 | 72 (Medium Low) |
| Decommissioning and Closure | 4 | 3 | 3 | 2 | 5 | 7 | 10 | 70 (Medium Low) |
| **Managed** | | | | | | | | |
| | Probability of Impact | Sensitivity of receiving environment | Severity | Spatial scale | Duration of impact | Likelihood | Consequence | Significance |
| Construction phase | 5 | 3 | 2 | 1 | 2 | 8 | 5 | 45 (Low) |
| Operational phase | 4 | 3 | 2 | 1 | 4 | 7 | 7 | 49 (Low) |
| Decommissioning and Closure | 3 | 3 | 2 | 1 | 3 | 6 | 6 | 36 (Low) |