BCR MINERALS (Pty) Ltd SPITSVALE MINING APPLICATION: TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT REPORT

PREPARED FOR:

ENVIRONMENTAL MANAGEMENT ASSISTANCE

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DATE:

January 2016

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DECLARATION

I, **Marianne Strohbach**, declare that -

- I act as the independent specialist;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

M Strohbach.

Signature of specialist

18 February 2016

Date

1 EXECUTIVE SUMMARY

BCR Minerals (Pty) Ltd has appointed Environmental Management Assistance to manage the EIA process for mining operations to extract chromium and related minerals near Steelpoort in the Limpopo Province.

The acceptance of scoping letter indicated following requisites for the EIA:

4) d) Details of the future land use for the site and infrastructure after decommissioning in 20-30 years

4) g) Possible impacts and effects of the development on the vegetation ecology with regard to lowland-highland interface in the locality should be indicated

4) k) A construction and operational phase in the EMPR should include mitigation and monitoring measures

4) l) Should blasting be required, appropriate mitigation measures should be provided

6) Maps of vegetation types of study area

This report discusses the approach and findings of a desktop and field survey carried out on the study area, to assess and verify ecological sensitivities occurring within the study area in an effort to identify any issues regarding fauna and flora that.

The area was visited for a field study from 11 - 15 January 2016. Although most of the vegetation was relatively green at the time, there was a noticeable absence of annual and geophytes due to the prevailing drought conditions.

Limpopo Conservation Plan (Desmet *et al.* 2013) as well as the Mining Guidelines (2013) depict most of the study as of moderate to high importance biodiversity areas, with which mining activities and creation of new infrastructure is not considered compatible. The field study confirmed the presence of many unique habitats that can never be re-created after destruction, and which also ensure the perseverance of many unique species, of which several are either endemic to Sekhukhuneland, protected or already threatened. As there are a multitude of other urban developments and mines adjacent and in close proximity of the study area, the anticipated mining activities will further reduce habitat valuable for this unique vegetation.

A list of plant species that has been recorded to date in the representative grid has been obtained from the POSA SANBI website, whilst a list of animal species that might occur in the study area has been derived from the UCT ADU and SANBI SIBIS Databases, as well as from Apps (2000). These lists have been evaluated against the SANBI and IUCN Species Status database and applicable legislation to obtain a list of species that are protected and/or in any way threatened, that may occur in the study area and that could be affected by the proposed development. The presence of several species of conservation concern was verified during field observations.

These plant species identified included:

- → 10 species endemic to Sekhukhuneland
- → 20 further species endemic to RSA
- → At least 9 red data species

→ At least on NEMBA (ToPS) species
→ At least 6 NFA protected tree species
→ At least 7 LEMA protected plant species, additionally tree-mosses observed

Of all of the above, several will be moderately to severely affected by the proposed mining activities.

The Vegetation Associations identified and delineated (Section 4) are as follows, also indicating sensitivity:

1: *Themeda triandra – Diheteropogon amplectens* Grasslands:

These are primarily grass-dominated slopes, with either a relatively sparse shrub cover or only small clumps of higher vegetation.

Sensitivity: HIGH - Avoid as far as possible

2: *Cyperus sexangularis – Flueggea virosa* Riparian Vegetation:

These include small rivers on more level areas as well as rocky washes and ravines higher into the mountains

Sensitivity: No Go Area – only suitable crossings permissible

3: *Acacia tortilis – Dichrostachys cinerea* Dry Mixed Bushveld:

The extent of this association is relatively limited, found on more level areas and has been variously disturbed, often leading to a diminished herb-layer and a heavily encroached shrub layer.

Sensitivity: Medium-Low

4: *Kirkia wilmsii – Terminalia prunioides* variable Bushveld:

This is found mostly on the lower footslopes of mountains and as an ecotone to the plains below, but also on rocky mountain scarps as well as undulating rocky flats

Sensitivity: Medium-High: Avoid large tree clumps and individuals as far as possible

5: *Hippobromus pauciflorus – Rhoicissus tridentata* Rock Outcrops:

This vegetation is highly variable, with no two outcrops with the same vegetation. Generally it is found between large boulders – either on mountain plateaus or on mountain slopes. The high niche diversity accounts for a very high biodiversity of these pockets of vegetation.

Sensitivity: HIGH - Treat as No Go Area as far as possible

6: *Combretum hereroense - Euclea sekhukhuniensis* low bushveld:

Very variable, this vegetation type is found on more level areas between slopes or on the plains and extensive donga systems within the study area, where *Euclea sekhukhuniensis* can form relatively dense stands. The latter species is a narrow endemic – although currently abundant, its limited distribution makes its populations highly vulnerable to the impacts of open-cast mining and other transformative developments.

Sensitivity: No Go, only limited access roads permissible

In line with the above, it must be realised that the proposed mining activities will have a significant local negative impact on the environment. From a terrestrial ecological perspective, the proposed development has been rated as follows:

The following could proceed if all mitigation measure are diligently implemented with all the necessary authorisations – including permits for protected species removal:

- The creation of additional internal access roads is discouraged, but it is anticipated that existing tracks will be upgraded and possibly doubled in width
- Phase 1: Klarinet Koppie mining near the discontinued Clarinet Mine could proceed
- Phase 3: Tubatse Koppie mining could proceed but with caution
- The sites for the main office and workshop complex as well as stockpiles 1 and 2 already exist from the prospecting phase, but are anticipated to be expanded
- The laydown area for Phase 3 should be restricted to temporary offices and an ore stockpile, together not exceeding 3-4 ha in total and not closer than 50 m (preferably 100 m) from the bank of any riparian area/drainage line

The following is considered ecologically unacceptable and should not proceed:

- Workshops within the Tubatse laydown area, except small storage areas for every-day maintenance of machinery, larger repairs should be done at the existing office complex
- Phase 3: Spitsvale Flats mining should not be allowed within the erosion plains (about half the area of the mapped ore) – the permanent impacts anticipated there will influence areas beyond the affected land portions and totally seize current landscape functionality (amongst other impacts), which cannot be justified

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Figures

1. GENERAL INFORMATION

1.1 APPLICANT

BCR Minerals (Pty) Ltd has appointed Environmental Management Assistance to manage the EIA process for a Mining Application for their Spitsvale Project near Tubatse and Steelpoort in the Limpopo Province.

1.1.1 Proposed Activity

The proposed mining application will progress from the current exploration activities to full mining operations to extract chromite and associated minerals, including the following:

- Open cast bulk extraction area to depths between 5 and maximally 80 m
    - Excavation pits over three mining areas are to be backfilled in sections as soon as extraction is completed within a particular section
    - Mining areas are:
        - Phase 1: Klarinet Koppie
        - Phase 2: Tubatse Koppie
        - Phase 3: Spitsvale Flats
- Stockpile areas for ore only – so far three sites planned, two of which already exist near Phase 1 for bulk sampling:
    - Stockpile area 1: Next to the current Office Area (which will remain as part of the mining operations)
    - Stockpile area 2: Just north of Phase 1: Klarinet Koppie excavations
    - Stockpile area 3: Planned to be within the Phase 3: Tubatse Koppie laydown area
- Office and workshop facilities – these already exist near the Phase 1 site and were erected as part of the prospecting licence
    - A second laydown area with temporary office and workshop facilities is planned for Phase 2 within 1 km south of Tubatse Koppie
- Facilities for bulk storage of fuels (diesel) and/or chemicals, including an oil separator - these already exist near the Phase 1 site and were erected as part of the prospecting licence
- Hazardous waste storage area - these already exist near the Phase 1 site and were erected as part of the prospecting licence
- Existing water- and power supply infrastructure will be used

1.1.2 Location

The proposed mining development will be just south-west of the Tubatse Township, on the farm portions:

- Kennedy's Vale 361 KT Ptn 8 and 22
- Spitskop 333 KT Ptn 24, 25, 26, and 28

These are located within the Greater Tubatse Municipality, Greater Sekhukhune District, Limpopo Province (Figure 1). The approximate position of the different mining sites, stockpile areas and known infrastructure locations is shown in Figure 2.

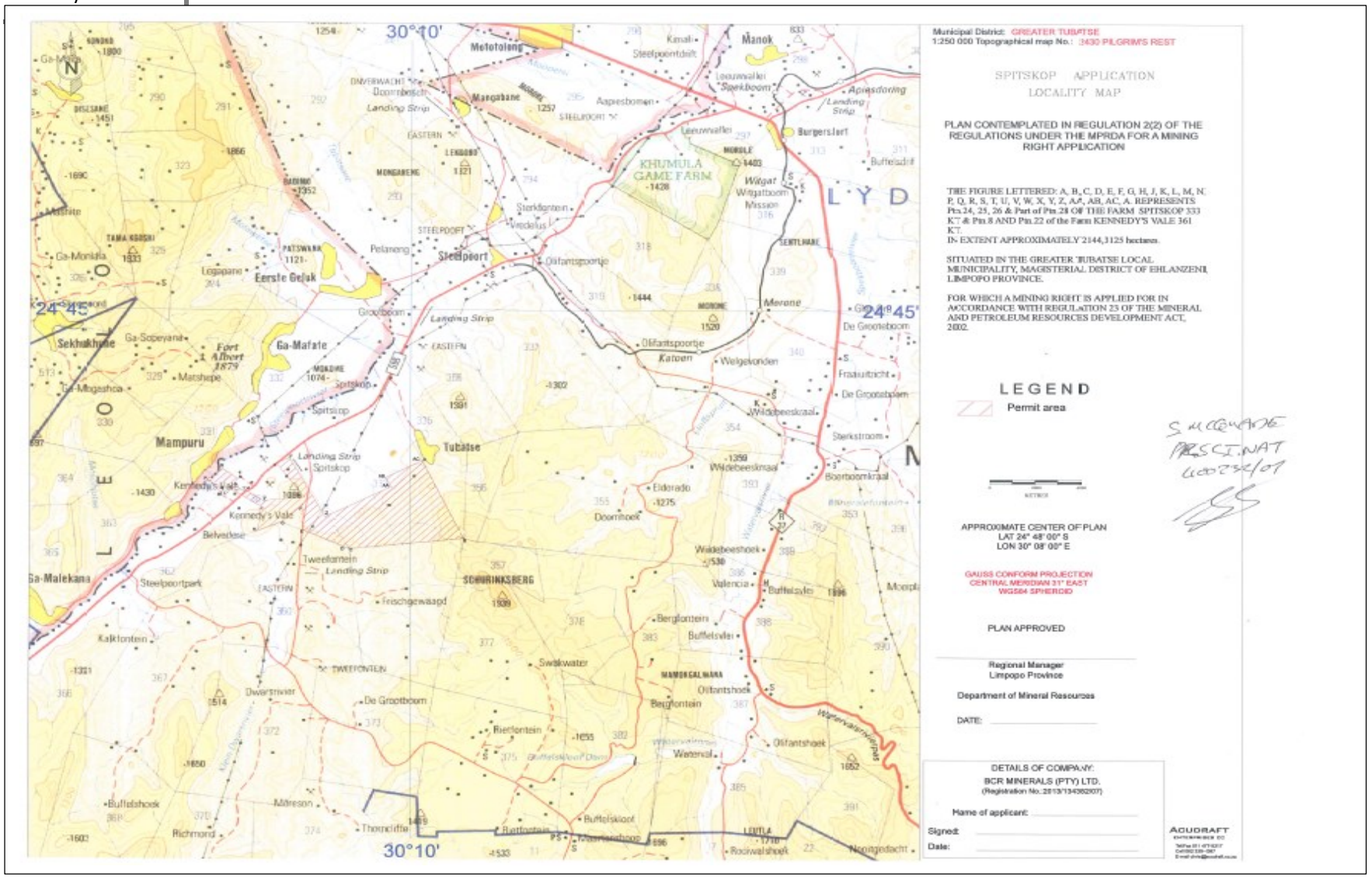

Figure 1: Location of the proposed Mining Development

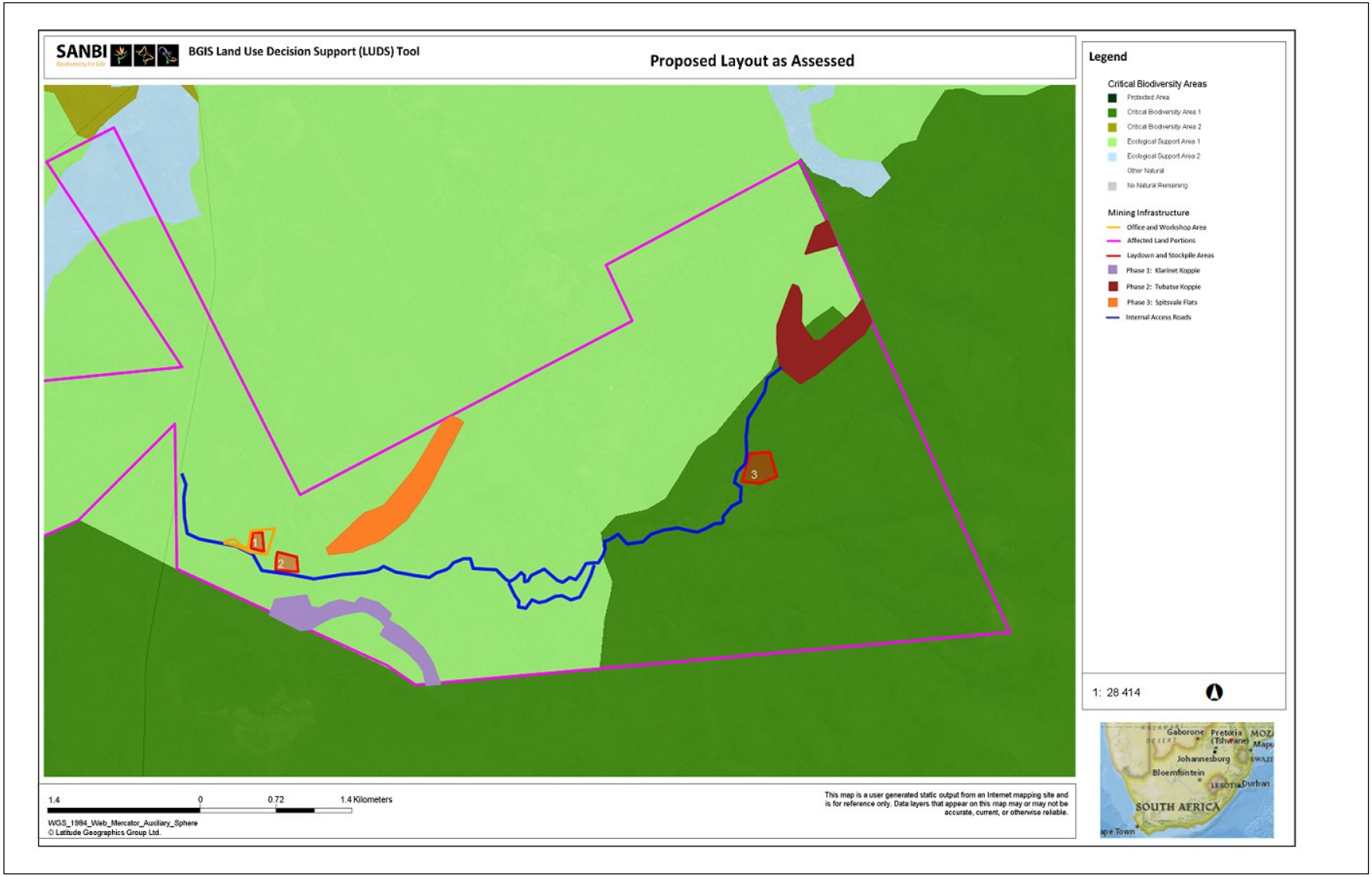

Figure 2: Localities of components of the proposed mine as currently planned.

1.2 SPECIALIST INVESTIGATOR

This report has been prepared by: Marianne Strohbach (MSc, PrSciNat). An abridged CV of the specialist is provided in Appendix D.

Specialist affiliation

- South African Council for Natural Scientific Professions (SACNASP)
  - PrSciNat; Registration no. 400079/10, Botanical Science, Ecological Science
- South African Association of Botanists (www.sabotany.com)

1.3 CONDITIONS OF THIS REPORT

Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. The author, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

No form of this report may be amended or extended *without the prior written consent of the author*.

Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

1.4 SCOPE AND PURPOSE OF REPORT

To conduct an ecological desktop study for an ecological assessment of the target area where the establishment of an open cast mine and associated infrastructure is proposed (Stage 3 below), and provide a professional opinion on terrestrial ecological issues pertaining to the target area to aid in future decisions regarding the proposed project.

The life cycle of a mining project consists of several stages:

1. discovery or reconnaissance stage
2. exploration or prospecting stage
3. development and production stage of mining
4. decommissioning and closure stage

1.5 LEGISLATION

This study has been conducted in accordance with the following legislation (abbreviations used further indicated in bold):

1.5.1 Provincial

- The Limpopo Environmental Management Act / **LEMA** (Act 7 of 2003) in its entirety, with special reference to:
  - Schedule 1: Protected Areas – site of ecological importance, protected natural environment, resource use areas
  - Schedule 2: Specially Protected Wild Animals
  - Schedule 3: Protected Wild Animals
  - Schedule 10: Invertebrates
  - Schedule 11: Specially Protected Plants
  - Schedule 12: Protected Plants

1.5.2 National

- National Environmental Management Act / **NEMA** (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
- Environment Conservation Act (**ECA**) (No 73 of 1989) and amendments
- National Environmental Management Act: Biodiversity Act / **NEMBA** (Act No. 10 of 2004) and amendments
- National Forest Act 1998 / **NFA** (No 84 of 1998)
- National Veld and Forest Fire Act (Act No. 101 of 1998)
- Conservation of Agricultural Resources Act / **CARA** (Act No. 43 of 1983) and amendments

1.5.3 International

- Convention on International Trade in Endangered Species of Fauna and Flora (**CITES**)
- Convention on Biological Diversity, 1995

2 INTRODUCTION

South Africa is committed to the Convention of Biological Diversity, and has introduced several legislative mechanisms to ensure that the preservation and sustainable use of all biological diversity, including ecosystem, species, and genetic diversity, is guaranteed for the benefit of current and future generations in South Africa and beyond. The impact of past and present conversion of natural habitat types by cultivation, grazing, urban developments, forestation, mining, dams, industries, and alien plant invasions continues to have a substantial impact on South African biodiversity, with significant portions of South Africa's flora and fauna being threatened (Wynberg 2002). Arid, semi-arid and dry sub-humid areas, covering an estimated 91% of South African land area (Hoffman and Ashwell 2001), including the study area, are particularly prone to degradation arising from human activities, leading to the acceleration of soil erosion, deterioration of the biotic, abiotic and economic properties of soil, and the long-term loss of natural vegetation (UNCCD 1995) and associated habitats for fauna. Rapid recovery of degradation is inhibited by the loss of topsoil and natural seed banks, low rainfall regimes and the unpredictability of rainfall events.

This report lists the findings of an ecological evaluation of the proposed mining site selected by BCR Minerals to help evaluate the possible impacts of such a development on the affected terrestrial biodiversity.

2.1 STUDY AREA

The locality of the study area is restricted to the farm portions as shown in section 1.1.3. It must be noted that it falls within the Sekhukhuneland Centre of Endemism – an area with a high proportion of species restricted to these habitats (and found nowhere else in the world).

2.1.1 Climate and Rainfall

The climate for the study area has been derived from recorded data (en.climate-data.org and worldweatheronline.com) for Steelpoort. The area receives summer rainfall and has dry winters. Long term average rainfall ranges from 650 - 720 mm. Most rains fall between November and March, indicating that field surveys should be carried out between mid-December and mid-April for the most accurate assessment of vegetation (as the primary producer) and associated biodiversity. Long-term climatic data has been summarised in the graphs presented in Figure 3 below.

2.1.2 Topography and drainage

The larger part of the study area is undulating to variably steep, with the southern and eastern periphery of the site being comprised of rocky outcrops and mountain-ranges, draining in a northerly direction into the Steelpoort River. The height of the peripheral mountains and outcrops ranges between approximately 1680 m and 1100 above sea level, whilst the lowest plains closer to the Steelpoort River are only 780 m above sea-level. A 600 to 800 m drop can thus be observed in distances as low as 2 km, incised by several smaller gorges, natural erosion plains (dongas) and drainage lines leading up to the Steelpoort River.

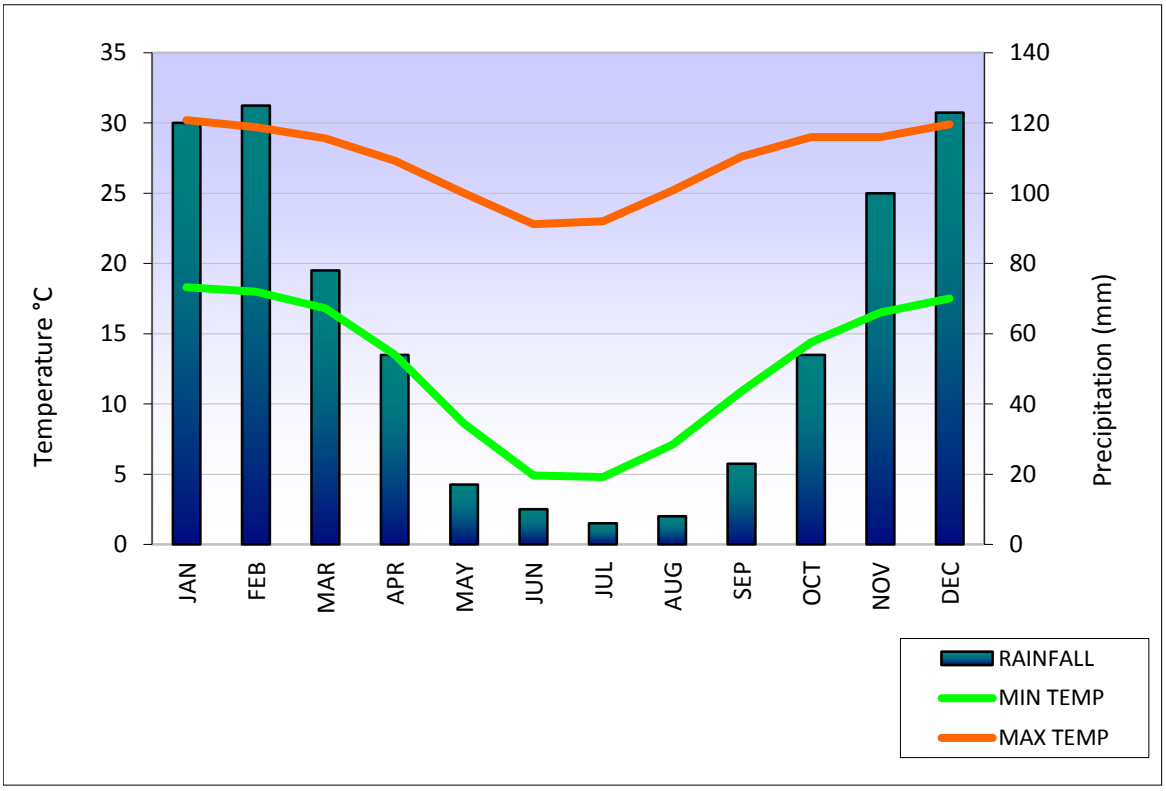

Figure 3: Average minimum and maximum temperatures and monthly rainfall for Steelpoort. (Adapted from http://en.climate-data.org/location/924290/)

2.1.3 Current Landuse and Infrastructure

The largest portion of the Spitskop farm portions are still natural vegetation, with a small rural settlement and communal livestock farming. In closer vicinity to the settlement many of the larger trees and shrubs have been cropped or entirely felled for fuelwood (Figure 4). The wood harvesting often starts with cutting large branches off trees, but eventually the entire tree is cut down. Adjacent to the north-eastern corner of Spitskop portion 28 is the Tubatse/Steelpoort Mining residence.

Of the Kennedy's Vale farm portions, at least one quarter of the area has been transformed by agricultural cropping, mining activities, industrial developments, roads and power lines. Adjacent to the north-eastern section of Kennedy's Vale portion 8, is the Xstrata Smelter.

Further, the landscapes are disturbed by several smaller tracks. The extent and intensity of the different anthropogenic disturbances on the natural environment will be assessed as part of the detailed field study during the Impact Assessment Phase.

2.1.4 Vegetation overview

The study area is situated in the Savanna biome, but bordering on the Grassland biome. The vegetation types on and in close proximity of the study area are (Figure 5):

- Sekhukhune Plains Bushveld (SVcb27)
- Sekhukhune Mountain Bushveld (SVcb28)
- Sekhukhune Montane Grassland (Gm19)

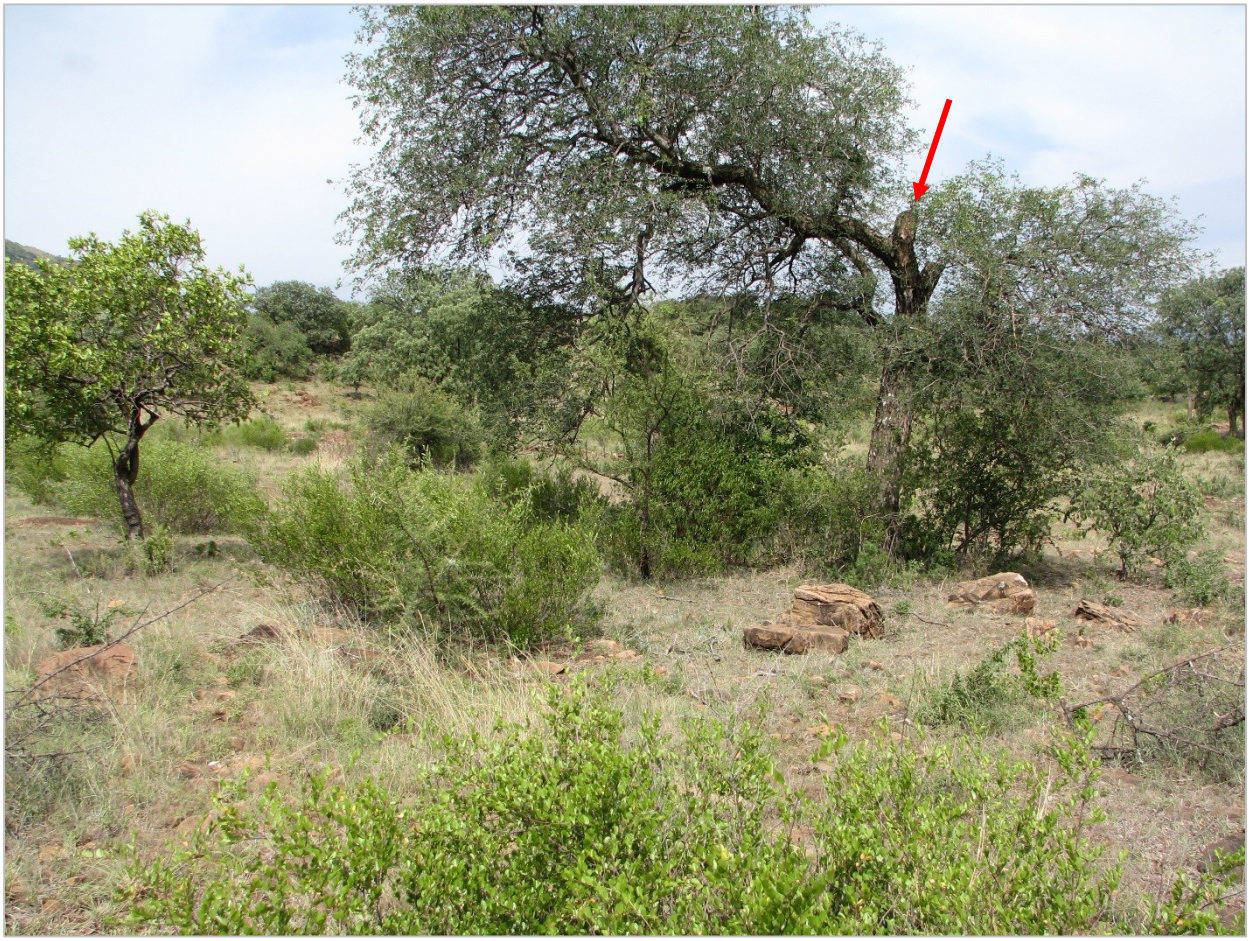

Figure 4: Wood harvesting by the resident community.

The Sekhukhune Plains Bushveld is found on the north-western portions of the study area towards the Steelpoort River and north of the Spitskop farm portions. It has been described by Mucina and Rutherford (2006) as semi-arid plains in open valleys with a predominantly low, open to closed thornveld with an abundance of *Aloe* and other succulent species. Occasionally disturbed by over-exploitation, some of the area show signs of severe bush-encroachment, whilst man-made and natural erosion dongas are common in clays rich in heavy metals (Mucina and Rutherford 2006). The shrub layer is characterised by Acacias: mostly *A. mellifera, A. tortilis* and *A. nilotica*. Other tall shrubs and trees include *Balanites maughamii, Albizia anthelminthica, Ziziphus mucronata, Dichrostachys cinerea, Ehretia rigida, Tinnea rhodesiana* and *Commiphora glandulosa*. Typical forbs include *Jamesbrittenia atropurpurea, Gossypium herbaceum, Jatropha latifolia* and *Melhania rehmannii*. *Aloe castanea* and *A. cryptopoda* occur either scattered or in localised stands, with the grass layer very variable, with *Cenchrus ciliaris* and *Urochloa mossambicensis* relatively common (Mucina and Rutherford 2006).

Mucina and Rutherford (2006) considered the conservation status of this vegetation as vulnerable, mainly due to high levels of degradation and transformation to dryland subsistence cultivation, as well as mining activities. So far, this vegetation has not been gazetted as a threatened ecosystem.

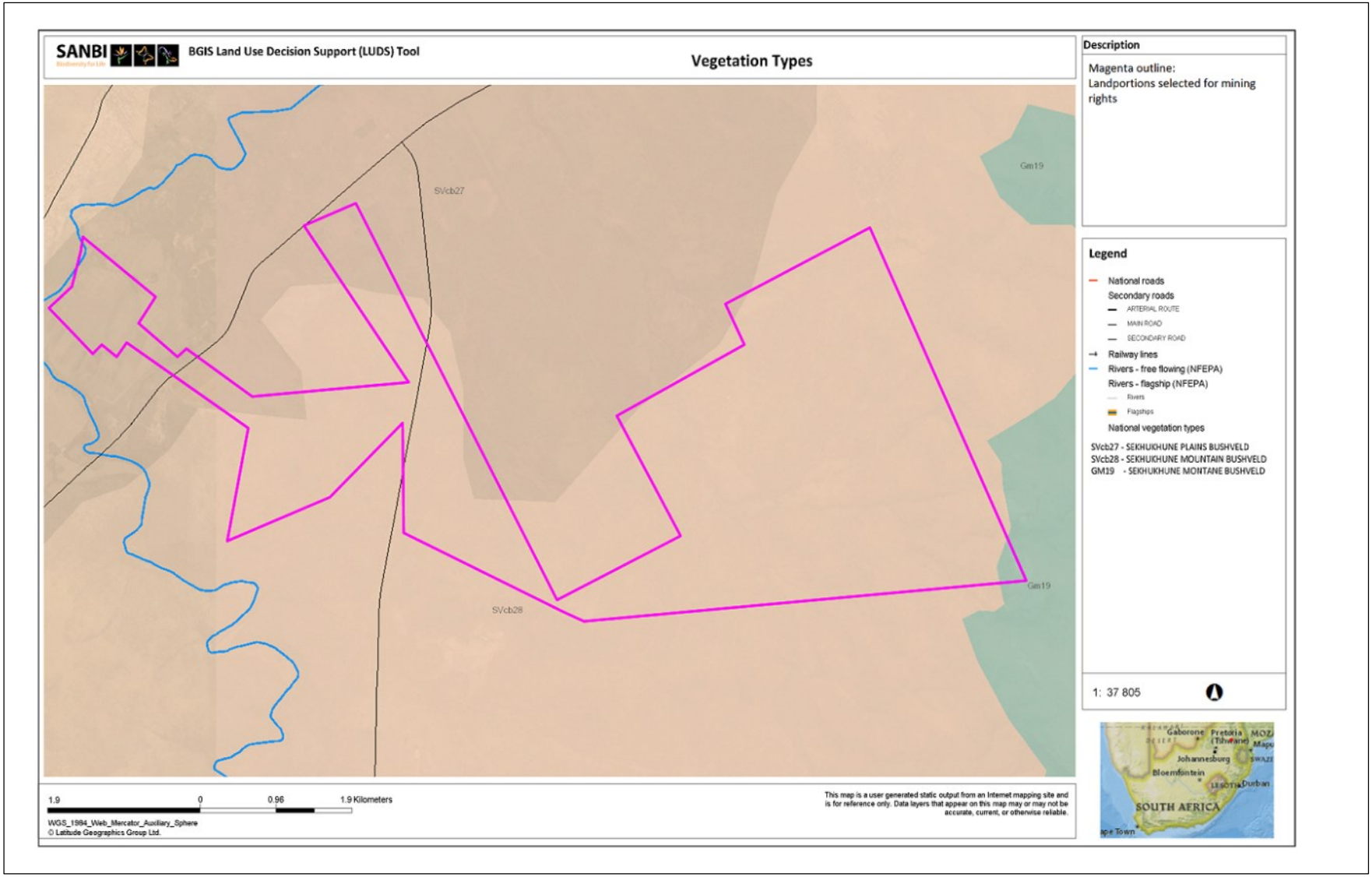

Figure 5: Vegetation types as described in Mucina and Rutherford (2006)

The Sekhukhune Mountain Bushveld covers most of the study area. Mucina and Rutherford (2006) describe this vegetation type as occurring on mountains, lower moderate to steep slopes and rocky hills – a very diverse and variable vegetation type due to the high niche variability, including steeper rocky gorges. Plant density and composition vary greatly depending on edaphic factors, and the ultramafic soils have led to the evolution of several edaphic specialists. The vegetation consists of open to dense low woodland, containing both broad-leaved and microphyllous species. The most characteristic microphyllous trees are *Kirkia wilmsii, Acacia nigrescens* and *A. senegal*; common broad-leaved species include *Combretum apiculatum, Bolusanthus speciosus, Terminalia prunioides, Hippobromus pauciflorus, Ozoroa sphaerocarpa, Croton gratissimus*, *Commiphora* species and *Sterculia rogersii.* Occasional high succulents occur such as *Aloe marlothii*, *Euphorbia ingens* (Naboom) and *E. tirucalli*. This habitat is also suitable for the Marula (*Sclerocarya birrea*). The great niche diversity on these mountain ranges creates habitat for a high diversity of plants. Of the low shrubs *Grewia vernicosa, Clerodendron ternatum* and *Triaspis glaucophylla* are the most common. The most common grasses include *Heteropogon contortus, Setaria lindenbergiana, Diheteropogon amplectens* and *Themeda triandra*.

The vegetation type is not currently listed as threatened ecosystem (Mucina and Rutherford 2006), but it is becoming increasingly under pressure from mining activities (Siebert *et al.* 2002b)

The Sekhukhune Montane Grassland merges into the south-eastern portion of the study area, with elements of this vegetation or small patches of these grasslands on some of the higher mountain-slopes as well as small plateaus between slopes throughout the study area. This vegetation type has been gazetted as Endangered Ecosystem. Shallow soils between boulders and stones support a mixture of sour grasslands with scattered groups of trees and shrubs. According to Mucina and Rutherford (2006), some of the characteristic and/or dominant species include *Apodytes dimidiata*, *Canthium suberosum*, *Cussonia transvaalensis*, *Rhoicissus tridentata*, *Triaspis glaucophylla*, *Euclea crispa, E. linearis, Elephantorrhiza praetermissa* and *Brachylaena ilicifolia*. The grass layer is dominated by *Aristida junciformis*, *Diheteropogon amplectens*, *Eragrostis chloromelas*, *Heteropogon contortus*, *Setaria sphacelata* and *Themeda triandra*. The more common and/or conspicuous forbs include *Tephrosia purpurea*, *Gerbera jamesonii* (Barberton Daisy), *Ipomoea crassipes* and *Xerophyta retinervis* (Bobbejaanstert) – the latter often reaching heights > 150 cm, which is nor very common for that species.

These grasslands are rich in species endemic to Sekhukhuneland, especially *Euclea sekhukhuniensis*, Lydenburgia cassinoides*, Searsia sekhukhuniensis, Rhoicissus sekhukhuniensis*, Dyschoriste perrottetii**, *Vitex obovata* subsp. *wilmsii**, *Gladiolus sekhukhuniensis* and *Zantedeschia pentlandii* (Mucina and Rutherford 2006). Some of the species found in the area during a detailed study of Sekhukhuneland still need to be formally described (Siebert *et al*. 2002c).

*occurrence within study area confirmed

A more detailed study of the Sekhukhune Centre of Plant Endemism was undertaken to describe the major vegetation within this area, and published in 2002 (Siebert *et al.* 2002a, 2002b, 2003). Although the study area may not have been sampled individually at that time, information from the above publications was highly relevant and incorporated into the results of the field study (see section 4 below).

2.1.5 Natural Water Courses and Wetlands

Within the largely undulating and mountainous landscape of the land portions affected, there are several, variously sized, ephemeral mountain streams and larger drainage lines in the valleys. These all ultimately drain to the Steelpoort River. This contributes to the classification of the larger study area as CBA 1 and ESA 1 areas according to the Limpopo Conservation Plan (Desmet *et al.* 2013 – see section 2.1.7 for more details).

2.1.6 Man-made wetlands

No man-made wetlands were observed.

2.1.7 Conservation Planning

2.1.7.1 Important biodiversity areas

The study area is situated within important biodiversity areas as delineated for Limpopo (Figure 6). The Limpopo Conservation Plan (Desmet *et al.* 2013, available through the BGIS website) classifies important biodiversity areas as CBA or ESA areas:

"Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

For CBAs, the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).

Ecological Support Areas (ESA's) are areas that are not essential for meeting biodiversity representation targets/thresholds, but which play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation, or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

For ESAs a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally, results in a reduction in stream flow at the catchment's exit which affects downstream biodiversity)."

CBA and ESA areas can be further divided into CBA 1 and CBA 2, or ESA 1 and ESA 2, depending on the level of protection, ecosystem functionality and -services and current intactness. For more detailed land use recommendations, refer to Appendix C.

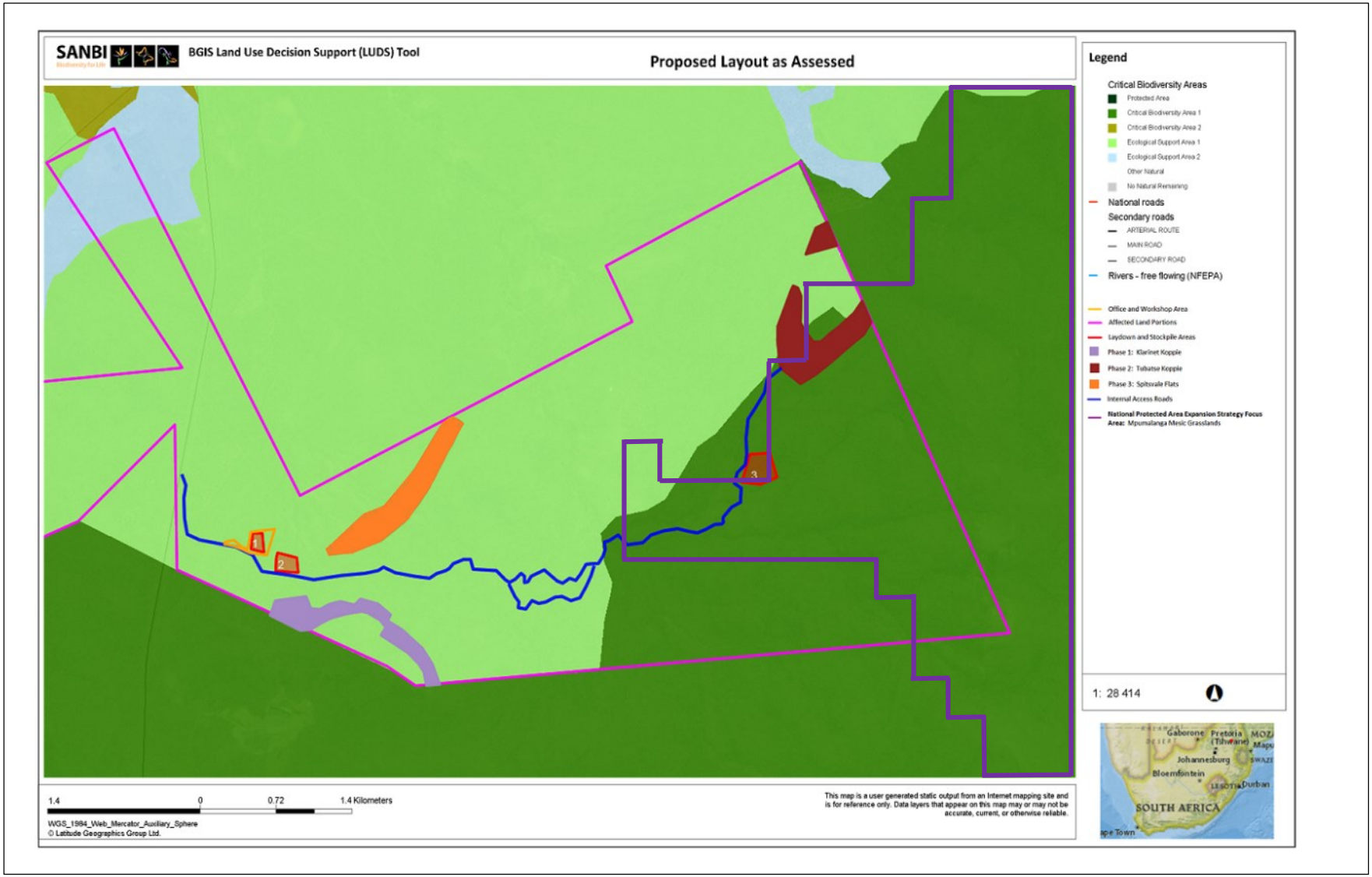

Figure 6: Overlay of proposed mining areas on the Limpopo conservation planning map.

Accordingly, portions of the study area have been demarcated as part of the National Protected Area Expansion Strategy Focus Area to conserve more of the Mpumalanga Mesic Grasslands (Figure 6 above).

Critical Biodiversity Areas (CBA 1)

Affected by the Tubatse mine and proposed stockpile (Mining area 6 and 7, Stockpile 3) as well as access roads to that area.

Description: Irreplaceable Sites.

- Areas required to meet biodiversity pattern and/or ecological processes targets.
- No alternative sites are available to meet targets.

Land Management Objectives:

- Maintain in a natural state with limited or no biodiversity loss.
- Rehabilitate degraded areas to a natural or near natural state, and manage for no further degradation.

Land Management Recommendations:

- Obtain formal conservation protection where possible.
- Implement appropriate zoning to avoid net loss of intact habitat or intensification of land use.

Compatible land-use

- Conservation and associated activities.
- Extensive game farming and eco-tourism operations with strict control on environmental impacts and carrying capacities, where the overall there is a net biodiversity gain.
- Extensive Livestock Production with strict control on environmental impacts and carrying capacities.
- Required support infrastructure for the above activities.
- Urban Open Space Systems

Incompatible land-use

- Urban **land-uses including** Residential (including golf estates, rural residential resorts), Business, **Mining** & industrial;
- **Infrastructure** (**roads, power lines**, pipelines).
- Intensive Animal Production (all types including dairy farming associated with confinement, imported foodstuffs, and improved/irrigated pastures).
- Arable Agriculture (forestry, dry land & irrigated cropping).
- Small holdings

Ecological Support Areas (ESA 1)

Affected by Phase 1 and Phase 3 mining (Mining areas 1 to 5), Stockpiles 1 and 2 and the offices and associated infrastructure, also in future the ore processing plant and tailings dam.

Description:

- Natural, near natural and degraded areas supporting CBAs by maintaining ecological processes.

Land Management Objectives:

- Maintain ecosystem functionality and connectivity allowing for limited loss of biodiversity pattern

Land Management Recommendations:

- Implement appropriate zoning and land management guidelines to avoid impacting ecological processes. Avoid intensification of land use. Avoid fragmentation of natural landscape

Compatible land-use

- Conservation and associated activities. Extensive game farming and eco-tourism operations. Extensive Livestock Production.
- Urban Open Space Systems.
- Low density rural residential, smallholdings or resorts where development design and overall development densities allow maintenance of ecological functioning.

Incompatible land-use

- Urban **land-uses including** Residential (including golf estates), Business, **Mining & industrial**;
- **Infrastructure** (**roads, power lines**, pipelines).
- Intensive Animal Production (all types including dairy farming associated with confinement, imported foodstuffs, and improved/irrigated pastures).
- Arable Agriculture (forestry, dry land & irrigated cropping).
- *Note: Certain elements of these activities could be allowed subject to detailed impact assessment to ensure that developments were designed to maintain overall ecological functioning of ESAs.*

Ecological Support Areas (ESA 2)

On north-western periphery of study area where almost no natural vegetation remains, this area will not be affected by the mine.

Description:

- Areas with no natural habitat that is important for supporting ecological processes.

Land Management Objectives:

- Areas with no natural habitat that is important for supporting ecological processes.

Land Management Recommendations:

- Maintain current land- use. Avoid intensification of land use, which may result in additional impact on ecological Processes.

Compatible land-use

- Existing activities (e.g. arable agriculture) should be maintained, but where possible a transition to less intensive land uses or ecological restoration should be favoured.

Incompatible land-use

- Any land use or activity that results in additional impacts on ecological functioning mostly associated with the intensification of land use in these areas (e.g. Change of floodplain from arable agriculture to an urban land use or from recreational fields and parks to urban).

2.1.7.2 National Mining and Biodiversity Guidelines

The mining guidelines as published in 2013 (DEA, available from the BGIS website), are complementary to the provincial and national biodiversity conservation guidelines and delineations, and often incorporate risks that will have an effect on biodiversity, but may be entirely abiotic in nature. Risks to mining are classified in categories, and some of the mining activities planned, especially around Tubatse Koppie and portions of the other mine pits as well as the offices and nearby stockpiles fall in areas regarded as of a Category B and C risk to mining developments (Figure 7).

These categories are described as follows:

Category: B. Highest biodiversity importance

Biodiversity priority areas

- Critically endangered and endangered ecosystems
- Critical Biodiversity Areas (or equivalent areas) from provincial spatial biodiversity plans
- River and wetland Freshwater Ecosystem Priority Areas (FEPAs) and a 1km buffer around these FEPAs
- Ramsar Sites

Risk for mining: Highest risk for mining

Implications for mining

- Environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licences, and environmental authorisations.
- If they (high biodiversity risks) are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being.

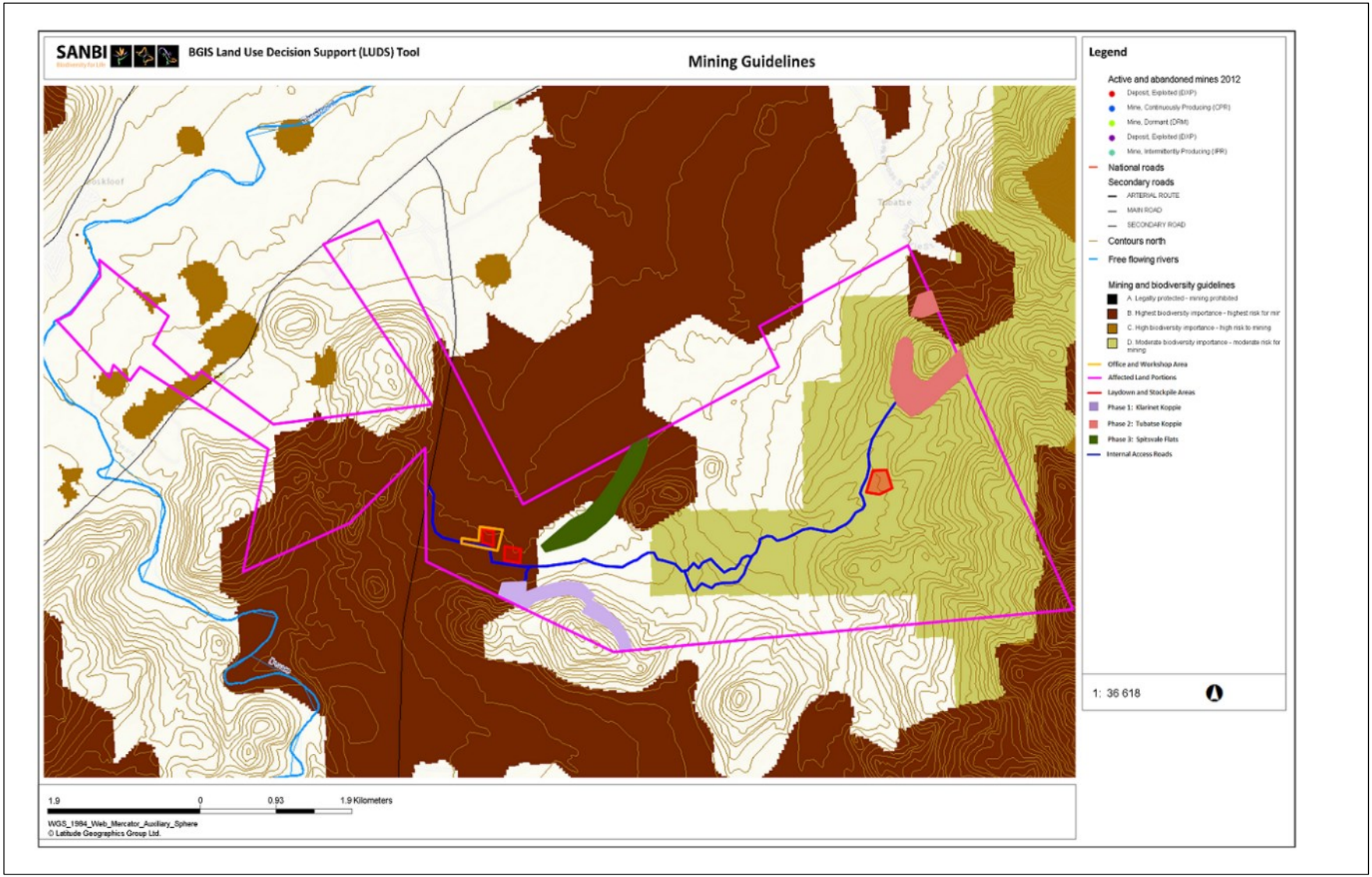

Figure 7: Overlay of the proposed mining activities on the mining guidelines

- An EIA must include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of
- Mining, as well as the potential strategic importance of the minerals to the country.
- Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into licence agreements and/or authorisations.

Category: D. Moderate biodiversity importance

Biodiversity priority areas

- Ecological support areas
- Vulnerable ecosystems
- Focus areas for protected area expansion (land-based and offshore protection)

Risk for mining: Moderate risk for mining

Implications for mining

- These areas are of moderate biodiversity value.
- EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy.
- Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.

3 METHODS

3.1 FLORA SURVEY

The area was visited for a field survey from 11 – 15 January 2016 for a vegetation survey of the area. At the time, due to relatively poor rainfall conditions of the season, most expected annual and geophytic species were still largely absent from the vegetation, but perennial grasses and forbs and woody species were in good condition.

A species list from POSA (http://posa.sanbi.org, November 2015, Grid reference: 2430C) containing the species that have been recorded up to date in the Tubatse/Steelpoort area was obtained. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants published by SANBI in *Strelitzia* 25 (Raimondo *et al.* 2009, updated 2015). In addition, species lists as contained in Siebert *et al.* (2001, 2002a, b and 2003, 2010) and Retief *et al*. (2008) were consulted for especially the expected endemic plant species (including Sekhukhune-specific forms) that may not have been captured in the POSA species list.

Plant species nomenclature follows Germishuizen and Meyer (2003) and the online African Plant Database (CJB 2014), Henderson (2001) and Bromilow (2010).

3.1.1 Vegetation survey methods

The vegetation types as described by Mucina and Rutherford (2006) give a general, large scale overview of the most common vegetation in the area based on very limited ground-truthing data. Vegetation types themselves consist of a multitude of smaller-scale plant communities, which again consist of vegetation associations, based on the specific habitat characteristics of a location. Vegetation type descriptions thus give very little indication of the actual, finer-scale plant associations, the prevailing habitats, and hence ecological sensitivities of a project site – these have to be determined by detailed field work and associated data collection.

The survey was undertaken by roughly stratifying the study area with the help of Google-Earth imagery into different landscape types identifiable, and then ensuring that at least four different sample-areas within landscape types were surveyed on each farm portion.

At the randomly selected sample areas within each homogeneous landscape unit, a survey of total visible floristic composition and the relative canopy cover percentage of each species was recorded, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Brown *et al.* 2013) and are considered an efficient method of describing vegetation and capturing species information. Notes were additionally made of the general habitat and any other features, biotic and abiotic, that might have an influence on the composition of landscape components and associated ecosystem processes.

Vegetation data entry and analysis was carried out using the standard TurboVeg phytosociological database (Hennekens and Schaminée 2001) and TWINSPAN classification techniques with JUICE (Tichý 2002). The aerial extent of the study area is not sufficient to fully describe the plant communities; hence, the vegetation is simply described in terms of 'vegetation associations', which are species associations within plant communities.

3.1.2 Vegetation Mapping

Mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery (which is a generalised colour composite image without any actual reflectance data attached to it) and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual mergers of vegetation associations, generalisations had to be made. Mapped associations will thus show where a certain vegetation unit is predominant, but smaller inclusions of another vegetation association or ecotones (gradual changes to another association) in this area do exist, but have not been mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery over a longer time period (with all reflectance data), which has not been available to this project due to the high cost of such imagery. It must also be noted that for most fluvial systems, the riparian vegetation and a small buffer around the zone has

been mapped as the respective association, primarily to make sure minimum buffer zones are adhered to by project planners.

3.2 Fauna Survey

The SANBI SIBIS and ADU databases were queried regarding vertebrate fauna and arachnid species historically recorded in the study area and surroundings. The likelihood of such species still occurring in the area was verified according to Apps (2000), and species of conservation concern or that are protected and most likely to occur in the study area listed. Protected and red data species that may be expected to occur on the study area are listed under results.

3.3 Explanations of Red Data classes

(After Raimondo *et al.* 2009)

Critically Endangered (CR): A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.

> Implications for development: RED LIST SPECIES: No further loss of natural habitat should be permitted as the species is on the verge of extinction. The Threatened Species Programme must be informed immediately, providing details of the location, size and threats to the subpopulation.

Endangered (EN): A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.

> Implications for development: RED LIST SPECIES:
> Case A: If the species has a restricted range (EOO < 2 000 km2), recommend no further loss of habitat. If range size is larger, the species is possibly long- lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the National Environmental Management: Protected Areas Act (Act 57 of 2003), and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
>
> Case B, C, D: No further loss of habitat should be permitted as the species is likely to go extinct in the near future if current pressures continue. All remaining subpopulations have to be conserved if this species is to survive in the long term.

Vulnerable (VU): A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.

> Implications for development: RED LIST SPECIES:
> Case D: This species either constitutes less than 1 000 individuals or is known from a very restricted range. No further loss of habitat should be permitted as the species' status will immediately become

either Critically Endangered or Endangered, should habitat be lost. The Threatened Species Programme must be informed immediately, providing details of the location, size and threats to the subpopulation.

Case B, C: The species is approaching extinction but there are still a number of subpopulations in existence. Recommend no further loss of habitat as this will increase the extinction risk of the species.

Case A: If the species has a restricted range, EOO < 2 000 km2, recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the Protected Areas Act, and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.

Near Threatened (NT): A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.

Implications for development: ORANGE LIST SPECIES:

Case D: Currently known from fewer than 10 locations, therefore preferably recommend no loss of habitat. Should loss of this species' habitat be considered, then an offset that includes conserving another viable subpopulation (in terms of the Protected Areas Act) should be implemented, provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities. The Threatened Species Programme must be informed immediately, providing details of the location, size and threats to the subpopulation.

Case B, C: The species is approaching thresholds for listing as threatened but there are still a number of subpopulations in existence and therefore there is need to minimise loss of habitat. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.

Case A: If the species has a restricted range, EOO < 2 000 km2, then recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant biodiversity conservation plan or (iii) on a site associated with additional ecological sensitivities.

Critically Rare: A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.

Implications for development: ORANGE LIST SPECIES: This is a highly range-restricted species, known from a single or isolated sites, and therefore no loss of habitat should be permitted as it may lead to extinction of the species. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay. The Threatened Species Programme must be informed immediately, providing details of the location, size and threats to the subpopulation.

Rare: A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.

> Implications for development: ORANGE LIST SPECIES: The species is likely to have a restricted range, or be highly habitat specific, or have small numbers of individuals, all of which makes it vulnerable to extinction should it lose habitat. Recommend no loss of habitat. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay. The Threatened Species Programme must be informed immediately, providing details of the location, size and threats to the subpopulation.

Declining: A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.

> Implications for development: ORANGE LIST SPECIES: The species is declining but the population has not yet reached a threshold of concern; limited loss of habitat may be permitted. Should the species is known to be used for traditional medicine and if individuals will not be conserved in situ, plants should be rescued and used as mother stock for medicinal plant cultivation programmes.

Data Deficient - Insufficient Information (DDD): A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.

> Implications for development: ORANGE LIST SPECIES:
> Case D: This species is very poorly known, with insufficient information on its habitat, population status or distribution to assess it. However, it is highly likely to be threatened. If a Data Deficient species will be affected by a proposed activity, the subpopulation should be well surveyed and the data sent to the Threatened Species Programme. The species will be reassessed and the new status of the species, with a recommendation, will be provided within a short timeframe. The Threatened Species Programme must be informed immediately, providing details of the location, size and threats to the subpopulation.
>
> Case T: There is uncertainty regarding the taxonomic status of this species, but it is likely to be threatened. Contact the taxonomist working on this group to resolve its taxonomic status; the species will then be reassessed by the Threatened Species Programme.

Data Deficient - Taxonomically Problematic (DDT): A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.

> Implications for development: GREEN LIST SPECIES: Implications for development: GREEN LIST SPECIES: Development is not expected to affect the conservation status of this species. Species removal may still be subject to provincial or national legislation.

3.4 SENSITIVITY ANALYSIS AND CRITERIA

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is rather complex and no single overarching criterion will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in a sensitivity analysis, however, include the following:

- Describing the nature and number of species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats, of various magnitudes
- Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships (Kremen 2005)
- Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
- Assessing key environmental factors that influence the provision of services (Kremen 2005)
- Gaining knowledge about the spatio-temporal scales over which these aspects operate (Kremen 2005).

This implies that in the sensitivity analysis not only aspects that currently prevail on the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed.

According to the above, sensitivity classes have been summarised as follows:

High Sensitivity: Areas that are relatively undisturbed or pristine and

- either very species-rich relative to immediate surroundings,
- or have a very unique and restricted indigenous species composition
- or constitute specific habitats or a high niche diversity for fauna and/or flora species of conservation concern, and where the total extent of such habitats and associated species of conservation concern remaining in southern Africa is limited.
- Excessive disturbance of such habitats may lead to ecosystem destabilisation and/or species loss.
- This would also include areas where the abiotic environment is of such nature that the habitat and its niche-diversity are the main reason for a higher species diversity and cannot be reconstructed or rehabilitated once physically altered in any way.

Medium Sensitivity: Areas where disturbances are at most limited and

- Areas with a species diversity representative of its natural state, but not exceptionally high or unique compared to its surroundings
- Areas that whose biotic configuration does not constitute a very specific or restricted habitat or very high niche diversity
- Areas that provide ecosystem services needed for the continued functioning of the ecosystem and the continued use thereof (e.g. grazing).
- Although species of conservation concern may occur on the area, these are not restricted to these habitats only.

- Areas that need to remain intact to ensure the functioning of adjacent ecosystems, or wildlife corridors or portions of land that prevent the excessive fragmentation of natural fauna and flora populations, or areas that will be difficult or impossible to rehabilitate to a functional state after physical alteration
    - **Medium high sensitivity** would include areas:
    - where the landscape can be rehabilitated to allow the re-establishment of some of the original species composition after physical alteration, but some of the species of conservation concern or ecosystem functionality may be lost
    - with a high species diversity and potentially higher number of species of conservation concern,
    - **Medium low sensitivity** would include areas:
    - with a high species diversity with few species of conservation concern,
    - this could also include areas with previous disturbance or transformation, where the impact of the development will lead to irreversible, unjustified degradation of the landscapes that will be difficult to prevent and mitigate
    - where the landscape can be rehabilitated to allow the re-establishment of most or all of the original species composition after physical alteration

Low Sensitivity: Areas that have been previously transformed or disturbed or

- Areas that provide limited ecosystem services, or have a low ecological value.
- Species diversity may be low or all species present have a much wider distribution beyond this habitat or locality.
- Species of conservation concern may be present on such areas, but these are not restricted to these habitats and can be relocated with ease.
- Further arguments may include landscapes where the abiotic nature is such that it can be rehabilitated relatively easy to allow the re-establishment of the original species composition, and where the development will not lead to any unjustified degradation of landscapes or ecosystem services if adequately mitigated.

3.5 ASSESSMENT OF IMPACTS

The Environmental Impact Assessment methodology that has been used in the evaluation of the overall effect of a proposed activity on the environment includes an assessment of the significant direct, indirect, and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

The **nature** of the impact refers to the causes of the effect, what will be affected and how it will be affected.

Extent (E) of impact

- Site specific: Rating = 1
- Site and surroundings: Rating = 2
- Site up to provincial extent: Rating = 3

- Site up to national extent: Rating = 4
- Site and beyond national borders: Rating = 5

Duration (D) rating is awarded as follows:
Whether the life-time of the impact will be:

- Very short term – up to 1 year: Rating = 1
- Short term – >1 – 5 years: Rating = 2
- Moderate term - >5 – 15 years: Rating = 3
- Long term – >15 years: Rating = 4
  The impact will occur during the operational life of the activity, and recovery may occur with mitigation (restoration and rehabilitation).
- Permanent – Rating = 5
  The impact will destroy the ecosystem functioning and mitigation (restoration and rehabilitation) will not contribute in such a way or in such a time span that the impact can be considered transient.

Magnitude (M) (severity):
A rating is awarded to each impact as follows:

- Small impact – the ecosystem pattern, process and functioning are not affected.
  Rating = 0
- Minor impact - a minor impact on the environment and processes will occur.
  Rating = 2
- Low impact - slight impact on ecosystem pattern, process and functioning.
  Rating = 4
- Moderate intensity – valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.
  Rating = 6
- High intensity – environment affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.
  Rating = 8
- Very high intensity – environment affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.
  Rating = 10

Probability (P) (certainty) describes the probability or likelihood of the impact actually occurring, and is rated as follows:

- Very improbable – where the impact will not occur, either because of design or because of historic experience.
  Rating = 1
- Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience.
  Rating = 2

- Probable - there is a distinct probability that the impact will occur (<50% chance of occurring).
  Rating = 3
- Highly probable - most likely that the impact will occur (50 – 90% chance of occurring).
  Rating = 4
- Definite – the impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).
  Rating = 5

Significance (S) - Rating of low, medium or high. Significance is determined through a synthesis of the characteristics described above where:
S = (E+D+M)*P

The **significance weighting** should influence the development project as follows:

- Low significance (significance weighting: <30 points)
  If the negative impacts have little real effects, it should not have an influence on the decision to proceed with the project. In such circumstances, there is a significant capacity of the environmental resources in the area to respond to change and withstand stress and they will be able to return to their pre-impacted state within the short-term.

- Medium significance (significance weighting: 30 – 60 points)
  If the impact is negative, it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved. In such circumstances, there is a reduction in the capacity of the environmental resources in the area to withstand stress and to return to their pre-impacted state within the medium to long-term.

- High significance (significance weighting: >60 points)
  The environmental resources will be destroyed in the area leading to the collapse of the ecosystem pattern, process and functioning. The impact strongly influences the decision whether or not to proceed with the project. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

4 RESULTS

4.1 FLORA SURVEY

The results focus on all land portions studied to give a full overview of vegetation and associated vegetation on an around the proposed mining infrastructure. It must be noted beforehand that most vegetation associations occur in very intricate mosaics, and the maps are therefore mere generalisations rather than a precise delineation of boundaries. Such clear boundaries of species associations do not exist in the study area – as most associations gradually change according to soil surface structure in regions termed 'ecotones'.

Currently about 850 indigenous higher plant species have been listed in the SANBI databases for the grid (2430 C) in which the study area is situated. As historic surveys of the area did not cover all different habitat niches, the existing species list should never be regarded as complete. Similarly, the prevailing drought over southern Africa at the time of the study prevented most of the geophytic and annual species from emerging. Still, at the time of the survey most of the grass- and shrub component of the vegetation was sufficiently green to allow a positive identification of species. Due to time-restrictions, the field-survey focused on areas that will most likely be most affected by the proposed mining activities, possible future exploration activities and habitats that were deemed highly sensitive to possibly no-go areas.

A total of 429 indigenous species have been recorded during the field survey. As indicated above, several more species can be expected – not just because of the effects of drought, but also due to limited sampling time. **This implies that prior to any new area being impacted by the mine, that area and a suitable buffer will have to be delineated and activities have to be preceded by a very thorough walkthrough, conducted between January and April, followed by the necessary plant Search and Rescue operations where applicable.**

The survey results were compared with the descriptions of vegetation published by Siebert *et al.* (2002a, b and 2003). This classification was found to correspond and was adapted, with few modifications and additions of species as was necessary.

The plant species identified included:

- → 10 species endemic to Sekhukhuneland
- → 20 further species endemic to RSA
- → At least 9 red data species
- → At least on NEMBA (ToPS) species
- → At least 6 NFA protected tree species
- → At least 7 LEMA protected plant species, additionally tree-mosses observed

Of all of the above, several will be moderately to severely affected by the proposed mining activities.

Vegetation associations identified during this and previous studies are based on the overall similarity in species composition, vegetation structure and abiotic attributes that are part of an ecosystem, but smaller phytosociological differences within each vegetation unit are present. Vegetation associations occur in intricate mosaics throughout the study area, with edges of vegetation units generally very

vague. Local species composition is primarily influenced by slope, soil depth, soil surface texture and underlying geology. There is also a large degree of species overlap between the mapped edges of vegetation associations identified.

In addition to the indigenous species, several alien invasive species were observed within the study area. These will be discussed in more detail in section 4.5.

The Vegetation Associations identified and delineated (Figure 8) are as follows, also indicating sensitivity (Figure 9):

1: *Themeda triandra – Diheteropogon amplectens* Grasslands:

These are primarily grass-dominated slopes, with either a relatively sparse shrub cover or only small clumps of higher vegetation.

Sensitivity: HIGH – Avoid as far as possible

2: *Cyperus sexangularis – Flueggea virosa* Riparian Vegetation:

These include small rivers on more level areas as well as rocky washes and ravines higher into the mountains

Sensitivity: No Go Area – only suitable crossings permissible

3: *Acacia tortilis – Dichrostachys cinerea* Dry Mixed Bushveld:

The extent of this association is relatively limited, found on more level areas and has been variously degraded, often leading to a diminished herb-layer and a heavily encroached shrub layer.

Sensitivity: Medium-Low

4: *Kirkia wilmsii – Terminalia prunioides* variable Bushveld:

This is found mostly on the lower footslopes of mountains and as an ecotone to the plains below, but also on rocky mountain scarps as well as undulating rocky flats

Sensitivity: Medium-High: Avoid large tree clumps and individuals as far as possible

5: *Hippobromus pauciflorus – Rhoicissus tridentata* Rock Outcrops:

This vegetation is highly variable, with no two outcrops with the same vegetation. Generally it is found between large boulders – either on mountain plateaus or on mountain slopes. The high niche diversity accounts for a very high biodiversity of these pockets of vegetation.

Sensitivity: HIGH – Treat as No Go Area as far as possible

6: *Combretum hereroense – Euclea sekhukhuniensis* low bushveld:

Very variable, this vegetation type is found on more level areas between slopes or on the plains and extensive donga systems within the study area, where *Euclea sekhukhuniensis* can form relatively dense stands. The latter species is a narrow endemic – although currently abundant, its limited distribution makes its populations highly vulnerable to the impacts of open-cast mining and other transformative developments.

Sensitivity: No Go, only limited access roads permissible

The description of the above vegetation associations and their habitats is given below, with the full species list given in Appendix A. Species of conservation concern are further discussed in section 4.4.

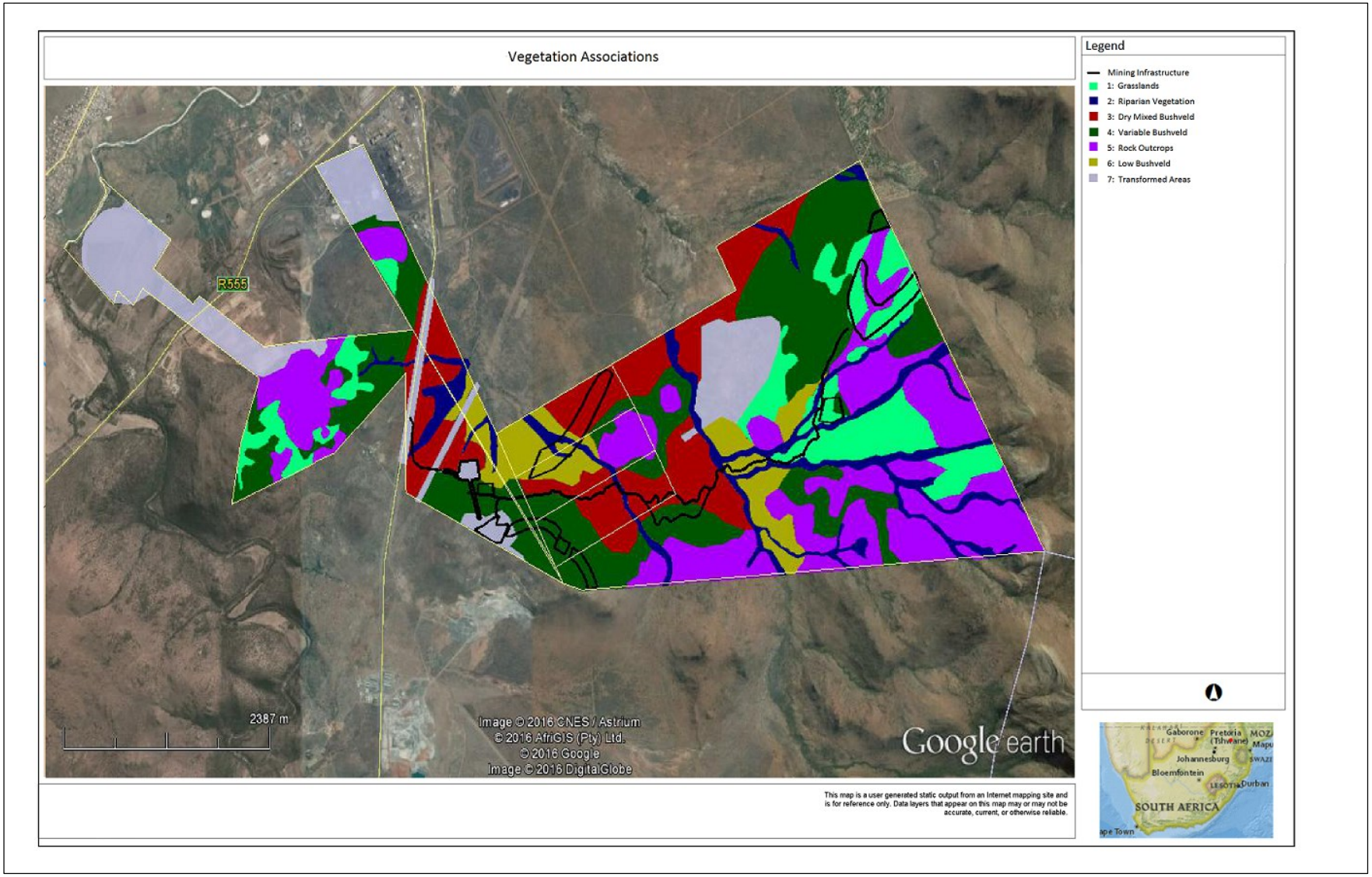

Figure 8: Map of Vegetation Associations identified within the study area.

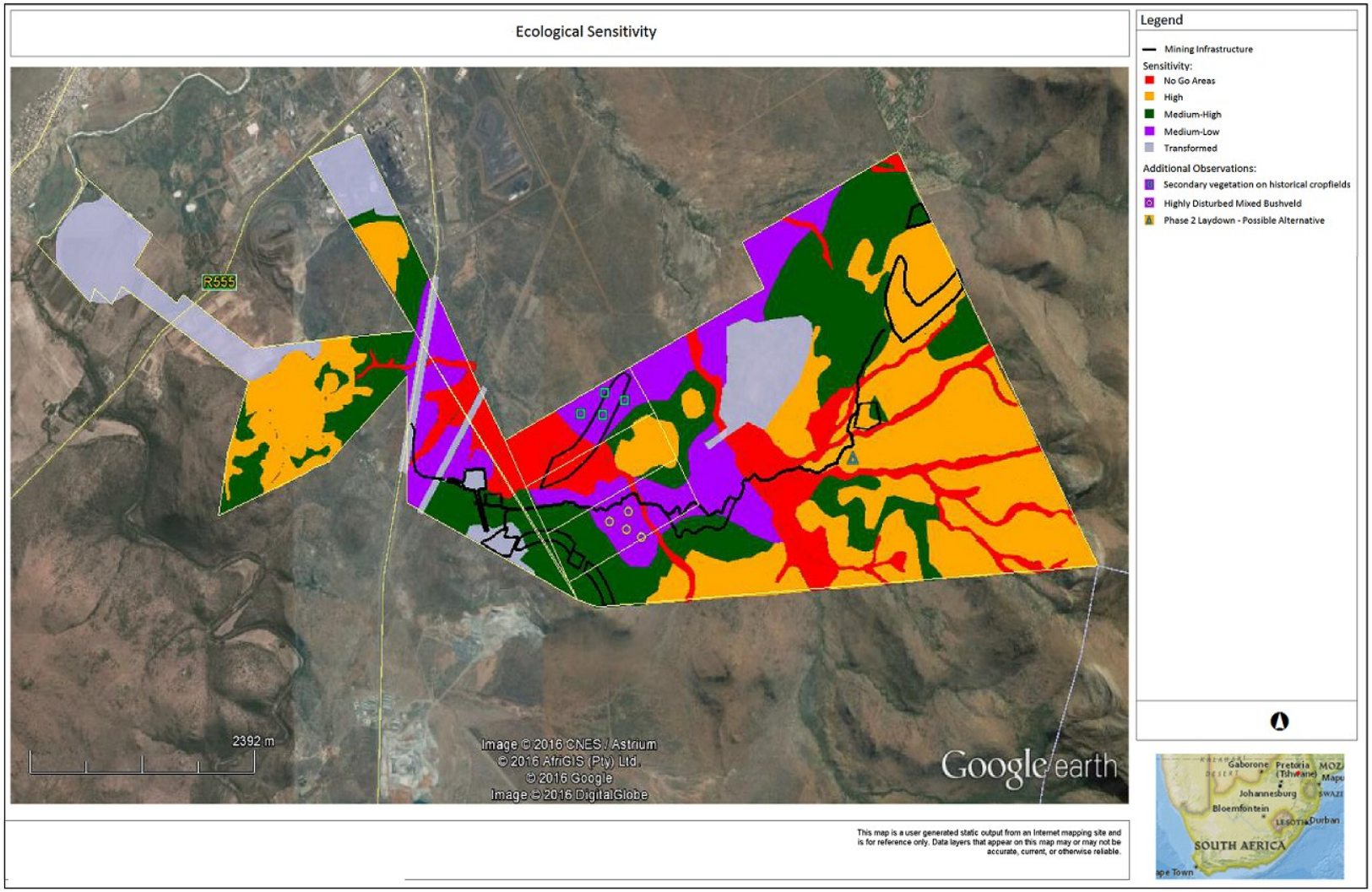

Figure 9: Ecological sensitivity map of the study area.

4.2 DESCRIPTION OF VEGETATION ASSOCIATIONS AND ASSOCIATED HABITATS

4.2.1 *Themeda triandra – Diheteropogon amplectens* Grasslands

Habitat Summary			
Substrate	Higher altitude undulating slopes, terraces or plateaus, shallow clay soils with small surface boulders and –pebbles over hard rock	**Disturbance**	Occasional heavy grazing and harvesting of wood
Species Richness	184 indigenous species recorded		
Sensitivities and/or unique features of habitat	Very high species diversity overall Very high number of endemic species		
Need for rehabilitation	Old prospecting roads forming erosion gullies (especially on Kennedy's Vale 361 portion 8)		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	2 – 4	3 – 5
High Shrubs	1 – 2.5	3 – 10
Low Shrubs	0.3 – 1.2	3 – 10
Grass	0.3 – 1.5	30 – 50
Forbs, including geophytes	0.01 – 0.5	3 – 5
Dominant species	*Andropogon schirensis, Brachiaria serrata, Commelina africana, Dicoma tomentosa, Diheteropogon amplectens, Eragrostis superba, Heteropogon contortus, Loudetia simplex, Melhania randii, Setaria sphacelata, Themeda triandra, Tristachya leucothrix, Vernonia oligocephala, Xerophyta retinervis*	

Conservation status	**Indigenous**	**Alien**	**Total**	**Endemic**	**Red Data**	**Protected**
Succulents	5		**5**	1		
Trees & high shrubs	28		**59**	10		1
Low shrubs	28		**28**	6	3	1
Forbs	82		**82**	3		
Grasses	30		**30**			
Geophytes	11		**11**		1	1
Total	**184**	**0**	**184**	**20**	**4**	**3**

The vegetation consists of moderate to dense grasslands with scattered woody species, very often in discontinuous bands between the denser footslope- and rocky outcrop vegetation. Species composition of dwarf shrubs and forbs is very variable. This vegetation association is scattered throughout the study area. Several geophytes were found in the grasslands, and it is expected that the number of species may be much higher during favourable years. The proposed Tubatse Stockpile area will obliterate some of the more diverse sections of these grasslands observed.

Figure 10: Grasslands on the area where the Tubatse laydown area has been proposed.

Most of the grasses found within these grasslands are relatively palatable, and it is thus not surprising that signs of grazing, even on steeper slopes, were quite common here. Due to the rather limited grazing of the study area as a whole, as well as the high species diversity, the destruction of these grasslands should be limited to the smallest portion possible. Tracts of this vegetation have already been significantly reduced by current bulk prospecting on Kennedy's Vale – as well as on surrounding land portions by other mines.

Sensitivity Analysis:

Conservation value of plant species present	» High in terms of species of conservation concern » Medium to high in terms of creation of microhabitats facilitating the persistence other plants as well as fauna
Habitat value and contribution to ecosystem processes	» High/some irreplaceable: o High species diversity adds to resilience of system and supports pollinator populations during different seasons o Important fauna refuge and feeding area, especially larger shrubs and grass species o High seasonal agricultural potential (livestock) o Presence of grasses is essential to facilitate rapid infiltration of runoff into sub-soil moisture reserves, protecting the scarce soil resources from eroding o Collection of scarce organic material to replenish soil nutrients o CBA 1 and ESA 1 areas
Stability	» High where the vegetation layer is moderate to dense, low if soils become bare » May also be negatively impacted if the immediate surroundings (with a radius of 50 to 100 m, especially upslope) are significantly altered or disturbed » Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively disturbed or compacted
Reversibility of degradation	» Functionality of these habitats must be maintained, re-creation of functionality after transformation will be extremely limited, especially in the absence of suitable topsoil and on steeper slopes » Disturbance will most likely lead to a rapid invasion by alien invasives
Rating	» ***HIGH: Avoid as far as possible***

General development recommendations:

Development in this vegetation/habitat should be limited to the absolute minimum, aiming for minimal to no alteration of the habitat configuration. If some of these habitats are impacted or will be altered by the proposed development, all development must be preceded by a thorough footprint investigation followed by a Search and Rescue operation for all plants of conservation concern.

Components of the proposed development that should under no circumstance be located in this vegetation would include:

- Buildings and/or ablution facilities
- Any form of waste/soil/overburden disposal or stockpiling
- Tailings dams or processing plants

- Any form of storage of materials or machinery

Figure 11: Grasslands on slopes between denser outcrop and foothill vegetation.

4.2.2 *Cyperus sexangularis* - *Flueggea virosa* Riparian Vegetation

Habitat Summary			
Substrate	Clay on solid rock, often with a sandy alluvial layer on the surface. Valley deeply or shallowly incised	**Disturbance**	Occasional occurrence of alien invasives, occasional stream-bank erosion
Species Richness	159 indigenous species recorded		
Sensitivities and/or unique features of habitat	Unique niche habitats with higher moisture levels that support a unique species assemblage Refuge for several specialist species		
Need for rehabilitation	Removal of alien vegetation, installation of proper water crossings where tracks cross drainage lines – the latter may never concentrate natural water flows		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	3 – 10	10 – 60
High Shrubs	1 – 3	10 – 30
Low Shrubs	0.3 – 1.2	5 – 15

Vegetation structure		
Grass	0.5 – 1.5	1 – 5
Forbs, including geophytes	0.01 – 0.9	1 – 5
Dominant species	*Abrus laevigatus, Acacia karroo, Berchemia zeyheri, Croton gratissimus, Cyperus sexangularis, Flueggea virosa, Peltophorum africanum, Pouzolzia mixta, Psiadia punctulata, Rhus leptodictya, Rhus pyroides, Schoenus nigricans, Triraphis andropogonoides*	

Conservation status	Indigenous	Alien	Total	Endemic	Red Data	Protected
Succulents	6		**6**			
Trees & high shrubs	60	1	**92**	3	1	5
Low shrubs	20		**20**	2		
Forbs	50	2	**52**	1		
Grasses	20		**20**			
Geophytes	3		**3**			1
Total	**159**	**3**	**162**	**6**	**1**	**6**

This vegetation association is restricted to mostly ephemeral mountain streams, ravines and seepage areas, as well as all riparian areas adjacent to drainage lines incising the lower plains. The woody vegetation layer is usually very well developed, with species attaining the largest heights here. Below the woody vegetation an often delicate herbaceous layer persists in moderate to deep shade on the banks of the streams. This vegetation will be negatively affected if destruction of upstream vegetation will result in a significant increase in storm water runoff, which will erode streambanks rapidly and with that destabilise and potentially remove portions of this vegetation as well. Steeper ravines in the upper reaches of mountains start resembling afromontane forests.

Figure 12: *Adiantum* species (fern) typically found in the shade of riparian areas (left) and *Karomia speciosa* (right), both found restricted to these habitats

Figure 13: Forest-like riparian vegetation along an ephemeral mountain stream (left) and a more disturbed drainage channel lower in the valley (right).

Sensitivity Analysis:

Conservation value of plant species present	» High in terms of species of conservation concern » High in terms of creation of microhabitats facilitating the persistence other plants as well as fauna
Habitat value and contribution to ecosystem processes	» High/some irreplaceable: o High species diversity adds to resilience of system and supports fauna populations during different seasons o Important fauna refuge o Deeper soils facilitate rapid infiltration of runoff into sub-soil moisture reserves, protecting such moisture reserves from rapid evaporation and hence supporting vegetation during extended dry periods o Corridor for water, nutrients, seed reserves and faunal movements o Collection of scarce organic material to replenish soil nutrients o Filtering of water and absorption of high runoff levels (latter only if vegetation is intact – also surrounding this habitat) o CBA 1 and ESA 1 areas
Stability	» High where the vegetation layer is moderate to dense, low if soils become bare » May also be negatively impacted if the immediate surroundings (with a radius of 50 to 100 m, depending on slopes) are significantly altered or disturbed » Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively disturbed or compacted
Reversibility of degradation	» Functionality of these habitats must be maintained, re-creation of functionality after transformation will be extremely limited » Disturbance will most likely lead to a rapid invasion by undesirable indigenous and possibly alien invasives » Disturbance and/or loss of this habitat mat lead to the rapid degradation (mainly by erosion) of lower-lying fluvial habitats as well
Rating	» ***No Go Area – only suitable crossings permissible***

General development recommendations:

Development in this vegetation/habitat and *at least 50 m beyond* should be limited to crossings of access roads only, aiming for minimal to no alteration of the habitat configuration. Mining/development in this vegetation/habitat is strongly discouraged. Where upstream vegetation will be obliterated or severely denuded, adequate storm water and erosion control measures must be put in place to slow down and disperse runoff volumes and prevent the degradation of other channels and riparian vegetation.

Where road crossings are necessary, channels may under no circumstance be sealed with any impermeable material, as this will lead to a loss of runoff- and related retention/replenishment of soil moisture reserves, nutrients and seeds. Culverts must be designed in a way that water will never be concentrated to a width narrower than the actual channel, causing accelerated erosion during heavy downpours.

Components of the proposed development that may under no circumstance be located in or within 100 m of any drainage would include:

- Buildings and/or ablution facilities
- Any form of waste/soil/overburden disposal or stockpile
- Tailings dams or processing plants
- Any form of storage of materials or machinery

There is a high potential of spread of alien invasive species, especially from machinery moving from infested areas (e.g. next to main traffic routes) through riparian habitats. Monitoring of the establishment of alien invasives will have to be carried out during the entire prospecting and operational phase of the development. New establishments must be controlled as soon as they are detected.

4.2.3 *Acacia tortilis – Dichrostachys cinerea* Dry Mixed Bushveld

Habitat Summary			
Substrate	Deeper, clay-rich soils on the flats between the mountains	**Disturbance**	Excessively grazed with varying levels of bush-encroachment, occasional harvesting of wood
Species Richness	109 indigenous species recorded		
Sensitivities and/or unique features	Occasional occurrence of protected trees		
Need for rehabilitation	Clearing of invasive indigenous and alien shrubs		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	2 – 4	0 – 3
High Shrubs	1 – 3	50 – 60
Low Shrubs	0.2 – 1.2	5 – 10
Grass	0.05 – 0.6	5 – 20
Forbs, including geophytes	0.01 – 0.6	2 – 3

Dominant species	*Acacia mellifera, Acacia tortilis, Carissa bispinosa, Commelina africana, Cynodon dactylon, Dichrostachys cinerea, Enneapogon scoparius, Fingerhuthia africana, Grewia flava, Terminalia prunioides, Tragus berteronianus, Tribulus terrestris, Urochloa mosambicensis*

Conservation status	Indigenous	Alien	Total	Endemic	Red Data	Protected
Succulents	7	1	**8**			
Trees & high shrubs	30		**61**	3		2
Low shrubs	13		**13**	3	1	
Forbs	41	2	**43**			
Grasses	15		**15**			
Geophytes	3		**3**			
Total	**109**	**3**	**112**	**6**	**1**	**2**

The extent of this association is relatively limited, found on more level areas and has been variously disturbed, often leading to a diminished herb-layer and a heavily encroached shrub layer. In a pristine condition it would be a sparse thornveld with an open grassy layer. As the latter consists of mostly 'sweet' grasses, in the study area these patches were probably heavily grazed for many years, leading to the current high levels of bush-encroachment. This also results in a diminishing cover of perennial grasses, replaced by a short-lived cover of weedy annual species, and often bare patches prone to soil-surface capping and then extensive sheet-erosion.

Figure 14: Relatively disturbed and encroached section of the mixed bushveld as found in the study area.

Interestingly, it has been found where other plains vegetation has historically been extensively disturbed by cultivation (see Figure 9 above), this is the vegetation that re-establishes on the disturbed plains, but very often with a relatively poor perennial grass layer, most likely due to the capping of bare topsoils, which forms an ecological barrier to water infiltration, penetration and germination of smaller herb seeds and thus also an impoverished soil seed reserve regarding desirable grass, forb and other species. The implications for rehabilitation of mining areas is that this is the vegetation most likely to establish naturally on plains, especially if topsoils are not adequately loosened by deep contour ripping and augmented with a seed mixture of desirable species and especially perennial grasses.

Sensitivity Analysis:

Conservation value of plant species present	» Low in terms of species of conservation concern » Low in terms of creation of microhabitats facilitating the persistence other plants as well as fauna
Habitat value and contribution to ecosystem processes	» Medium: ○ In a good condition, important fauna refuge and feeding area, especially larger shrubs and grass species ○ Potential high seasonal agricultural potential (livestock) if rehabilitated

	○ Herb layer – where it is relatively intact, slows runoff from higher areas and helps prevent erosion and donga formation lower down ○ Mostly ESA 1 area
Stability	» High where the perennial herb layer is moderate to dense, low if soils become bare and thornbush layer exceeds 10 percent cover » Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively disturbed or compacted
Reversibility of degradation	» Stability of the perennial grass layer of these habitats must be maintained, re-creation of functionality after transformation should be possible if it can be adequately protected from too heavy grazing, especially in the early stages of establishment » Disturbance will most likely lead to a rapid invasion by undesirable indigenous and possibly alien invasives
Rating	» ***Medium-Low***

General development recommendations:

It is recommended that if additional space is required in future for any additional infrastructure, this will be situated on the more disturbed sections of this vegetation. In addition, community members should be engaged to clear out as much wood as possible from areas to be developed to alleviate the wood-clearing of more valuable large trees in the area. Runoff from any sealed or bare surface must be contained to prevent the erosion of the donga areas and drainage lines below these plains.

There is a high potential of spread of alien invasive species, especially from machinery moving from infested areas, e.g. next to main traffic routes. Monitoring of the establishment of indigenous and alien invasives will have to be carried out during the entire prospecting and operational phase of the development. New establishments must be controlled as soon as they are detected.

After decommissioning, it will be important to facilitate the re-establishment of a perennial grass layer – seeds of suitable species are available commercially.

Mine management has indicated that they will attempt, where possible, to create more grazing for the Dithamaga community by trying to clear some of the encroached bush to allow perennial grasses to become re-established. For this, it was strongly advised against removing all vegetation with a bulldozer. Rather, the following should be done to break the sealed upper surface and reduce sheet erosion:

- With a Ripper *only*, rip sections of up to 5 m wide along the contour, alternating with ± 5 m of bushveld as it is
- Rips should be at least 500 mm deep, and invasive thorn bushes uprooted to that depth as well to ensure their resprouting capacity from the below-ground lignotuber is also eradicated

- If possible, hand-collected seeds from surrounding areas should be re-introduced to the rips
- Use the cleared thorn bushes to loosely brush-pack the area - with the branching side facing upslope
    - This is to catch/trap further sediment and runoff as well as protect the freshly prepared soil surface from trampling and newly emerging grass and other forbs from rapid destruction by cattle, as this will create initial small areas of preferential grazing.
    - These branches will disintegrate in a matter of 2 – 3 years, after which perennial grasses should be well enough established to withstand grazing.

4.2.4 *Kirkia wilmsii – Terminalia prunioides* variable Bushveld

Habitat Summary			
Substrate	Clay soils of gradual footslopes, mid-slopes, low ridges and undulating rock plains, underlain by Norite and pyroxenite.	**Disturbance**	Wood cutting
Species Richness	131 indigenous species recorded		
Sensitivities and/or unique features of habitat	High habitat and species diversity High cover of slow-growing, large trees High number of endemic and red-data species		
Need for rehabilitation	Restriction of wood-cutting activities where possible		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	3 – 6	8 – 20
High Shrubs	1 – 3	3 – 20
Low Shrubs	0.3 – 1.2	10 – 20
Grass	0.3 – 1.2	10 – 30
Forbs, including geophytes	0.01 – 0.9	5 – 10
Dominant species	*Acacia senegal, Blepharis subvolubilis, Clerodendrum ternatum, Combretum apiculatum, Commelina africana, Croton gratissimus, Digitaria eriantha, Elephantorrhiza praetermissa, Enneapogon scoparius, Grewia vernicosa, Heteropogon contortus, Hippobromus pauciflorus, Kirkia wilmsii, Peltophorum africanum, Petalidium oblongifolium, Psiadia*	

	punctulata, Sclerocarya birrea, Sphedamnocarpus pruriens, Terminalia prunioides, Themeda triandra, Triaspis glaucophylla

Conservation status	Indigenous	Alien	Total	Endemic	Red Data	Protected
Succulents	5		**5**			
Trees & high shrubs	35		**66**	5	1	4
Low shrubs	22		**22**	5		1
Forbs	40	2	**42**	1		
Grasses	20		**20**			
Geophytes	9		**9**	1	1	1
Total	**131**	**2**	**133**	**12**	**2**	**6**

This is found mostly on the lower footslopes of mountains and as an ecotone to the plains below, but also on rocky mountain scarps as well as undulating rocky flats. The grass layer is well developed, indicating generally more favourable soil conditions. It forms an intricate mosaic with surrounding plains bushveld as well as open mountain bushveld and mountain grassland. Edges of this vegetation on the undulating plains may be prone to bush-encroachment from adjacent more degraded vegetation. A highly variable surface rockiness contributes to high niche diversity within this habitat, which will be almost impossible to re-create once destroyed.

Figure 15: Large stands of *Kirkia wilmsii* on undulating rock plains.

Sensitivity Analysis:

Conservation value of plant species present	» High in terms of species of conservation concern » Medium to high in terms of creation of microhabitats facilitating the persistence other plants, especially geophytes, as well as fauna
Habitat value and contribution to ecosystem processes	» High/some irreplaceable: o High species diversity adds to resilience of system overall o Important fauna refuge and feeding area o Dense grass layer important for slowing storm water runoff, high rock cover preserves soil-water reserves enabling the longer persistence of this vegetation o Grazing potential (livestock) o Collection of scarce organic material to replenish soil nutrients o CBA 1 and ESA 1 areas
Stability	» High where the vegetation layer is moderate to dense, low if soils become bare or soil surface is altered

	» Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively altered
Reversibility of degradation	» Functionality of these habitats must be maintained, re-creation of functionality after transformation will be extremely limited » Disturbance will most likely lead to a rapid invasion by undesirable indigenous and possibly alien invasives
Rating	» ***Medium-High: Avoid as far as possible***

General development recommendations:

Mining/development in this vegetation/habitat should be limited to the absolute minimum, aiming for minimal alteration of the habitat configuration. This is most important within 100 m of any mountain streams and drainages, to prevent the accelerated erosion of lower-lying plains and fluvial systems.

If some of these habitats are impacted or will be altered by the proposed development, newly created slopes should preferably be shallower than the original slopes, but never steeper to enable a gradual re-establishment of the woody and herbaceous layer.

There is a high potential of spread of alien invasive species. Monitoring of the establishment of indigenous and alien invasives will have to be carried out during the entire operational phase of the development. New establishments must be controlled as soon as they are detected.

After decommissioning, it will be important to facilitate the re-establishment of a diverse vegetation layer as soon as possible.

4.2.5 *Hippobromus pauciflorus - Rhoicissus tridentata* Rock Outcrops

Habitat Summary			
Substrate	Sheltered habitats of rock outcrops, ridges, flats and boulders	**Disturbance**	Wood harvesting
Species Richness	146 indigenous species recorded, several more expected, especially geophytes (including Orchidaceae)		
Sensitivities and/or unique features of habitat	High niche diversity High species diversity Often unique species assemblage Many endemic species and habitat specialists Unique habitat configuration that cannot be re-established once destroyed		

Need for rehabilitation	None observed

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	3 – 6	20 – 30
High Shrubs	1 – 3	8 – 15
Low Shrubs	0.3 – 1.2	5 – 10
Grass	0.3 – 1.2	10 – 20
Forbs, including geophytes	0.05 – 0.6	2 – 5
Dominant species	*Clerodendrum ternatum, Commelina africana, Diheteropogon amplectens, Elephantorrhiza praetermissa, Euclea crispa, Grewia vernicosa, Heteropogon contortus, Kirkia wilmsii, Panicum deustum, Pouzolzia mixta, Rhoicissus tridentata, Rhus leptodictya, Sclerocarya birrea, Setaria sphacelata, Themeda triandra, Tinnea rhodesiana, Triaspis glaucophylla, Vitex obovata s. Wilmsii*	

Conservation status	**Indigenous**	**Alien**	**Total**	**Endemic**	**Red Data**	**Protected**
Succulents	8		**8**	2		
Trees & high shrubs	49		**80**	4	2	1
Low shrubs	27		**27**	4	2	1
Forbs	37	2	**39**	3		
Grasses	17		**17**			
Geophytes	8		**8**		8	
Total	**146**	**2**	**148**	**13**	**12**	**2**

This vegetation is highly variable, with no two outcrops with the same vegetation. Generally it is found between large boulders – either on mountain plateaus or on mountain slopes. The high niche diversity accounts for a very high biodiversity of these pockets of vegetation. This vegetation associations is scattered as bush-clumps r stages of it, throughout the study area. The woody layer is dominated by broad-leaved species with a strong link to afromontane forests. The herbaceous lower layer often comprises species that are restricted to the shelter of those habitats. Several more geophytic species are expected to occur here than recorded during the field survey.

Figure 16: Typical rock outcrop vegetation.

Figure 17: *Scadoxus* (left) and *Ficus* (right) species typically restricted to rocky refugia.

Sensitivity Analysis:

Conservation value of plant species present	» High in terms of species of conservation concern and species diversity » High in terms of creation of microhabitats facilitating the persistence other plants as well as fauna

Habitat value and contribution to ecosystem processes	» High and irreplaceable: o High species diversity adds to resilience of system o Important fauna refuge and feeding area o Refuge for several unique species – fauna and flora o Rapid absorption of runoff, even during intense downpours, thus preventing accelerated erosion of lower-lying slopes o Rocks provide protection of sub-soil moisture reserves from rapid evaporation and hence help support vegetation during extended dry periods, creating islands of fertility that maintain fauna during adverse conditions o Collection of scarce organic material to replenish soil nutrients o CBA 1 and ESA 1 areas
Stability	» High where the vegetation layer and habitat is intact » May be negatively impacted if the immediate surroundings (with a radius of 50 to 100 m, depending on slopes) are significantly altered or disturbed » Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively altered
Reversibility of degradation	» Functionality of these habitats must be maintained, re-creation of functionality after transformation is not possible » Disturbance will most likely lead to a rapid decline in habitat integrity of lower-lying slopes
Rating	» ***HIGH: Treat as No Go Area as far as possible***

General development recommendations:

Mining/development in this vegetation/habitat should be avoided as far as possible, aiming for no or only minimal alteration of the habitat configuration or loss of these habitats. This is most important within 100 m of any mountain streams and drainages, to prevent the accelerated erosion of lower-lying plains and fluvial systems.

If some of these habitats are impacted or will be altered by the proposed development, newly created slopes should preferably be shallower than the original slopes, but never steeper to enable a gradual re-establishment of the woody and herbaceous layer. It is highly unlikely that this habitat will ever be recreated, even with the most diligent rehabilitation efforts.

There is a high potential of spread of alien invasive species. Monitoring of the establishment of indigenous and alien invasives will have to be carried out during the entire operational phase of the development. New establishments must be controlled as soon as they are detected.

After decommissioning, it will be important to facilitate the re-establishment of a diverse vegetation layer as soon as possible.

4.2.6 *Combretum hereroense – Euclea sekhukhuniensis* low bushveld

Habitat Summary			
Substrate	Mostly anomalous soils that are freely drained or may contain variable concentrations of plant-toxic metals.	**Disturbance**	Donga erosion, occasional bush-encroachment
Species Richness	91 indigenous species recorded		
Sensitivities and/or unique features of habitat	Soils have a weak structure and extremely high erosion potential Many species specially adapted to less favourable soil conditions and thus highly valuable for rehabilitation efforts Several endemic species limited to these habitats		
Need for rehabilitation	Occasional erosion control Occasional removal of alien invasive species		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	2 – 4	0 – 3
High Shrubs	1.5 – 3	30 – 35
Low Shrubs	0.3 – 0.9	8 – 12
Grass	0.2 – 1.5	20 – 35
Forbs, including geophytes	0.3 – 0.9	3 – 5
Dominant species	*Combretum hereroense, Commelina africana, Dichrostachys cinerea, Diospyros lycioides, Dodonaea angustifolia, Enneapogon scoparius, Eragrostis rigidior, Euclea sekhukhuniensis, Fingerhuthia africana, Grewia vernicosa, Petalidium oblongifolium, Psiadia punctulata, Sporobolus fimbriatus, Terminalia prunioides, Themeda triandra, Tinnea rhodesiana*	

Conservation status	**Indigenous**	**Alien**	**Total**	**Endemic**	**Red Data**	**Protected**
Succulents	2	1	**3**			
Trees & high shrubs	29		**60**	5		3
Low shrubs	12		**12**	3	2	1
Forbs	30	1	**31**			
Grasses	13		**13**			

Conservation status	Indigenous	Alien	Total	Endemic	Red Data	Protected
Geophytes	5		**5**			
Total	**91**	**2**	**93**	**8**	**2**	**4**

Relatively variable, this vegetation type is found on more level areas between slopes or on the plains and extensive donga systems within the study area, where *Euclea sekhukhuniensis* can form relatively dense stands. The latter species is a narrow endemic – although currently abundant, its limited distribution makes its populations highly vulnerable to the impacts of open-cast mining and other transformative developments. This vegetation type is seen as an anomaly with its distinctive species composition and stunted appearance, which is very different from surrounding vegetation.

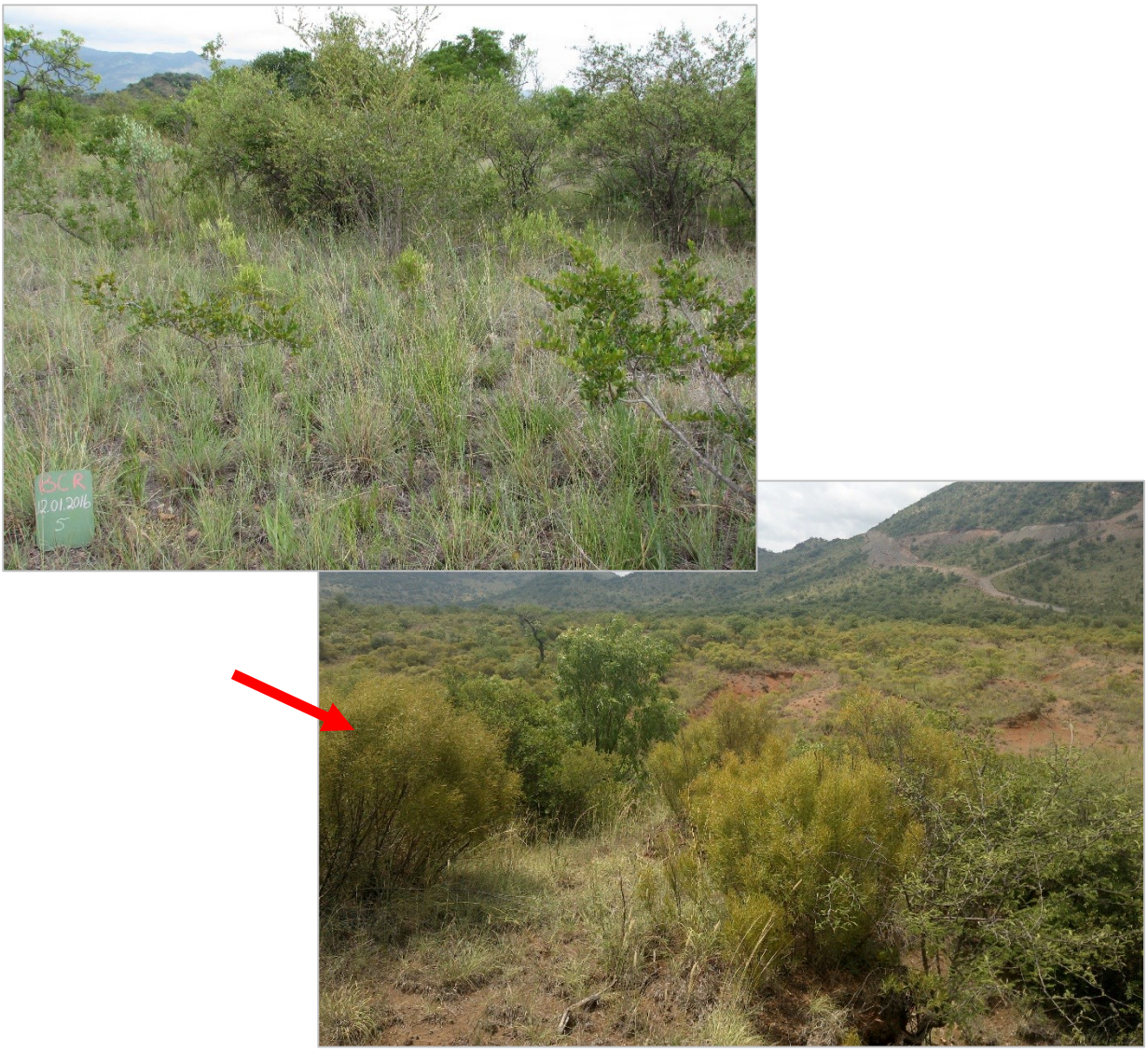

Figure 18: The stunted shrub layer of the erosion plains, often with donga erosion. The conspicuous yellow-green shrub (arrow) is the narrow endemic *Euclea sekhukhuniensis*.

Sensitivity Analysis:

Conservation value of plant species present	» Medium in terms of species of conservation concern » Dense stands of narrow endemics restricted to these habitats
Habitat value and contribution to ecosystem processes	» High: o Species unique and tolerant to less favourable soil conditions and thus potentially of high value for rehabilitation of mining areas o Moderate to high grazing potential (livestock) o Dense vegetation layer important to prevent excessive erosion of these highly erodible soils o Also considered amongst habitat that is most sensitive to mining operations (Mining and Biodiversity Guidelines, DEA 2013) o CBA 1 and ESA 1 areas
Stability	» High to moderate where the vegetation layer is moderate to dense, low if soils become bare » May also be negatively impacted if the upstream surrounding are significantly disturbed or altered in a way that will create significantly more runoff after heavy downpours » Grass, forb and low shrub layer will fluctuate during seasons and from year to year » Very low if soil surface if extensively disturbed or compacted
Reversibility of degradation	» Functionality of these habitats must be maintained, re-creation of functionality after transformation will be extremely limited » Disturbance will most likely lead to a rapid and irreversible degradation
Rating	» ***No Go, only limited access roads permissible*** » ***This indicates that Mining Area 5 is potentially fatally flawed***

General development recommendations:

Mining/development in this vegetation/habitat is strongly discouraged, aiming for no alteration of the habitat. Adjacent (upstream) areas also need to be cleared with care, ensuring that no excessive runoff is directed toward the donga plains. Although current dongas may be relatively old and stable, new and accelerated erosion must be monitored and mitigated at all times.

There is a high potential of spread of alien invasive species. Monitoring of the establishment of indigenous and alien invasives will have to be carried out during the entire operational phase of the development. New establishments must be controlled as soon as they are detected.

After decommissioning, it will be important to facilitate the re-establishment of a dense herbaceous vegetation layer as soon as possible where these plains have been impacted.

4.2.7 Transformed areas

The northern section of concession on Kennedy's Vale 361 portion 22 has been previously transformed, both by past mining/construction activities as well as crop cultivation. Although sections have been subjected to rehabilitation efforts, this has only resulted in the establishment of a sparse grass layer, but not vegetation that resembles anything of the original assumed state.

These transformed areas were not further investigated as BCR Minerals had indicated that it had no interest in any operations on those areas in the future.

Figure 19: View of the transformed areas on Kennedy's Vale 361 Portion 22.

In addition, areas have also been transformed by the licenced Spitsvale Prospecting Activities, as well as where the Dithamaga have created their settlement.

4.3 TERRESTRIAL FAUNA SURVEY

4.3.1 Invertebrates

Theraphosidae (baboon spiders), are known to occur widely in Limpopo. Actual databases for locality-specific occurrences of Arachnids are limited (South African National Survey of Arachnida). Baboon spiders are nocturnal, hiding during the day in silk-lined burrows – referred to as scrapes – from where they will jump at unsuspecting prey at night. Due to an increasing trade in exotic animals, wild populations of Baboon spider are starting to decline, and hence they are protected by LEMA Schedule 10. The presence of such spiders on the study area is very likely, thus areas to be developed should be investigated prior to commencement of activity. Should their burrows be noted, a suitably qualified entomologist must be contracted to relocate all affected specimens prior to any commencement of activity.

Following species of Theraphosidae have been historically recorded in the 2430 grid:
Brachionopus robustus, Ceratogyrus darlingi, Harpactira gigas, Harpactirella overdijki, Idiothele nigrofulva

4.3.2 Amphibians

The ADU lists 15 amphibian species for the greater project area. Of these, one species is listed as *Endemic,* the Queckett's River Frog (*Amietia quecketti*), which is listed as *Least Concern.*

4.3.3 Reptiles

The ADU lists 68 reptile species for the greater project area. Of these, one species is considered *Near Threatened,* FitzSimons' Flat Lizard (*Platysaurus orientalis* subsp *fitzsimonsi*), and 29 species are protected provincially under LEMA Schedule 3, including the Chamaeleon observed. It should however be noted that most species have not had their population status evaluated at this stage.

Figure 20: Common Flap-neck Chameleon (*Chamaeleo dilepis subsp dilepis*)

4.3.4 Mammals

The ADU database currently has an underrepresented species list for mammals of the region, although some smaller mammals are expected to occur on the proposed project area. It is, however, not expected that any threatened mammal species rely on the proposed project area for survival. Signs of Duiker, Jackal and Porcupine could be found, while the Chakma Baboon was observed, as well tree squirrels.

Figure 21: Tree Squirrel (*Paraxerus cepapi*) observed in the rock outcrops

4.4 Species of Conservation Concern

The following red data species (see section 3.3 for implications for development) have been recorded from the area (Grid 2430 C) according to the red data species list of SANBI and the ADU database:

Plants				
Species	**Red Data Status**	**Suitable Habitat**	**Possibility of being present**	**Threat**
Acacia (Vachellia) sekhukhuniensis	**Critically Endangered B1ab(ii,iii)**	Rocky slopes and outcrops	Unlikely	Habitat transformation Sekhukhune-endemic

Plants				
Species	**Red Data Status**	**Suitable Habitat**	**Possibility of being present**	**Threat**
Acalypha caperonioides var. caperonioides	**Data Deficient – Taxonomically Problematic**	Rocky slopes and outcrops	Likely	Habitat transformation
Adenia fruticosa subsp. fruticosa	**Near Threatened A2c; B1ab(iii,v)+2ab(iii,v)**	Rocky slopes and outcrops	Likely	Habitat transformation
Alepidea peduncularis	**Data Deficient – Taxonomically Problematic**	Rocky slopes and outcrops	Likely	Habitat transformation
Aloe integra	**Vulnerable B1ab(ii,iii,iv,v)**	Rocky slopes and outcrops	Likely	Habitat transformation
Ansellia africana	**Declining**	Rocky outcrops, woody riparian vegetation	Likely	Habitat transformation Wood-harvesting (it is an epiphyte on large trees)
Asparagus intricatus	**Data Deficient – Taxonomically Problematic**	Rocky slopes and outcrops	Confirmed	Habitat loss (RSA endemic)
Asparagus sekukuniensis	**Endangered A2c**	Rocky slopes and outcrops	Confirmed	Habitat transformation Sekhukhune-endemic
Ceropegia decidua subsp. pretoriensis	**Vulnerable D1+2**	Rocky slopes and outcrops	Likely	Habitat transformation
Combretum petrophilum	**Rare**	Rocky slopes and outcrops	Highly Likely	Habitat transformation Sekhukhune-endemic
Dicliptera fruticosa	**Near Threatened B1ab(iii)**	Open woodland or rocky magnetite slopes	Highly Likely	Habitat transformation
Drimia sanguinea	**Near Threatened A2d**	Variable plain habitats	Confirmed	Medicinal trade
Elaeodendron transvaalense	**Near Threatened A4ad**	Rocky slopes and outcrops	Confirmed	Habitat transformation
Erica atherstonei	**Near Threatened D2**	High-altitude grasslands	Small possibility	Habitat transformation
Euclea sekhukhuniensis	**Least concern at present**	Plains with poor and erodible soils	Confirmed	Habitat transformation Sekhukhune-endemic
Eulophia speciosa	**Declining**	Montane grasslands	Likely	Habitat transformation Collection
Euphorbia barnardii	**Endangered A2ace; B1ab(ii,iii,iv,v)+2ab (ii,iii,iv,v)**	Rocky slopes and outcrops, mainly Norite outcrops	Small possibility	Habitat transformation

Plants				
Species	**Red Data Status**	**Suitable Habitat**	**Possibility of being present**	**Threat**
Euphorbia sekukuniensis	**Rare**	Rocky slopes and outcrops, shallow Norite soils	Small possibility	Habitat transformation Sekhukhune-endemic
Gladiolus sekukuniensis	**Vulnerable D2**	Rocky slopes and outcrops	Highly Likely	Habitat transformation Sekhukhune-endemic
Gnidia variabilis	**Vulnerable D2**	Rocky slopes and outcrops	Confirmed	Habitat transformation Sekhukhune-endemic
Hypoxis hemerocallidea	**Declining**	Variable	Likely	Habitat transformation Medicinal trade
Ilex mitis	**Declining**	Mostly riparian woodlands	Confirmed	Habitat loss, wood harvesting
Indigofera leendertziae	**Data Deficient – Taxonomically Problematic**	Rocky slopes and outcrops	Likely	Habitat transformation
Jamesbrittenia macrantha	**Near Threatened B1ab(iii)**	Undulating rocky plains	Confirmed	Habitat transformation Sekhukhune-endemic
Kniphofia typhoides	**Near Threatened A2ac**	Heavy black clay soils or riparian areas	Likely	Habitat transformation
Lydenburgia cassinoides	**Near Threatened B1ab(ii,iii,v)**	Rock outcrops and riparian areas	Confirmed	Habitat transformation Sekhukhune-endemic
Merwilla plumbea (Scilla natalensis)	**Near Threatened A2bd**	Variable – flats and undulating plains	Confirmed	Habitat transformation, horticultural harvesting
Myrothamnus flabellifolius	**Data Deficient – Taxonomically Problematic**	Rocky slopes and outcrops	Unlikely	Habitat transformation, Medicinal trade
Nemesia zimbabwensis	**Endangered B1ab(ii,iii)**	Rocky slopes and outcrops	Small possibility	Habitat transformation
Orthosiphon fruticosus	**Least concern at present**	Rock outcrops and riparian areas	Confirmed	Habitat transformation Sekhukhune-endemic
Polygala sekhukhuniensis	**Vulnerable A4c**	Erosion plains and lower slopes	Confirmed	Habitat transformation, mainly by mining
Rhoicissus sekhukhuniensis	**Least concern at present**	Rock outcrops and riparian areas	Confirmed	Habitat transformation Sekhukhune-endemic
Searsia batophylla	**Vulnerable A2c**	Riparian donga areas	Small possibility	Habitat transformation Sekhukhune-endemic
Searsia sekhukhuniensis	**Rare**	Rocky slopes and outcrops, pyroxenitic substrates	Likely	Habitat transformation Sekhukhune-endemic

Plants				
Species	**Red Data Status**	**Suitable Habitat**	**Possibility of being present**	**Threat**
Thesium gracilentum	**Vulnerable D2**	Serpentine soils	Unlikely	Habitat transformation Sekhukhune-endemic
Zantedeschia jucunda	**Vulnerable B1ab(v)+2ab(v)**	Rocky slopes and outcrops	Likely	Habitat transformation, Horticultural trade Sekhukhune-endemic
Zantedeschia pentlandii	**Vulnerable B1ab(v)**	Rocky slopes and outcrops	Confirmed	Habitat transformation Sekhukhune-endemic

Terrestrial Fauna				
Common name	**Scientific name**	**Habitat**	**Status**	**Likelihood of occurrence**
Reptiles				
Common Flap-neck Chameleon	*Chamaeleo dilepis subsp dilepis*	Shrubby vegetation	LEMA	Confirmed
FitzSimons' Flat Lizard	***Platysaurus orientalis subsp fitzsimonsi***	Rocky areas	**Near Threatened**	Highly likely

The following species observed on the study site during this survey are protected:

Limpopo Environmental Management Act (Act 7 of 2003)

Flora: *Elephantorrhiza praetermissa*, *Boscia foetida*, *Spirostachys africana*, *Scadoxus puniceus*, *Merwilla plumbea (Scilla natalensis)*, *Jamesbrittenia macrantha*, *Zantedeschia pentlandii*

Fauna: *Chamaeleo dilepis subsp dilepis*

National Forest Act (Act No. 84 of 1998)

- *Boscia albitrunca*
- *Elaeodendron transvaalense*
- *Sclerocarya birrea*
- *Balanites maughamii*
- *Prunus africana*
- *Lydenburgia cassinoides*

National Environmental Management Act: Biodiversity Act (Act No. 10 of 2004) and amendments

- *Merwilla plumbea (Scilla natalensis)*

4.5 INVASIVE PLANTS

A detailed alien invasives species management plan will have to be implemented during prospecting, construction, and mining and maintained until decommissioning has been completed. This management plan must also ensure following regulations of NEMBA are adhered to:

d. Conveying, moving or otherwise translocating any specimen of a listed invasive species

f. Spreading or allowing the spread of any specimen of a listed invasive species

According to Government Notice R598, Chapters 2 and 3 as relevant to this inspection:

Section 3. Category 1b Listed Invasive Species

(1) Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled.

(2) A person in control of a Category 1 b Listed Invasive Species must control the listed invasive species in compliance with sections 75(1), (2) and (3) of the Act.

(3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.

(4) A person contemplated in sub-regulation (2) must allow an authorised official from the Department to enter onto the land to monitor, assist with or implement the control of the listed invasive species, or compliance with the Invasive Species Management Programme contemplated in section 75(4) of the Act.

Section 4. Category 2 Listed Invasive Species

(1) Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be.

(2) Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit.

(3) A landowner on whose land a Category 2 Listed Invasive Species occurs or person in possession of a permit, must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or permit.

(4) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.

(5) Unless otherwise specified in the Notice, any species listed as a Category 2 Listed Invasive Species that occurs outside the specified area contemplated in sub-regulation (1), must, for purposes of these regulations, be considered to be a Category 1 b Listed Invasive Species and must be managed according to Regulation 3.

(6) Notwithstanding the specific exemptions relating to existing plantations in respect of Listed Invasive Plant Species published in Government Gazette No. 37886, Notice 599 of 1 August 2014 (as amended), any person or organ of state must ensure that the specimens of such Listed Invasive Plant Species do not spread outside of the land over which they have control.

Section 5. Category 3 Listed Invasive Species

(1) Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.

(2) Any plant species identified as a Category 3 Listed Invasive Species that occurs in riparian areas, must, for the purposes of these regulations, be considered to be a Category 1b Listed Invasive Species and must be managed according to regulation 3.

(3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.

Section 6. Restricted activities

In addition to those activities defined in terms of section 1 of the Act as restricted activities, the following activities are hereby prescribed as restricted activities:

(a) Spreading or allowing the spread of, any specimen of a listed invasive species;

Introduction of alien invasives often happens accidentally/unintentionally through machinery and staff movement onto and across sites, and large-scale disturbance of vegetation presents an ideal opportunity for the establishment of these unwanted plants.

The following alien invasive species have been observed on the land portions:

Category 1b:

- *Argemone ochroleuca*
- *Datura stramonium*
- *Lantana camara*
- *Melia azedarach*

- *Pennisetum setaceum*
- *Opuntia* species

Category 2:

- *Agave sisalana*

Category 3:

- *Morus alba*

Figure 22: *Opuntia* and *Pennisetum* found on the mining area next to road

5 ASSESSMENT OF IMPACTS

5.1 ASSUMPTIONS

The following is assumed and/or known:

- Prospecting has already resulted in the creation of most of the internal access tracks (which will be expanded) and transformation of areas including the Office and Workshop area, Stockpile areas 1 and 2 below Klarinet Koppie as well as Portions of Phase 1: Klarinet Koppie (Figure 23)

Figure 23: Offices and stockpiles as well as current prospecting operations on Klarinet Koppie (envisaged Phase 1).

- Existing access roads and tracks (gravel) will be used as much as possible and upgraded where applicable, whilst new access roads will coincide as far as possible with existing infrastructure (e.g. follow existing powerline servitudes). Access roads will be suitably reinforced and maintained, and complemented with an appropriate storm water management design that will under no circumstance concentrate any water
- **A thorough ecological investigation of all footprint areas (see Appendix E) will be conducted to estimate population sizes and relocate all plant species of conservation concern by a suitably**

qualified botanist prior to commencement of any new activities where areas will be cleared or excavated

- Such investigation must be carried out at a time when the maximum amount of species are actively growing and thus visible (January to May)
- It must be followed by the necessary Search and Rescue actions prior to any groundworks taking place
- Results of this investigation must be made available to the contractor and the EO/ECO and be part of the overall EMPr

» A full-time EO/ECO (preferably both) will be present on site and will inspect all sections of the development area prior to commencement of new mining activities to determine the presence of burrowing and other vertebrates and baboon spiders possible on site and will notify the contractor immediately where such animals need to be captured and relocated to other portions of the selected properties by a suitably qualified person or company

» Prior to development, during operation and up to decommissioning the area will be routinely cleared of all alien invasive plants

» All removal of vegetation will be done manually or mechanically, with the use of herbicides only where other options will not be successful and in such case with the approval of the relevant Agricultural and Conservation Departments

5.2 TYPES OF IMPACTS: SOME EXPLANATORY NOTES

Mining can have the following types of impacts:

- *Direct impacts* are those impacts directly linked to the project (e.g. clearing of land, extraction of water, contamination of water bodies, blasting, sedimentation, and change in water table levels). These can be temporary or remain as residual impacts.
- *Indirect impacts* are those impacts resulting from the project that may occur beyond or downstream of the boundaries of the project site and/or after the project activity has ceased (e.g. migration of pollutants from waste sites, reduced flow in downstream rivers).
- *Induced impacts* are impacts that are not directly attributable to the project, but are anticipated to occur because of the presence of project (e.g. impacts of associated industries, establishment of residential settlements with increased pressure on biodiversity).
- *Cumulative impacts* are those impacts from the project combined with the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity or natural resources (e.g. a number of mines in the same catchment or ecosystem type collectively affected water quality or flow, or impacting the same local endemic species).

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other factors. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly

extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of a development be kept as close together as possible. Thus new power lines should follow routes of existing servitudes if such exist, renewable energy facilities should be constructed as close as possible to existing infrastructure or substations, and if several developments are planned within close proximity, these developments should be situated as close together as possible and in a way that interferes as little as possible with natural ecosystem processes, not scattered throughout the landscape.

5.3 Impacts of the Bushveld Chrome Minerals Mine, access roads and associated infrastructure

5.3.1 Site access and internal roads

Description: Where access roads are created or widened for upgrading, vegetation is cleared, surface is compacted and levelled, road surface is reinforced with compacted gravel (as a minimum, possibly later covered with tar or concrete), raised where necessary to ensure rapid runoff of water, internal access roads will have to cross some streams CBA 1 and ESA 1 areas (confirmed by fieldwork) will be affected		
Environmental impacts: Loss of vegetation, increase in runoff and erosion, possible distribution and increased establishment of alien invasive species, possible disturbance and reduction of habitat, injury or death to terrestrial fauna, possible change of natural runoff and drainage patterns causing accelerated erosion, possible loss of protected species, possible permanent loss of revegetation potential of soil surface, increase in dust levels, interference with fauna behavioural activities, possible exposure of fauna and flora to contaminants – especially hydrocarbons and increased dust levels *Note: relatively large access tracks already exist to parts of the land portions selected, but their width may at least double for mining operations*		
	Without mitigation	**With mitigation**
Extent (E)	Ste and surrounds (2)	Site (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (4)	Minor (2)
Probability (P)	Definite (5)	Highly probable (4)
Significance **(S = E+D+M)*P**	**Medium (50)**	**Low (28)**

Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Relatively reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	
Indirect impacts: None expected if mitigation measures are diligently implemented		
Induced impacts: Increased loss of large trees due to wood-harvesting by local residents where access by vehicle is expanded		
Cumulative impacts: i. Increase in transformed areas in the Steelpoort Valley, adding to the overall impact of mines in the area ii. Possible erosion of areas lower than the access road, possible contamination of wetlands and/or groundwater reserves due to hydrocarbon or other spillage iii. Possible spread and establishment of alien invasive species iv. Increased transformed areas (together with surrounding developments) that will affect fauna and flora population dynamics and runoff patterns		
Residual impacts: i. Localised loss of vegetation, including individuals of endemics with restricted habitats ii. Altered topsoil conditions iii. Potential barren areas remaining after decommissioning iv. Potential for erosion and invasion by weeds or alien species		

5.3.2 Offices, workshops and other associated infrastructure, including Hydrocarbon Storage and Waste site next to Stockpile Area 1

Description: Where offices, workshops, hydrocarbon storage- and waste collection areas are established, vegetation is cleared, surface is compacted and levelled, surfaces may be sealed and permanently transformed *Note: most of the area earmarked for offices has already been cleared and established during prospecting operations, including a weighbridge*
Environmental impacts: Loss of vegetation, increase in runoff and erosion, possible distribution and increased establishment of alien invasive species, change of natural runoff and drainage patterns, increase in *concentrated* runoff from sealed surfaces and possibly higher accelerated erosion, reduction of habitat and resource availability for terrestrial fauna, possible loss of protected species,

possible permanent loss of revegetation potential of soil surface, interference with fauna behavioural activities, possible exposure of fauna and flora to contaminants		
	Without mitigation	**With mitigation**
Extent (E)	Site and surrounds (2)	Site (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (4)	Minor (2)
Probability (P)	Highly probable (4)	Probable (3)
Significance (S = E+D+M)*P	**Medium (40)**	**Low (27)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Relatively reversible
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	
Indirect impacts: None expected if mitigation measures are diligently implemented		
Induced impacts: None expected if mitigation measures are diligently implemented		
Cumulative impacts: i. Possible erosion of areas lower than the access road, possible contamination of wetlands and/or groundwater reserves due to oil or other spillage ii. Possible spread and establishment of alien invasive species iii. Increased transformed areas (together with surrounding developments) that will affect fauna and flora population dynamics and runoff patterns		
Residual impacts: i. Localised loss of vegetation, some loss of large indigenous shrubs ii. Altered topsoil conditions iii. Potential barren areas remaining after decommissioning iv. Potential for erosion and invasion by weeds or alien species v. Potential for increased dust and its impact on surrounding environments and biodiversity		

5.3.3 Open Cast Bulk Extraction – Phase 1: Klarinet Koppie

Description: sides of the ore-containing Koppies are blasted in portions and then further excavated with large machinery. Currently only extracted ore is stored in stockpiles, overburden is tipped over

the edge of excavation sites onto the mountain slopes (see Figure 23 above). The plan is to re-fill mined-out pits with existing overburden as soon as possible, thus minimising the need for storage of overburden material.

ESA 1 area, sensitivity medium-high

Environmental impacts: Loss of vegetation – including large trees of conservation concern – and unique habitats; increase in runoff and erosion; possible distribution and increased establishment of alien invasive species; reduction of habitat, injury or death to terrestrial fauna; change of natural runoff and drainage patterns; possible loss of protected and/or red-data species; possible permanent loss of revegetation potential of soil surface; increase in dust levels, possible exposure of fauna and flora to contaminants

	Without mitigation	**With mitigation**
Extent (E)	Site and surrounds (2)	Site and surrounds (2)
Duration (D)	Permanent (5)	Long-term (4)
Magnitude (M)	Very High Intensity (10)	High Intensity (8)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**High (85)**	**High (70)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Slightly reversible
Irreplaceable loss of resources?	Probable	Probable
Can impacts be mitigated?	To small degree	

Indirect impacts:

- Possible gradual degradation of adjacent plains due to changed runoff patterns and change in soil chemistry to which vegetation is intolerant, also after decommissioning

Induced impacts:

Increased loss of large trees due to wood-harvesting by local residents where access by vehicle is expanded

Cumulative impacts:

i. Increased loss of habitats and species unique to Sekhukhuneland, increasing the impact of existing surrounding mining activities in the Steelpoort area
ii. Possible erosion of lower-lying areas, including contamination of downstream wetlands and/or groundwater reserves due to hydrocarbon or other spillage
iii. Possible spread and establishment of alien invasive species

Residual impacts:

i. Localised loss of vegetation, loss of large (slow-growing) indigenous shrubs and trees

ii. Altered topsoil conditions iii. Potential barren areas remaining after decommissioning iv. Potential for accelerated erosion and invasion by weeds or alien species

5.3.4 Open Cast Bulk Extraction – Phase 2: Tubatse Koppie

Description: sides of the ore-containing Koppies (Tubatse-Koppie) are blasted in portions and then further excavated with large machinery. Currently only extracted ore is stored in stockpiles, overburden is tipped over the edge of excavation sites onto the mountain slopes (see Figure 23 above). The plan is to re-fill mined-out pits with existing overburden as soon as possible, thus minimising the need for storage of overburden material. Mostly on CBA 1 (confirmed) and some on ESA 1 area, Mining Guideline Category C (confirmed) sensitivity Medium-High to High		
Environmental impacts: Loss of vegetation – including geophytes, shrubs and large trees of conservation concern – and unique habitats; increase in runoff and erosion; possible distribution and increased establishment of alien invasive species; reduction of habitat, injury or death to terrestrial fauna; change of natural runoff and drainage patterns; possible loss of protected and/or red-data species; possible permanent loss of revegetation potential of soil surface; increase in dust levels, possible exposure of fauna and flora to contaminants		
	Without mitigation	**With mitigation**
Extent (E)	Site and surrounds (2)	Site and surrounds (2)
Duration (D)	Permanent (5)	Long-term (4)
Magnitude (M)	Very High Intensity (10)	High Intensity (9)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**High (85)**	**High (75)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Slightly reversible
Irreplaceable loss of resources?	Probable	Probable
Can impacts be mitigated?	To small degree	
Indirect impacts: • Possible gradual degradation of adjacent plains due to changed runoff patterns and change in soil chemistry to which vegetation is intolerant, also after decommissioning		
Induced impacts:		

Increased loss of large trees due to wood-harvesting by local residents where access by vehicle is expanded
Cumulative impacts: i. Increased loss of habitats and species unique to Sekhukhuneland, increasing the impact of existing surrounding mining activities in the Steelpoort area ii. Possible erosion of lower-lying areas, including contamination of downstream wetlands and/or groundwater reserves due to hydrocarbon or other spillage iii. Possible spread and establishment of alien invasive species
Residual impacts: i. Localised loss of vegetation, loss of large (slow-growing) indigenous shrubs and trees, loss of rare geophytes and succulents ii. Altered topsoil conditions iii. Potential barren areas remaining after decommissioning iv. Potential for accelerated erosion and invasion by weeds or alien species

5.3.5 Open Cast Bulk Extraction – Phase 3: Spitsvale Flats

Description: erosion plains and associated drainage lines are blasted in portions and then further excavated with large machinery. Currently only extracted ore is stored in stockpiles, overburden is tipped over the edge of excavation sites onto the mountain slopes (see Figure 23 above). The plan is to re-fill mined-out pits with existing overburden as soon as possible, thus minimising the need for storage of overburden material. ESA 1 area, Mining Guideline Category B (confirmed), Sensitivity: Medium-Low to **NO GO**		
Environmental impacts: Loss of vegetation – including large trees of conservation concern and a high number of endemic shrubs restricted to these plains – and unique habitats; obliteration of parts of a large ephemeral watercourse; possible significant increase in erosion and rapid degradation of (stable) donga system; distribution and increased establishment of alien invasive species; reduction of habitat, injury or death to terrestrial fauna; change of natural runoff and drainage patterns; possible loss of protected and/or red-data species; possible permanent loss of revegetation potential of soil surface; increase in dust levels, possible exposure of fauna and flora to contaminants		
	Without mitigation	**With mitigation**
Extent (E)	Site and surrounds (2)	Site and surrounds (2)
Duration (D)	Permanent (5)	Permanent (5)
Magnitude (M)	Very High Intensity (10)	Very High Intensity (10)

Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**High (85)**	**High (85)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Expected	Expected
Can impacts be mitigated?	**Minimal: Even with mitigation the impacts in the NO GO area cannot be reduced** **From an ecological perspective FATALLY FLAWED across the erosion plains**	

Indirect impacts:

- Continued gradual to rapid degradation of adjacent plains and downstream riparian habitats due to significantly destabilised soil surface, significantly altered runoff patterns, also after decommissioning
- Loss of genetic diversity of a narrow Sekhukhuneland endemics (*Euclea sekhukhuniensis, Searsia batophylla* and *Polygala sekhukhuniensis*) and possible change in current threat status (no definite population assessment done up to date)

Induced impacts:

Increased loss of large trees due to wood-harvesting by local residents where access by vehicle is expanded, loss of specific niche habitat

Cumulative impacts:

i. Increased loss of habitats and species unique to Sekhukhuneland, increasing the impact of existing surrounding mining activities in the Steelpoort area
ii. Possible erosion of lower-lying areas, including contamination of downstream wetlands and/or groundwater reserves due to hydrocarbon or other spillage
iii. Possible spread and establishment of alien invasive species

Residual impacts:

i. Localised loss of vegetation
ii. Loss of large part of unique habitat and riparian area associated to the ephemeral drainages that will be obliterated
iii. Altered topsoil conditions
iv. Potential barren areas remaining after decommissioning
v. Potential for accelerated erosion and invasion by weeds or alien species

5.3.6 Stockpiles 1 and 2

Description: Excavated ore will be stockpiled before processing and/or transport to markets, , areas of stockpiles will first be cleared, after which soils are levelled and compacted

These stockpiles already exist as part of the current prospecting operations at the mine (see Figure 23), but may be expanded

ESA 1 area, Mining Guideline Category B (only individual species confirmed), sensitivity Medium-High to Medium-Low, BUT bordering on No-Go areas

Environmental impacts: Loss of vegetation and possibly trees and shrubs of conservation concern; possible distribution and increased establishment of alien invasive species; disturbance and reduction of habitat, injury or death to terrestrial fauna; possible change of natural runoff and drainage patterns and associated accelerated erosion of sensitive habitats; possible permanent loss of revegetation potential of soil surface, increase in dust levels, possible exposure of fauna and flora as well as lower-lying habitats to contaminants

	Without mitigation	**With mitigation**
Extent (E)	Site and surrounds (2)	Site (1)
Duration (D)	Permanent (5)	Long-term (4)
Magnitude (M)	Moderate (6)	Low (4)
Probability (P)	Definite (5)	Highly probable (4)
Significance (S = E+D+M)*P	**Medium (55)**	**Medium (36)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Reversible to some degree
Irreplaceable loss of resources?	Probable	Not likely
Can impacts be mitigated?	Reasonably well	

Indirect impacts:

- Possible gradual degradation of adjacent highly sensitive plains due to changed runoff patterns and change in soil chemistry to which vegetation is intolerant, also after decommissioning

Induced impacts:

None expected if mitigation measures are diligently implemented

Cumulative impacts:

i. Possible erosion of areas lower than the access road, possible contamination of lower-lying wetlands, riparian areas and/or groundwater reserves due to hydrocarbon or other spillage
ii. Possible spread and establishment of alien invasive species
iii. Increased transformed areas (together with surrounding developments) that will affect fauna and flora population dynamics and runoff patterns

Residual impacts:

i. Localised loss of vegetation, some loss of large indigenous trees or geophytes of conservation concern
ii. Altered topsoil conditions
iii. Potential barren areas remaining after decommissioning
iv. Potential for erosion and invasion by weeds or alien species
v. Potential for increased dust and its impact on surrounding environments and biodiversity

5.3.7 Phase 2 laydown area, including ore stockpile

Description: Excavated ore will be stockpiled before processing and/or transport to markets, stockpiling and sorting close to source reduces risks associated with movement of large mining vehicles, limited temporary offices and staff facilities will need to be created, workshop areas have been proposed, areas will first be cleared and levelled, after which soils are levelled and compacted CBA 1 area (confirmed), Mining Guideline Category C (sensitive habitat and species confirmed), sensitivity Medium-High to High, BUT bordering on No-Go areas

Environmental impacts: Loss of highly diverse grassland vegetation and trees and shrubs of conservation concern; high risk of negative spill-over-effect from the stockpile and/or workshops onto the adjacent ephemeral mountain streams (either side and downstream of the stockpile) and their highly unique riparian vegetation; high risk of distribution and increased establishment of alien invasive species into upstream intact riparian and other vegetation; disturbance and reduction of habitat, injury or death to terrestrial fauna; possible change of natural runoff and drainage patterns and associated accelerated erosion of sensitive downstream habitats; possible permanent loss of revegetation potential of soil surface, increase in dust levels, possible exposure of fauna and flora as well as lower-lying habitats to contaminants

Note: a possible alternative site about 300 m further south could pose a slightly lower pollution risk as it has a lower slope (see Figure 9 above), but the same mitigation restrictions will apply

	Without mitigation	**With mitigation**
Extent (E)	Site and surrounds (2)	Site and surrounds (2)
Duration (D)	Permanent (5)	Long-term (4)
Magnitude (M)	Very High Intensity (10)	Moderate Intensity (6)
Probability (P)	Definite (5)	Highly Probable (4)
Significance (S = E+D+M)*P	**High (85)**	**Medium (48)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Not reversible	Reversible to some degree

Irreplaceable loss of resources?	Highly Probable	Likely
Can impacts be mitigated?	Possible to some extent, but laydown area may not exceed 3 – 4 ha in size (depending on recommendations by Soil- and Hydrological Specialists), areas must be at least 50 m, preferably 100 m from any riparian vegetation and adequately protected by runoff- and spill-containing berms. Workshop facilities may only cater for daily maintenance of heavy vehicles, no extensive repairs. All other mitigation measures to be strictly implemented as well.	

Indirect impacts:

- Expected gradual to rapid degradation of adjacent AND downstream highly sensitive riparian areas due to changed runoff patterns and change in soil chemistry to which vegetation is intolerant, also after decommissioning
- Expected continued leaching of pollutants into downstream fluvial systems and associated degradation of riparian vegetation and loss of suitable habitat

Induced impacts:

Increased pressure on large trees in especially riparian areas for unsustainable wood harvesting in more sensitive habitats around the area after decommissioning because of ease of access that will be created

Cumulative impacts:

i. Possible erosion of areas lower than the access road, possible contamination of lower-lying wetlands, riparian areas and/or groundwater reserves due to hydrocarbon or other spillage
ii. Possible spread and establishment of alien invasive species
iii. Increased transformed areas (together with surrounding developments) that will affect fauna and flora population dynamics and runoff patterns

Residual impacts:

i. Localised loss of vegetation, some loss of large indigenous trees, shrubs or geophytes of conservation concern
ii. Altered topsoil conditions
iii. Potential barren areas remaining after decommissioning
iv. Potential for erosion and invasion by weeds or alien species
v. Potential for increased dust and its impact on surrounding environments and biodiversity

5.3.8 Processing (Ore Crushing and Screening) Plant

Description: excavated ore will have to be separated from the surrounding rock to concentrate the valuable ore, this will be done on an area cleared, levelled and compacted, and may be associated with high levels of generated dust as the excavated material is crushed. *Note: A mobile screening unit is used at the Spitsvale Project, and is moved as necessary within the stockpile areas. No other area has been earmarked for this and hence will not be further assessed as impacts are expected to be the same as for ore stockpiling.*
Environmental impacts: Possible distribution and increased establishment of alien invasive species if contaminated machinery is moved around, possible high increase in dust levels that may gradually suffocate surrounding vegetation and lead to capping (and sealing) of the soil surface – making it hydrophobic; possible exposure of fauna and flora to contaminants

5.4 MITIGATION MEASURES

a. Avoid additional clearing in habitats with a No-Go or High sensitivity rating

b. Minimise clearing and operations in habitats with a High or Medium-high sensitivity rating

c. Rehabilitate and revegetate all areas that have been disturbed as soon as practically possible

   - Continually monitor the progress/success of rehabilitation efforts and adapt if rehabilitation targets are not met in acceptable timeframes

d. As part of decommissioning, all stockpiles must be entirely obliterated and landscaped to merge into the surroundings

e. Keep main internal access route as planned along existing gravel roads

f. After the final layout of mining operation components has been approved, conduct a thorough footprint investigation to determine any protected or red data plant species population location and size, and animal burrows

   - Map (by GPS) as far as possible *larger* concentrations of large trees and protected species that could be avoided or must be relocated
   - Protected trees, succulents and geophytes: must be relocated (trees as far as feasible)
   - Animal burrows: must be monitored by EO/ECO prior to ground clearing for activity/presence of animal species. If detected, such animals must be removed and relocated by a qualified professional/contractor

g. Strictly restrict all movement of vehicles and heavy machinery to permissible areas, these being designated access roads, maintenance roads, turning points and parking areas. No off-road driving beyond designated areas may be allowed

h. Parking areas should be regularly inspected for oil spills and covered with an impermeable or absorbent layer (with the necessary storm water control) if oil and fuel spillages are highly likely to occur

i. Wheels of large machinery should be checked prior to entering the site and cleared of seed material of alien invasive plants if transport routes go through infested areas (especially of species with spiny or bur-like seeds). Such seed must be destroyed.

j. Strict speed limits must be set and adhered to

k. Animals accidentally injured by moving vehicles or machinery must be taken to a local veterinarian to be treated or put down in a humane manner

l. Create designated turning areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas

m. Keep the clearing of natural veld to a minimum

    - It is desirable that community members be engaged to remove wood suitable for their purposes from areas to be cleared to alleviate the pressure of wood-harvesting currently on other areas of the land portions

    - All remaining material of cleared shrubs and trees must be shredded and used as mulch

n. Dust levels must be controlled and minimised, especially from the processing plant and tailings dam

o. If filling material is to be used, this should be sourced from areas free of invasive species

p. Topsoil (the upper 25 cm of soil) is an important natural resource as it contains most of the geophytic storage organs as well as valuable soil seed resources necessary for re-vegetation; where it can (*and then must*) be stripped, never mix it with subsoil or any other material, store and protect it separately until it can be re-applied, minimise handling of topsoil

q. Reinforce portions of existing access routes that are prone to erosion or seasonal inundation, create structures or low banks to drain the access road rapidly during rainfall events, yet preventing erosion of the track and surrounding areas

    - Ensure that water flows are never concentrated in any way as soils are highly erodible

r. Ensure that runoff from compacted or sealed surfaces is slowed down and dispersed sufficiently to prevent accelerated erosion from being initiated (erosion management plan required)

s. Prevent spillage of hydrocarbons, possible construction materials and other pollutants, contain and treat any spillages immediately, strictly prohibit any pollution/littering according to the relevant EMPr

t. No open fires may be lit for cooking or any other purposes, unless in specifically designated and secured areas

u. Facilities may not be used as staff accommodation

v. Monitor the establishment of (alien) invasive species and remove as soon as detected, whenever possible before flowers or other regenerative material can be produced

    - Destruction of regenerative material by burning in a protected area is encouraged

w. After decommissioning, if access roads or portions thereof will not be of further use to the landowner (s), remove all foreign material and rip area to facilitate the establishment of vegetation, followed by a suitable revegetation program (see closure plan for more details)

For a more comprehensive Plant Search and Rescue, Revegetation and Alien Invasives Management Plan refer to Appendix E.

5.5 LIMITATIONS OF STUDY

There is a key difference between the approach of the ecological consultant and that of the ecological researcher. In consultancy, judgements have to be made and advice provided that is based on the best available evidence, combined with collective experience and professional opinion. The available evidence may not be especially good, potentially leading to over-simplification of ecological systems and responses, and do contain a considerable deal of uncertainty. This is opposed to ecological research, where evidence needs to be compelling before conclusions are reached and research is published (Hill & Arnold 2012). The best option available to the consulting industry is to push for more research to be conducted to address its questions. However, such research is often of a baseline nature and thus attracts little interest by larger institutions that need to do innovative research to be able to publish and attract the necessary funding. Clients in need of ecological assessments are used to funding such assessments, but are seldom willing to fund further research to monitor the effects of developments. Furthermore, a review to test the accuracy of the predictions of an ecologist following completion of the development is very rarely undertaken, which means the capacity to predict the future is not tested and therefore remains unknown (Hill & Arnold 2012).

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases of such as the total loss of a habitat to development. However, most development impacts are indirect, subtle, and cumulative or unfold over several years following construction or commencement of mining. Whilst a possible mechanism for an impact to occur can usually be identified, the actual likelihood of occurrence and its severity are much harder to describe (Hill & Arnold 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments, as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the latter category, protected species, because there is a regulatory framework

for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill & Arnold 2012).

6 DISCUSSION AND CONCLUDING IMPACT STATEMENT

The area was visited for a field study from 11 – 15 January 2016. Although most of the vegetation was relatively green at the time, there was a noticeable absence of annual and geophytes due to the prevailing drought conditions.

Limpopo Conservation Plan (Desmet *et al.* 2013) as well as the Mining Guidelines (2013) depict most of the study as of moderate to high importance biodiversity areas, with which mining activities and creation of new infrastructure is not considered compatible. The field study confirmed the presence of many unique habitats that can never be re-created after destruction, and which also ensure the perseverance of many unique species, of which several are either endemic to Sekhukhuneland, protected or already threatened. As there are a multitude of other urban developments and mines adjacent and in close proximity of the study area, the anticipated mining activities will further reduce habitat valuable for this unique vegetation.

In line with the above, it must be realised that the proposed mining activities will have a significant local negative impact on the environment. From a terrestrial ecological perspective, the proposed development has been rated as follows:

The following could proceed if all mitigation measure are diligently implemented with all the necessary authorisations – including permits for protected species removal:

- The creation of additional internal access roads is discouraged, but it is anticipated that existing tracks will be upgraded and possibly doubled in width
- Phase 1: Klarinet Koppie mining near the discontinued Clarinet Mine could proceed
- Phase 3: Tubatse Koppie mining could proceed but with caution
- The sites for the main office and workshop complex as well as stockpiles 1 and 2 already exist from the prospecting phase, but are anticipated to be expanded
- The laydown area for Phase 3 should be restricted to temporary offices and an ore stockpile, together not exceeding 3-4 ha in total and not closer than 50 m (preferably 100 m) from the bank of any riparian area/drainage line

The following is considered ecologically unacceptable and should not proceed:

- Workshops within the Tubatse laydown area, except small storage areas for every-day maintenance of machinery, larger repairs should be done at the existing office complex
- Phase 3: Spitsvale Flats mining should not be allowed within the erosion plains (about half the area of the mapped ore) – the permanent impacts anticipated there will influence areas beyond the affected land portions and totally seize current landscape functionality (amongst other impacts), which cannot be justified

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http://SIBIS.sanbi.org

South African National Survey of Arachnida:
http://www.arc.agric.za/home.asp?pid=3282

Acronyms:

ADU	Animal Demography Unit
BGIS	Biodiversity Geographic Information System
CBA	Critical Biodiversity Area
DEA	Department of Environmental Affairs
ECO	Environmental Control Officers
EMP	Environmental Management Programme
ESA	Ecosystem Support Area
LUPO	Land Use Planning Ordinance
NEMA	National Environmental Management Act (No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (No. 10 of 2004)
SANBI	South African National Biodiversity Institute
SARCA	South African Reptile Conservation Assessment

8 APPENDIX A: FLORA PHYTOSOCIOLOGICAL TABLE

Plant species of the different vegetation associations recorded:

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
High shrubs and Trees									
Acacia ataxacantha (Senegalia ataxacantha)					+			r	
Acacia caffra (Senegalia caffra)				r					
Acacia galpinii (Senegalia galpinii)					r				
Acacia karroo (Vachellia karroo)				r					
Acacia luederitzii (Vachellia luederitzii)									r
Acacia mellifera (Senegalia mellifera)						1			
Acacia nigrescens (Senegalia nigrescens)					+		1	r	r
Acacia senegal (Senegalia senegal)				r					
Acacia tortilis (Vachellia tortilis)						2	1		+
Albizia anthelmintica					r	+			r
Allophylus africanus					r			r	
Apodytes dimidiata					+		r	r	+
Balanites maughamii			NFA		+				
Berchemia zeyheri					1	1		r	
Bolusanthus speciosus				+					
Boscia albitrunca			NFA			+	r		r
Boscia foetida			LEMA 12		+	r	r		r
Buddleja auriculata					r				
Cadaba termitaria						r			
Calodendrum capense					r				
Carissa bispinosa						1	1	+	+
Cassine peragua					+				
Cassinopsis ilicifolia					r				
Catha transvaalensis					+				
Celtis africana					+				
Clausena anisata					r				
Combretum apiculatum				r		+		r	
Combretum hereroense				r					
Combretum molle							r	r	
Commiphora africana						+			
Commiphora glandulosa						r	r		
Commiphora mollis							1	+	
Commiphora schimperi					r			r	
Croton gratissimus					1	+	1	+	
Croton megalobotrys								r	
Cussonia transvaalensis					r	+		r	r
Dichrostachys cinerea					+	2	r	r	1
Diospyros lycioides					+			r	1

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Diospyros whyteana					+			r	
Dittrichia graveolens			AI		r				
Dodonaea angustifolia						1			2
Dombeya rotundifolia					r		r	r	
Ehretia rigida					+	+			
Elaeodendron transvaalense			NFA		r			r	
Elephantorrhiza praetermissa	SEK-end		LEMA 12	r					
Erythrina lysistemon					r				
Euclea crispa				r					
Euclea linearis				r	+				
Euclea sekhukhuniensis	SEK-end								3
Euclea undulata						1			
Ficus craterostoma					r			r	
Flueggea virosa					2	r			+
Grewia bicolor					+	r		r	
Grewia flava					r	1	1	r	+
Grewia monticola							r	r	
Grewia occidentalis								r	
Grewia vernicosa	RSA-end			r					
Grewia villosa					r				
Hippobromus pauciflorus				r			1	+	r
Homalium dentatum					r				
Ilex mitis		Declining			r				
Karomia speciosa					r				
Kirkia wilmsii				r	+	+	r	r	2
Lydenburgia cassinoides	SEK-end	Near Threatened	NFA				r	r	
Maytenus acuminata					+			r	
Maytenus heterophylla					+				
Maytenus undata				r			+	+	
Mundulea sericea				r				r	
Myrsine africana					r		r	r	
Nuxia floribunda					+				
Nuxia gracilis	RSA-end				+				
Nuxia species								r	
Obetia tenax					r				
Ochna serrulata					+	1	r		+
Olea capensis							r	r	
Olea europaea s. africana					+	1			+
Olinia emarginata							r		
Ormocarpum kirkii							r	r	
Ozoroa sphaerocarpa					+		r	r	+
Pappea capensis					r		r	r	
Pavetta gardeniifolia					r			r	
Pavetta zeyheri								r	
Peltophorum africanum				r					

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Pouzolzia mixta					2			1	
Prunus africana			NFA		+				
Psydrax livida					+				
Rhamnus prinoides					r				
Rhoicissus sekhukhuniensis	SEK-end			r					
Rhoicissus tridentata	RSA-end			r	1	1	r	r	+
Sclerocarya birrea			NFA		+	r	1	1	+
Searsia discolor				r					
Searsia engleri	RSA-end			r		r	2	r	r
Searsia gueinzii							r	r	
Searsia keetii	RSA-end			r					
Searsia leptodictya				r			r	r	
Searsia pyroides					1			r	r
Searsia rigida					+				
Searsia tumulicola var. meeuseana	RSA-end			r	r		r		r
Searsia wilmsii	RSA-end			r			r	r	r
Searsia zeyheri								r	
Spirostachys africana			LEMA 12		r				
Sterculia rogersii								+	
Tabernaemontana elegans					r				
Tarchonanthus camphoratus				r				r	
Terminalia prunioides				+			1	1	r
Triaspis glaucophylla	RSA-end			+					
Vangueria infausta				r					
Vepris reflexa					r				
Vitex obovata s. wilmsii	RSA-end			r		+			
Ximenia americana						+	r		+
Ximenia caffra						+			
Zanthoxylum thorncroftii					r				
Ziziphus mucronata					+	+	r	r	r
Succulents									
Aloe castanea	RSA-end			r				r	
Aloe cryptopoda				r			+		
Aloe globuligemma							r		
Aloe greatheadii				r	+	r	r	1	r
Aloe marlothii					r		r	r	
Cyphostemma segmentatum				r				r	
Cyphostemma subciliatum				r					
Euphorbia ingens					r		r		
Euphorbia tirucalli					+				
Kalanchoe paniculata						r	r		
Kleinia longiflora						+			
Kleinia stapeliiformis	RSA-end							r	
Opuntia ficus-indica			AI			r			
Portulaca oleracea						+			
Portulaca quadrifida						+			

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Sansevieria hyacinthoides					+	+		+	r
Sarcostemma viminale					r	+		r	
Tetradenia brevispicata								r	
Grasses									
Andropogon eucomus					+				
Andropogon schirensis				1	+	+	+		r
Anthephora pubescens							+		
Aristida adscensionis						+			
Aristida bipartita				+					
Aristida canescens				+					
Aristida congesta						+			
Aristida rhiniochloa								r	
Aristida transvaalensis								+	
Arthraxon lanceolatus	RSA-end				r				
Bothriochloa insculpta					+				
Brachiaria brizantha					r				
Brachiaria deflexa								r	
Brachiaria eruciformis				r					
Brachiaria serrata				1			r	r	
Cenchrus ciliaris						r			+
Cymbopogon excavatus								r	
Cymbopogon validus				r					
Cynodon dactylon				+	+		1	+	+
Digitaria eriantha						1	1		
Digitaria sanguinalis					+				
Diheteropogon amplectens				2		r			
Elionurus muticus				+					
Enneapogon cenchroides						+			
Enneapogon scoparius						1	1	+	2
Eragrostis chloromelas				+					
Eragrostis curvula				+					
Eragrostis heteromera							+		
Eragrostis nindensis				+					
Eragrostis pseudosclerantha				r	r		r	+	
Eragrostis racemosa				+			+	r	
Eragrostis rigidior									2
Eragrostis superba				1					
Eragrostis trichophora						+	+		
Eulalia villosa				r					r
Fingerhuthia africana						1	1	+	1
Hemarthria altissima					r				
Heteropogon contortus				2	+		3	1	r
Hyparrhenia filipendula				r					
Hyparrhenia tamba					r				
Imperata cylindrica					r				
Ischaemum fasciculatum					r				

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Koeleria capensis				+					
Loudetia simplex				1	+				
Melinis nerviglumis							+	r	
Microchloa caffra					r				
Panicum deustum				r	+		2	1	1
Panicum maximum				+					r
Schmidtia pappophoroides						r			
Setaria incrassata				r					
Setaria lindenbergiana					+		+	+	
Setaria nigrirostris				+			r	r	
Setaria sphacelata				1					
Sporobolus centrifugus				r					
Sporobolus fimbriatus					+				1
Sporobolus stapfianus								r	
Stipagrostis hirtigluma						+			+
Themeda triandra					+	+	2	1	2
Themeda triandra				2			+		
Trachypogon spicatus				+			+		
Tragus berteronianus						1	+		
Triraphis andropogonoides					1				
Tristachya leucothrix				1					
Tristachya rehmannii				r					
Urochloa mosambicensis					+	2			
Herbs and Forbs									
Abildgaardia ovata				r		+	r	r	
Abutilon austro-africanum					r				
Achyranthes aspera					+	+			
Adiantum capillus-veneris					+				
Alepidea amatymbica					r				
Alepidea setifera				r					
Anthospermum rigidum				+					
Aptosimum lineare						r	r		r
Becium filamentosum					r	+			
Becium obovatum				+					
Berkheya insignis				r	+	1	2	1	
Berkheya seminivea				r					
Berula erecta					+				
Blepharis integrifolia						r			
Blepharis subvolubilis				+	+		r		
Bulbostylis contexta				r					
Bulbostylis hispidula					r				
Callilepis leptophylla				+		r	+	+	
Calostephane divaricata				r	1	r	1	+	+
Cephalaria zeyheriana				r					
Chamaecrista comosa				r					
Chamaecrista mimosoides									r

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Chironia purpurascens					+				
Chlorophytum bowkeri								r	
Chlorophytum fasciculatum				r			r	r	r
Coccinia sessilifolia					r				
Coleochloa setifera					r				
Commelina africana				1		+	+	+	
Commelina benghalensis						r			
Commelina erecta					r			r	
Convolvulus sagittatus				r	+			r	
Corbichonia decumbens				+		+	1	+	+
Corchorus asplenifolius						r			r
Crabbea angustifolia							+	r	
Crabbea hirsuta				+					
Cromidon gracile									+
Cucumis anguria						r			
Cucumis zeyheri				r	+		r	1	r
Cuscuta natalensis					r				
Cyanotis pachyrrhiza				r					
Cyperus margaritaceus								r	
Cyperus sexangularis					1				
Cyperus sphaerospermus					r				
Dalechampia galpinii				+					
Dicoma anomala									+
Dicoma gerrardii									r
Dicoma tomentosa				1	+	1	+		
Dicoma zeyheri				+		+	1		1
Dierama mossii				r	+		r	r	+
Emilia transvaalensis				r	r	+	+	+	
Equisetum ramosissimum					r				
Evolvulus alsinoides						+	r	r	r
Felicia clavipilosa						+	r		r
Fimbristylis ferruginea					r				
Fuirena pubescens					+				
Geigeria ornativa						+	r		
Gerbera ambigua				r					
Gerbera jamesonii				r					
Gisekia africana						+			
Haplocarpha scaposa				r					
Hebenstretia species								r	
Helichrysum cephaloideum				r		r	r		r
Helichrysum cooperi					r				
Helichrysum gerberifolium				r	r			r	
Helichrysum pilosellum				r	2	+	1	1	
Helichrysum setosum				+					1
Hermannia antonii	RSA-end			r	+			r	
Hermannia modesta						r			

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Hibiscus caesius						+			
Hibiscus pusillus							r		
Hibiscus trionum						r			r
Hirpicium bechuanense				+					
Holubia saccata					r				
Indigofera colutea						r			
Indigofera hilaris				r					
Ipomoea crassipes				+			2	1	+
Ipomoea dichroa				r					
Ipomoea magnusiana					r		r		
Ipomoea obscura				+					
Juncus punctorius					+				
Kedrostis foetidissima				r					
Kohautia caespitosa				r					
Kohautia cynanchica									r
Kyllinga alba					r				
Kyllinga erecta					+				
Kyphocarpa angustifolia				r					
Leonotis nepetifolia									r
Leucas sexdentata						r			
Limeum fenestratum							r		
Lotononis macrosepala				r					
Lotononis pungens				r			1	r	
Mariscus congestus					+				
Mariscus dregeanus				+		+	+	+	
Melhania prostrata				r					
Melhania randii				1					
Melhania rehmannii						+	r		+
Melhania virescens						r			
Mentha longifolia				r					
Merremia kentrocaulos				+					
Mollugo nudicaulis				+		1			
Monechma divaricatum						+	1		
Monopsis decipiens					r				
Oxalis semiloba					r				
Pavonia burchellii					+				
Pearsonia aristata				r					
Pearsonia obovata				r					
Pegolettia lanceolata	RSA-end			+					
Pellaea calomelanos				+	+		+	+	
Pentanisia prunelloides				r			r	+	
Pergularia daemia								r	
Phyllanthus glaucophyllus				+					
Phyllanthus maderaspatensis						+			
Phyllanthus parvulus				+			r		1
Plectranthus xerophilus	RSA-end							r	

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Pollichia campestris				+				+	+
Polygala amatymbica				r	+				
Polygala hottentotta				+	+				
Polygala sekhukhuniensis	SEK - end								+
Polygala uncinata				+					
Pteris vittata					+				
Ptycholobium contortum						r			
Pulicaria scabra					r				
Pycnostachys reticulata					r				
Rhynchosia hirta				r					
Rhynchosia minima						r	+	r	+
Rhynchosia nitens	RSA-end			r			r	r	
Rhynchosia sordida				+					
Rhynchosia spectabilis				+			+		
Rhynchosia totta				+					
Ruellia patula				r					
Scabiosa columbaria				+					
Schkuhria pinnata			AI			+	+		
Schoenoplectus corymbosus					+				
Schoenus nigricans					1				
Scleria dieterlenii				+					+
Sebaea grandis				r					
Seddera capensis				+				+	
Seddera suffruticosa						+	+		
Senecio coronatus				r				r	
Senecio gerrardii					+				
Senecio gregatus					r				
Senecio latifolius				+			+	r	
Senecio lygodes				r					
Senecio microglossus				+					
Senecio scitus				+	+	1	+		+
Senna italica						+			
Solanum catombelense						r			
Solanum panduriforme						+			
Striga bilabiata				r				r	
Striga elegans				r		r		r	r
Tagetes minuta			AI		+			r	
Tephrosia purpurea				+					
Thunbergia atriplicifolia				r	+		1	1	+
Tragia rupestris				r					
Tribulus terrestris			AI			1			
Vernonia galpinii				+			+		+
Vernonia natalensis				+					
Vernonia oligocephala				1			+	+	
Waltheria indica			AI		+				+
Xenostegia tridentata									+

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Zinnia peruviana			AI				+	r	
Dwarf Shrubs									
Abrus laevigatus					2				
Acalypha punctata				+			+	+	+
Argyrolobium transvaalense				+	+	1	2	+	1
Artemisia afra					r				
Asparagus africanus					+				
Asparagus buchananii								r	
Asparagus divaricatus					+				
Asparagus intricatus	RSA-end	Data Deficient			r			r	
Asparagus sekukuniensis	SEK-end	Endangered					r		
Asparagus suaveolens				+					
Athrixia elata				r			+	r	
Barleria gueinzii								r	
Barleria obtusa					r			r	
Barleria ovata				+			+		r
Barleria rotundifolia								r	
Barleria saxatilis						r	r		
Cardiospermum corindum					+				
Clerodendrum glabrum					+		r	r	
Clerodendrum myricoides					+				
Clerodendrum ternatum				+	+		1	1	1
Clerodendrum triphyllum				+					
Cliffortia nitidula					r				
Cyphostemma woodii							r	r	
Gnidia caffra (Lasiosiphon caffer)	RSA-end			r	r	r	r	r	
Gnidia capitata (Lasiosiphon capitatus)				+			1	1	
Gnidia variabilis	SEK-end	Vulnerable		r					
Gossypium herbaceum						r			
Heliotropium ciliatum						+	r		
Heteromorpha occidentalis								r	
Hibiscus micranthus						r			
Indigofera egens				r		+	+	+	
Indigofera heterotricha						+		r	
Jamesbrittenia atropurpurea									+
Jamesbrittenia macrantha	SEK-end	Near Threatened	LEMA 12	r			+	+	+
Jasminum multipartitum							r	r	
Jasminum quinatum	RSA-end			r					
Jatropha latifolia	RSA-end			r					
Justicia protracta							+		
Lantana rugosa					+	r		r	
Leonotis leonurus					r				
Leonotis ocymifolia				r	+				+
Leucas capensis				+					

				Plant Associations					
Species	**Endemic**	**Red Data**	**Status**	**1**	**2**	**3**	**4**	**5**	**6**
Lippia javanica					r				
Lippia rehmannii				r					
Ocimum labiatum								r	
Orthosiphon fruticosus	SEK-end						+	r	
Petalidium oblongifolium	RSA-end					r	2		1
Plectranthus laxiflorus					+				
Psiadia punctulata					1	r	1	+	1
Schistostephium crataegifolium				r		1	+	+	+
Schistostephium heptalobum				r				r	
Sphedamnocarpus pruriens				r					
Sphenostylis angustifolia				r					
Syncolostemon concinnus				+					
Tetraselago wilmsii				r					
Thesium gracilarioides								r	
Thesium gracilentum	SEK-end	Vulnerable		+		+			r
Thesium magalismontanum				r					
Thesium multiramulosum				+			1	1	3
Tinnea rhodesiana				+	+		1	1	
Xerophyta retinervis				1					
Geophytes									
Crinum species					r				
Drimia sanguinea		Near Threatened						+	
Drimiopsis atropurpurea				r			1	+	1
Drimiopsis maxima					r			r	
Eucomis autumnalis				r		1	1	1	1
Gladiolus species				+			r	+	
Hypoxis hemerocallidea				r					
Hypoxis rigidula				r		+	1		+
Ledebouria marginata				r			+	+	
Merwilla plumbea (Scilla natalensis)		Near Threatened	NEMBA, LEMA 12	+					
Pachycarpus transvaalensis				r		r	r	r	
Raphionacme galpinii				r			+	1	+
Raphionacme species									r
Scadoxus puniceus			LEMA 12		r				
Stylochaeton natalensis				r					
Trachyandra species							r		
Tylosema esculentum				r					
Zantedeschia pentlandii	SEK-end	Vulnerable	LEMA 12				r		

9 APPENDIX B: FAUNA SPECIES

Historical list of terrestrial vertebrates recorded in the grid of the study area:

Green: Observed, Red: Red Data Species (see section 4)

Family	Species	Common name
Reptiles		
Agamidae	*Acanthocercus atricollis subsp. atricollis*	Southern Tree Agama
Scincidae	*Acontias plumbeus*	Giant Legless Skink
Scincidae	*Afroablepharus maculicollis*	Spotted-neck Snake-eyed Skink
Scincidae	*Afroablepharus wahlbergii*	Wahlberg's Snake-eyed Skink
Gekkonidae	*Afroedura leoloensis*	Sekhukhuneland Flat Gecko
Agamidae	*Agama atra*	Southern Rock Agama
Agamidae	*Agamaaculeata distanti*	Distant's Ground Agama
Chamaeleonidae	*Bradypodion transvaalense*	Wolkberg Dwarf Chameleon
Chamaeleonidae	*Chamaeleo dilepis dilepis*	Common Flap-neck Chameleon
Gekkonidae	*Chondrodactylus turneri*	Turner's Gecko
Cordylidae	*Cordylus vittifer*	Common Girdled Lizard
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard
Colubridae	*Gonionotophis nyassae*	Black File Snake
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko
Gekkonidae	*Homopholis wahlbergii*	Wahlberg's Velvet Gecko
Testudinidae	*Kinixys spekii*	Speke's Hinged Tortoise
Gekkonidae	*Lygodactylus capensis subsp capensis*	Common Dwarf Gecko
Gekkonidae	*Lygodactylus nigropunctatus*	Black-spotted Dwarf Gecko
Gekkonidae	*Lygodactylus ocellatus*	Spotted Dwarf Gecko
Gerrhosauridae	*Matobosaurus validus*	Common Giant Plated Lizard
Lacertidae	*Meroles squamulosus*	Common Rough-scaled Lizard
Scincidae	*Mochlus sundevallii subsp sundevallii*	Sundevall's Writhing Skink
Lacertidae	*Nucras holubi*	Holub's Sandveld Lizard
Lacertidae	*Nucras ornata*	Ornate Sandveld Lizard
Gekkonidae	*Pachydactylus affinis*	Transvaal Gecko
Gekkonidae	*Pachydactylus capensis*	Cape Gecko
Gekkonidae	*Pachydactylus vansoni*	Van Son's Gecko
Pelomedusidae	*Pelomedusa subrufa*	Central Marsh Terrapin
Cordylidae	*Platysaurus orientalis subsp fitzsimonsi*	FitzSimons' Flat Lizard
Cordylidae	*Platysaurus orientalis subsp orientalis*	Sekhukhune Flat Lizard
Pythonidae	*Python natalensis*	Southern African Python
Scincidae	*Scelotes mirus*	Montane Dwarf Burrowing Skink
Cordylidae	*Smaug vandami*	Van Dam's Girdled Lizard
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise
Scincidae	*Trachylepis capensis*	Cape Skink
Scincidae	*Trachylepis margaritifer*	Rainbow Skink

Family	Species	Common name
Reptiles		
Scincidae	*Trachylepis striata*	Striped Skink
Scincidae	*Trachylepis varia*	Variable Skink
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake
Atractaspididae	*Aparallactus capensis*	Black-headed Centipede-eater
Atractaspididae	*Atractaspis bibronii*	Bibron's Stiletto Snake
Viperidae	*Bitis arietans subsp arietans*	Puff Adder
Colubridae	*Boaedon capensis*	Brown House Snake
Viperidae	*Causus defilippii*	Snouted Night Adder
Viperidae	*Causus rhombeatus*	Rhombic Night Adder
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater
Elapidae	*Dendroaspis polylepis*	Black Mamba
Elapidae	*Elapsoidea sundevallii subsp media*	Highveld Garter Snake
Colubridae	*Hemirhagerrhis nototaenia*	Eastern Bark Snake
Colubridae	*Lamprophis guttatus*	Spotted House Snake
Leptotyphlopidae	*Leptotyphlops jacobseni*	Jacobsen's Thread Snake
Leptotyphlopidae	*Leptotyphlops scutifrons subsp conjunctus*	Eastern Thread Snake
Elapidae	*Naja mossambica*	Mozambique Spitting Cobra
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake
Colubridae	*Psammophis brevirostris*	Short-snouted Grass Snake
Colubridae	*Psammophis crucifer*	Cross-marked Grass Snake
Colubridae	*Psammophis mossambicus*	Olive Grass Snake
Colubridae	*Psammophis subtaeniatus*	Western Yellow-bellied Sand Snake
Colubridae	*Psammophis trinasalis*	Fork-marked Sand Snake
Colubridae	*Psammophylax rhombeatus subsp rhombeatus*	Spotted Grass Snake
Colubridae	*Psammophylax tritaeniatus*	Striped Grass Snake
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
Colubridae	*Telescopus semiannulatus subsp semiannulatus*	Eastern Tiger Snake
Colubridae	*Thelotornis capensis subsp capensis*	Southern Twig Snake
Varanidae	*Varanus albigularis subsp albigularis*	Rock Monitor
Varanidae	*Varanus niloticus*	Water Monitor
Amphibians		
Brevicepitidae	*Breviceps adspersus*	Bushveld Rain Frog
Brevicepitidae	*Breviceps mossambicus*	Mozambique Rain Frog
Bufonidae	*Amietophrynus gutturalis*	Guttural Toad
Bufonidae	*Amietophrynus maculatus*	Flatbacked Toad
Bufonidae	*Amietophrynus rangeri*	Raucous Toad
Bufonidae	*Schismaderma carens*	Red Toad
Hyperoliidae	*Hyperolius marmoratus*	Painted Reed Frog
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina
Phrynobatrachidae	*Phrynobatrachus natalensis*	Snoring Puddle Frog
Pipidae	*Xenopus laevis*	Common Platanna

Ptychadenidae	*Ptychadena anchietae*	Plain Grass Frog
Ptychadenidae	*Ptychadena mossambica*	Broadbanded Grass Frog
Pyxicephalidae	*Amietia quecketti*	Queckett's River Frog
Pyxicephalidae	*Strongylopus grayii*	Clicking Stream Frog
Pyxicephalidae	*Tomopterna natalensis*	Natal Sand Frog

Mammals		
Bovidae	*Aepyceros melampus*	Impala
Bovidae	*Oreotragus oreotragus*	Klipspringer
Bovidae	*Tragelaphus oryx*	Common Eland
Bovidae	*Tragelaphus scriptus*	Bushbuck
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu
Canidae	*Canis adustus*	Side-striped Jackal
Canidae	*Canis mesomelas*	Black-backed Jackal
Cercopithecidae	*Cercopithecus pygerythrus ssp pygerythrus*	Vervet Monkey
Cercopithecidae	*Papio ursinus*	Chacma Baboon
Elephantidae	*Loxodonta africana*	African Bush Elephant
Equidae	*Equus quagga*	Plains Zebra
Felidae	*Caracal caracal*	Caracal
Felidae	*Leptailurus serval*	Serval
Felidae	*Panthera leo*	Lion
Felidae	*Panthera pardus*	Leopard
Giraffidae	*Giraffa camelopardalis ssp giraffa*	The South African Giraffe
Herpestidae	*Helogale parvula*	Common Dwarf Mongoose
Herpestidae	*Herpestes sanguineus*	Slender Mongoose
Herpestidae	*Ichneumia albicauda*	White-tailed Mongoose
Herpestidae	*Mungos mungo*	Banded Mongoose
Hyaenidae	*Hyaena brunnea*	Brown Hyena
Hyaenidae	*Proteles cristata*	Aardwolf
Muridae	*Mastomys*	Multimammate Mice
Mustelidae	*Mellivora capensis*	Honey Badger
Rhinolophidae	*Rhinolophus cohenae*	Cohen's Horseshoe Bat
Viverridae	*Civettictis civetta*	African Civet
Viverridae	*Genetta maculata*	Rusty-spotted Genet

10 APPENDIX C: CONSERVATION PLAN DEFINITIONS AND GUIDELINES

Limpopo Conservation Plan (Desmet *et al.* 2013)

Recommended land management guidelines for Critical Biodiversity Areas and Ecological Support Areas

CRITICAL BIODIVERSITY AREAS ONE (CBA1)

Main objective: Keep in a NATURAL STATE

General recommendations:

- No further loss of natural habitat should occur i.e. land in this category should be maintained as natural vegetation cover as far as possible;
- These areas of land can act as possible biodiversity offset receiving areas;
- Prioritise CBAs for land care projects, Working for Water (WfW) and NGOs to direct their conservation projects, programmes and activities;
- An Ecological Management Plan should be compiled where required for CBAs. EMP to include alien plant control, fire management etc.;
- Control of illegal activities (such a hunting and dumping), which impact biodiversity should be prioritized in CBA areas.

Protection:

- CBAs not formally protected should be rezoned where possible to conservation or appropriate open space zoning, and where possible declared in terms of NEM: Protected Areas Act.
- The Stewardship program should prioritise privately owned erven in CBAs to be incorporated into the protected area network through Stewardship Agreements and incentives (e.g. rates rebates):~

Rehabilitation:

- Degraded or disturbed CBAs should be prioritized for rehabilitation through programmes such as Working for Water, Working for Wetlands.

Development Guidelines:

Where infrastructure is proposed, the following guidelines should be implemented -

- Rezoning of properties to afford additional land-use rights that will result in increased biodiversity loss should not be granted;
- Permission to increase the permitted number of units per erf or per ha should not be granted;
- Developments should be limited to existing developed / degraded footprints, if present;

- Units carefully dispersed or clumped to achieve least impact, particularly with regard to habitat loss and fragmentation;
- The installation of infrastructure in CBAs is not desirable and should only be considered if all alternative alignment and design options have been assessed and found to be nonviable. Under such conditions, at least a Basic Assessment (BA) should be undertaken, and if approved, a comprehensive EMP must be developed and best-practice restoration efforts strictly implemented;
- Ecological Specialist to conduct the ecological assessment;

Where development proposals other than the preferred biodiversity-compatible land-uses (see table above are submitted in terms of the NEMA: EIA regulations or Land Use Planning Ordinance (LUPO):

- A Screening Exercise should be undertaken by a Biodiversity Specialist or Ecologist to verify the CBA map category on site;
- If the site is verified as a CBA, developments other than the preferred biodiversity-compatible land-uses should be investigated in detail and the mitigation hierarchy applied in full;
- If the application is pursued they should be informed by a specialist biodiversity assessment.

Aquatic Ecosystems:

- Maintain water quality and flow regimes should be maintained as close to natural as possible;
- Where Environmental Reserves or Environmental Flow Requirements have been determined these should be strictly adhered to;
- All effluent (including municipal, mining and industrial waste water) as well as acid mine drainage should be treated to required specifications before release;
- Storm water flow should be managed to avoid damage to CBA areas.
- Where CBAs include floodplains (e.g. areas within the 1:100 year flood line), riparian areas (e.g. as a minimum, a 32m buffer around rivers) or buffers around wetlands, particular attention should applied to ensure that these remain in a natural state or are rehabilitated to this state. In addition to avoiding land transformation, other activities such as livestock access may need to be controlled and alien vegetation managed to avoid damage to banks. Do not permit infilling, excavation, drainage, hardened surfaces (including buildings and asphalt), intensive agriculture or any new developments within a river or wetland.
- Areas that are degraded or disturbed should be rehabilitated, through programmes such as Working for Water, Working for Wetlands and a systematic alien vegetation eradication programme implemented.

ECOLOGICAL SUPPORT AREAS ONE (ESA1)

Main objective: Maintain in an ECOLOGICALFUNCTIONAL STATE.

General Recommendations:

- Maintain in a functional state, avoid intensification of land-uses, and rehabilitate to a natural or semi-natural state where possible. in transformed areas which are important for maintaining ecological processes, current land uses should be maintained, intensification of use (e.g. a transition from agriculture to urban) should be avoided, and where possible areas should be rehabilitated.
- No further loss of natural habitat should be allowed, and land in this category currently in a degraded state should be rehabilitated or restored to a natural or semi-natural state once the current land—use has ceased;
- Maintain current land uses where these play a role in supporting ecological processes;
- Ensure land use changes do not impact negatively on ecological processes.
- The maintenance of connectivity between CBAs, continued ecosystem functioning within the CBA corridors, and the prevention of degradation of adjacent Critical Biodiversity Areas must be achieved;
- After the CBA1s, ESA1s should be prioritised for land care projects, Working for Water (WfW) and NGOs to direct their conservation projects, programmes and activities;
- An Ecological Management Plan should be compiled where required for ESAs. EMP to include alien plant control, fire management etc.

Development Guidelines:

Where infrastructure is proposed, the following guidelines should be implemented -

- Rezoning of properties to afford additional land-use rights that will result in increased impact on ecological processes should not be granted, unless significant net conservation gains can be achieved, ecosystem functioning and connectivity of Ecosystem Support Areas (ESAs) will not compromised, and biodiversity impacts with regard to species and habitats are of at an acceptable significance and mitigated where possible.
- Developments should be limited to existing developed / degraded footprints, where possible;
- Units carefully dispersed or clumped to achieve least impact, particularly with regard to impacts on ecological processes.
- Ecological Specialist to conduct the ecological assessment.

Where development proposals other than the preferred biodiversity-compatible land-uses are submitted in terms of the NEMA: EIA regulations or Land Use Planning Ordinance (LUPO) for areas which remain intact:

- A Screening Exercise should be undertaken by a Biodiversity Specialist or Ecologist to verify the CBA map category on site.
- If the site is verified as an ESA, developments other than the preferred biodiversity—compatible land—uses should be carefully screened to ensure that developments are planned and activities undertaken in a way that minimizes impact on ecological processes. Impacts should be mitigated.
- If the application is pursued they should be informed by a specialist biodiversity assessment.

In transformed areas which are still important for supporting ecological processes, the following guidelines should be implemented -

- Current land uses should be maintained, intensification of use (e.g. a transition from extensive agriculture to urban) should be avoided, and where possible areas should be rehabilitated.
- Developments should be screened to ensure that they do not have an unacceptable impact on ecological processes.

Aquatic Ecosystems:

- Water quality and flow regimes should be maintained as close to natural as possible.
- Where Environmental Reserves or Environmental Flow Requirements have been determined these should be strictly adhered to.
- All effluent (including municipal, mining and industrial waste water) as well as acid mine drainage should be treated to required specifications before release.
- Storm water flow should be managed to avoid damage to ESA areas
- Where ESAs include floodplains (e.g. areas within the 1:100 year flood line), riparian areas (e.g. as a minimum, the 32m around rivers) or buffers around wetlands, particular attention should applied to ensure that these remain in a natural state or are rehabilitated to this state. In addition to avoiding land transformation, other activities such as livestock access may need to be controlled and alien vegetation managed to avoid damage to banks. Do not permit infilling, excavation, drainage, hardened surfaces (including buildings), intensive agriculture or any new developments within a river or wetland.
- Areas that are degraded or disturbed should be rehabilitated, through programmes such as Working for Water, Working for Wetlands and a systematic alien vegetation eradication programme implemented.
- Creation of berms, roads, culverts, canalisation, channelisation, alien vegetation, impoundment, abstraction, well points, storm-water or other point source inflows, irrigation return flows, grazing / trampling, agriculture, golf courses, suburban gardens, artificial deepening, and drainage, should be avoided where possible within the 1:20 year floodline.

ECOLOGICAL SUPPORT AREAS TWO (ESA2)

Main objectives: Maintain existing and restore ECOLOGICAL FUNCTIONING

General Recommendations:

- Additional impacts on ecological processes should be avoided. In transformed areas, which are important for maintaining ecological processes, current land uses should be maintained, intensification of use (e.g. a transition from agriculture to urban) should be avoided, and where possible areas should be rehabilitated.
- The maintenance of connectivity between CBAs, continued ecosystem functioning within the CBA corridors, and the prevention of degradation of adjacent Critical Biodiversity Areas must be achieved;

- In some cases the rehabilitation of ESA2s may be the suitable for land care projects, Working for Water (WfW) and NGOs to direct their conservation projects, programmes and activities

Development Guidelines:

Where infrastructure is proposed, the following guidelines should be implemented -

- Infrastructure should be designed to avoid additional impacts on ecological processes.

In transformed areas which are still important for supporting ecological processes, the following guidelines should be implemented -

- Current land uses should be maintained, intensification of use (e.g. a transition from agriculture to urban) should be avoided, and where possible areas should be rehabilitated;
- Developments should be screened to ensure that they do not have an unacceptable impact on ecological processes.

Aquatic Ecosystems:

- Water quality and flow regimes should be maintained as close to natural as possible.
- Where Environmental Reserves or Environmental Flow Requirements have been determined these should be strictly adhered to.
- All effluent (including municipal, mining and industrial waste water) as well as acid mine drainage should be treated to required specifications before release.
- Storm water flow should be managed to avoid damage to ESA2 areas.
- Where ESA2s include floodplains (e.g. areas within the 1:100 year flood line), riparian areas (e.g. as a minimum, the 32m around rivers) or buffers around wetlands, particular attention should applied to ensure that there is no additional impact on ecological functioning, and where possible these areas rehabilitated to improve ecological functioning. In addition to avoiding intensification of land use, other activities such as livestock access may need to be controlled and alien vegetation managed to avoid damage to banks. Do not permit infilling, excavation, drainage, hardened surfaces (including buildings), intensive agriculture or any new developments within a river or wetland.
- Creation of berms, roads, culverts, canalisation, channelisation, alien vegetation, impoundment, abstraction, well points, storm-water or other point source inflows, irrigation return flows, grazing / trampling, agriculture, golf courses, suburban gardens, artificial deepening, and drainage, should be avoided where possible within the 1:20 year flood line.

11 APPENDIX D: SPECIALIST CV

CURRICULUM VITAE
MARIANNE STROHBACH

Profession : Specialist Scientist
Specialisation: Plant Ecology and Botany, with special reference to vegetation mapping, vegetation state assessment, dynamics of arid and semi-arid vegetation and population dynamics of harvested plants, conservation planning
Work experience: Twenty five (25) years active in Plant Ecology

SKILLS BASE AND CORE COMPETENCIES

- Four years Plant Conservation (Namibia)
- 16 years active research in vegetation mapping, vegetation state assessment, vegetation and plant population dynamics, long-term vegetation monitoring
- Advisory to International Standards for plant species that are harvested for commercial purposes
- Research Project Management
- Ecological assessments for developmental purposes (BAR, EIA)
- Working knowledge of environmental planning policies, regulatory frameworks and legislation
- Identification and assessment of potential environmental impacts and benefits
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to project execution
- Experienced in environmental monitoring and research
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa, as well as Zimbabwe and Namibia
- Several publications in peer-reviewed journals, book chapters, scientific conference presentations and popular articles

EDUCATION AND PROFESSIONAL STATUS

Degrees:
2003: M.Sc. in Botany, University of Pretoria, Pretoria, RSA
1991: B.Sc. Hons in Botany, Nelson Mandela Metropolitan University, Port Elizabeth, RSA
1990: B.Sc. in Biological Sciences, Nelson Mandela Metropolitan University, Port Elizabeth

Short Courses:
2008: Landscape Functional Analysis for vegetation condition and restoration monitoring
2002: Satellite Image Analysis for Vegetation Mapping, German Aerospace Centre (DLR) in Cologne/Würzburg, Germany
1994: Methods and Techniques of Environmental Management, Deutsche Stiftung für Internationale Entwicklung, Berlin, Germany
1993: Conservation Law Enforcement, Ministry of Environment and Tourism, Namibia

Professional Society Affiliations:

- South African Association for Botanists
- Association of Desert Net International
- The South African Council for Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400079/10 (Botany and Ecology)

Publications:

- 7 Articles in peer-reviewed scientific journals
- 5 Book-chapters in scientific publications
- 10 Popular articles
- 9 presentations at scientific conferences
- 2 contributions to TV documentaries on nature

Ongoing outputs:

- Project-specific specialist reports for Ecological Screening Studies, Basic Assessments, Environmental Scoping and Impact Assessments and Ecological Footprint Investigations
- Compilation of Environmental Management Plans: Invasive Plant management, Plant Search and Rescue, Revegetation, Erosion Control

EMPLOYMENT

- 2015 onwards: Freelance Ecologist
- 2012 - 2015: Ecologist, Savannah Environmental (Pty) Ltd
- 2011: Lecturer, Plant Ecology, University of Pretoria
- 1997 onwards: working as vegetation ecologist on a freelance basis, involved in part-time positions and contractual research as outlined below
- 1995 to 1996: Agricultural Researcher at the National Botanical Research Institute, Windhoek, Namibia
- 1992 to 1995: Vegetation ecologist at the Ministry of Environment and Tourism, Namibia, Directorate of Scientific Services

Past Affiliations and Research
2001 – 2010: contractual work with BIOTA (BIOdiversity Transect analysis in Africa) as affiliate to the National Botanical Research Institute, Namibia.
Deliverables:
Project management, including research proposal, financial management and project implementation.

Modelling of Savanna Dynamics:
Collating and summarising available phytosociological data for ecological modellers to use in creating a generic savanna model for the Namibian savannas
Defining plant functional types to simplify vegetation data and to use as indicators in monitoring techniques by livestock farmers

Vegetation Patterns and Processes in Namibian Savannas:
Small scale monitoring of vegetation dynamics over a range of soil conditions and seasons
Determine ecological barriers to and best practice for rangeland restoration

Vegetation classification and mapping in Central Namibia:
Collection and analysis of phytosociological baseline data for the central Thornbush Savanna in Namibia, delineation of vegetation types with the aid of satellite imagery

2006: German Scientific Authority to CITES, Plants, Federal Agency for Nature Conservation
International Standard for the Sustainable Wild Collection of Medicinal & Aromatic Plants
Assisting in the compilation of a reference guide for minimum research standards necessary to ensure sustainable use of economically utilised plants (updated in FairWild Standard Version 2, 2010)

2004: contractual work for Desert Research Foundation of Namibia
Vegetation description and mapping of the Namibian Eastern Communal Areas and assess possible development options using indigenous plant resources

1997 to 2010: contractual work with CRIAA-SADC as ecologist.
Deliverables:

The Sustainably Harvested Devil's Claw Project:
Annual surveys of *Harpagophytum* populations to determine harvesting quotas for rural communities
Determine and monitor impact of harvesting frequency and techniques on survival of *Harpagophytum procumbens*
Educate harvester communities on issues of resource management
In collaboration with the German Federal Agency for Nature Conservation
This work was extended in 2006 to the Hwange Area, NW Zimbabwe, together with Africa Now

Pilot Devil's Claw cultivation trials:
Increase available resources of *Harpagophytum procumbens*
Give communities ownership and better access of their resources to improve their income

Namibian National Devil's Claw Situation Analysis:
Design and implement a country-wide survey of *Harpagophytum* species to assess resource availability compared to annual export figure

1999 to 2001: Assistant curator at the Swakopmund Museum (part-time position)

Help maintain existing collections and exhibits , design and create new exhibits for the museum in collaboration with the Museum Hannover, Germany

Specialist Scientist Vegetation Surveys and related Impact Assessments were done for following clients:

- Langer Heinrich Uranium Pty (Ltd): Central Namib Desert, Namibia
- University of Namibia, Hentiesbay Research Centre: West Coast, Namibia
- Sasol – Limpopo Province
- EcoAgent – Northern Cape, Eastern Cape, Limpopo and Mpumalanga
- Namwater – Karst aquifers, north-central Namibia
- ENVASS (for AfriDevo) – Northern Cape
- Savannah Environmental – Northern Cape, Eastern Cape, Free State, North-West Province, Western Cape, Limpopo

Nature of developments covered by the above EIA studies and selection of projects:

- New mines and associated infrastructure, including material processing, housing and transport
  - Langer Heinrich Uranium Mine, Central Namib Desert, Namibia
  - Mafutha Coal Mine and mining town (Waterberg District)
- Post-development rehabilitation evaluation
  - !Khi and !KaXu topsoil stockpiles (ZF Mgcawu and Namakwa Districts)
  - Veld rehabilitation on rangelands in the Otjozondjupa Region, Central Namibia
  - Adams, Kathu and Sishen Photovoltaic Solar Protected Tree re-planting and Offset Programs (Kgalagadi District)
- Coastal infrastructure development
  - Construction of tidal pools and coastal research ponds near Henties Bay, Central Namibia
- Renewable energy facilities: Wind, Photovoltaic Solar and Concentrated Solar Plants
  - Amakhala Emoyeni Wind Energy Facility (Cacadu District)
  - Msenge Emoyeni Wind Energy Facility (Cacadu District)
  - Cookhouse Western Stage Wind Energy Facility (Cacadu District)
  - Dorper Wind Farm (Chris Hani District)
  - !Khi and !KaXu Concentrated Solar (ZF Mgcawu and Namakwa Districts)
  - Tsitsikamma Wind Energy Facility (Cacadu District)
  - Peddie – Wesley Powerline for Photovoltaic Solar (Amathole District)
  - Sishen, Kathu and San Photovoltaic Solar (Kgalagadi District)
  - Adam Photovoltaic Solar (Kgalagadi District)
  - Prieska Photovoltaic Solar (Pixley ka Seme District)
  - Merapi and Sannaspos Photovoltaic Solar (Motheo District)
  - West Coast One Wind Energy Facility (West Coast District)
  - Groenkloof, Platfontein Photovoltaic Solar (Frances Baard District)
  - Zuurwater Photovoltaic Solar (Namakwa District)
  - Allemansfontein, Naauwpoort, Inkukuleko, Gilbert, Carolus Poort, Damfontein and Wonderheuwel Photovoltaic Solar (Pixley ka Seme District)
  - Sirius Photovoltaic Solar (ZF Mgcawu District)
  - Everest, Oryx and Grootkop Photovoltaic Solar (Lejweleputsa District)
  - Watershed Photovoltaic Solar (Ngaka Modiri Molema District)
  - Gihon, Amandel, Kison and Spitskop Photovoltaic Solar (Waterberg District)
  - Blackwood and Boundary Photovoltaic Solar (Lejweleputswa District)
  - Kheis and Albany/Grootdrink Photovoltaic Solar (ZF Mgcawu District)
  - Exheredo Kenhardt Concentrated and Photovoltaic Solar (Namakwa District)
- Large-scale ground water abstraction
  - Karst Water Abstraction, Otavi Area, Namibia
- Housing developments
  - Postmasburg (Frances Baard District)
  - Steenbokspan (Waterberg District)
- Electrical infrastructure (long-distance power lines, substations, coal-based power generating plants)

12 APPENDIX E: ENVIRONMENTAL MANAGEMENT PROGRAMS

It is understood that BCR will be responsible for the overall implementation of the EMPr, or responsible for the appointment of relevant contractors, special staff or other specialists where necessary to be able to fully implement the required actions.

12.1 SPECIES SEARCH AND RESCUE

OBJECTIVE: Minimise loss of indigenous biodiversity, including plants of conservation concern

Prior to commencement of any new activity where extensive earthworks will be involved (grading, road construction, new excavation areas and security berms) within areas of natural (primary) vegetation, a plant Search and Rescue program must be implemented, preceded by a meticulous investigation of all footprint areas by a suitably qualified botanist, conducted during the optimal growing season (late January to March) along the entire footprint area as specified below.

Project Component/s	Project components affecting the objective: • Access roads • Laydown areas • Protective fencing around development • Prospecting operations • Mining excavations, including safety berms
Potential Impact	• Substantial loss of species of conservation concern and species useful for rehabilitation, waste of on-site plant resources, lack of locally sourced material for rehabilitation of disturbed areas; • Increased cost of rehabilitation
Activities/Risk Sources	• Mining-related loss and damage to natural and semi-natural vegetation
Mitigation: Target/Objective	• Rescue, maintenance and subsequent replanting of at least all geophyte and succulent protected plant species within the specific land portion, where possible also the salvage and replanting of specimens of protected trees

Mitigation: Action/Control	Responsibility	Timeframe
Undertake pre-clearing walkthrough survey of the footprint area for protected flora and burrowing terrestrial fauna: The final footprint investigation (walkthrough) is aimed to fully inform the Project Company, responsible conservation authority (that will issue the relevant permits and authorisations), contractors, EO and ECO about:	Carried out by Specialist	Prior to any new expansion of mining operations where new ground has to be cleared

Mitigation: Action/Control	Responsibility	Timeframe

• Protected and red data species that will be affected by the development
  ○ indicating the red-data and protection status of each species observed
• Location of protected plant species within the footprint area – either individually mapped or approximate areas of occurrence, especially dense patches (alternatively, for linear structures, between which structures or other markers)
• Identification of the affected species by providing a representative photo record that enables EO/ECOs and contractors to identify such plants
• How many specimens per species may be affected –estimate based on counts or random transect surveys
• Which species can be successfully relocated, which and how many will have to be destroyed
• Location and nature of any nesting sites or active burrows of vertebrate species (birds, amphibians, reptiles and mammals), that will have to be inspected and cleared/relocated prior to ground clearing by the contractor or duly appointed person(s)
  ○ GPS coordinates must be provided for such burrows and nests observed, **with clear photographs** that will enable the EO/ECO and contracting staff to identify more that will most likely be on the footprint area
• Location and nature of any other significant environmental concerns, e.g. extreme gully erosion, that will need to be addressed by the contractor to prevent any unnecessary (further) degradation of the development footprint
• Note: should more than 1000 specimens of any critically endangered or endangered species be affected, as risk assessment report for that species must be prepared according to Section 15 of the NEMBA Draft Threatened or Protected Species Regulations, Gazetted General Notice 388 of 2013.		

Obtain permits for protected plant removal and relocation prior to commencement of any activity related to this development • As a minimum, permits will be required to remove all or some of the species listed under section 4.4	Project Company, or contractor responsible for vegetation clearing	Prior to any new expansion of mining operations where new ground has to be cleared
• Search and Rescue (S&R) of all protected plants that will be affected by the mining operations ○ The necessary permits must be in place • Plants that can be considered for rescue and included in subsequent rehabilitation programs are all geophytes and indigenous succulents of conservation concern as a minimum	Horticultural Contractor/EO, monitored and approved by ECO, possibly with	Prior to any new expansion of mining operations where

Mitigation: Action/Control	Responsibility	Timeframe
• It is recommended that as far as practicable, all succulents and geophytes be salvaged, as well as forbs with underground storage organs (e.g. *Gerbera jamesoni*) and possibly trees and maintained in an on-site nursery until they can be replanted as part of the re-vegetation process o Geophytes could also be salvaged by removing about 250 mm of topsoil where feasible and re-distributing this topsoil over rehabilitated areas within 2 months of stripping • All new mining footprints must be surveyed and pegged out as soon as possible, after which a local horticulturist or community members with Search and Rescue experience should be appointed to undertake the S&R. • All rescued species should be transplanted as soon as possible or bagged and kept in the horticulturist's or a designated on-site nursery, and should be returned to site or land portion as soon as areas can be rehabilitated. • Replanting should occur from early spring to early summer once sufficient rains have fallen, in order to facilitate establishment.	supervision of a botanist	new ground has to be cleared
• All trenches and excavations must be checked on a daily basis for the presence of trapped animals. • Any animal found must be removed in a safe manner, unharmed, and placed in an area where it will be comfortable (i.e. relocated to a suitable habitat). • If the ECO or contractor is unable to assist in the movement of a fauna species, obtain the assistance of a suitably qualified person(s) to assist with the translocation. • All mammal, large reptiles and avifauna species found injured during operation will be taken to a suitably qualified veterinarian or rehabilitation centre to either be put down in a humane manner or cared for until it can be released again	Staff Contractor ECO	Duration of mining

Performance Indicator	• Rescue of species of conservation concern • No undue damage or injury to fauna • Re-establishment of rescued species
Monitoring	• ECO and/or botanist to monitor Search and Rescue, assist with the continuation of search and rescue operations during the mining process where it becomes necessary after the initial S&R (e.g. geophytes that emerge later in the season) • It may be possible that geophytic species may emerge later during more favourable conditions and such were not accounted for in the original S&R plan – once observed the ECO should consult the botanists on the identification and possible S&R for those plant species

12.2 REVEGETATION AFTER REHABILITATION

OBJECTIVE: Minimisation of disturbance to and loss of topsoil and ecosystem functionality

Note: This is to be read together with soil remediation and rehabilitation recommendations contained within the soil specialist study.

Rehabilitation and re-vegetation efforts must aim to mimic and establish the following:

Dysfunctional element	Mitigation
• Relatively steep slopes that are prone to surface capping and accelerated erosion	• Reduce slope angle where possible (see diagram below) • Alternatively achieve above by reducing slope length by dividing it into a series of closely-spaced run-off and run-on zones by appropriate landscaping (appropriate contour berms) • Ensure erosion prevention and mitigation
• Relatively low infiltration rates due to surface instability or excessive compaction o Compaction also leading to decreased soil surface porosity, decreased aeration and soil health o Compaction acts as a physical barrier to plant establishment	• Loosen excessively compacted soils • Firm down very loose topsoils, but without excessive compaction • Increase topsoil stability where necessary with mulch from chipped woody vegetation, brush packing (branched side to top of slope) or geotextile • This should be gradually be replaced by a stable perennial vegetation cover • Reduce slope length by a series of swales and berms
• Lack or dysfunction of natural reserves and hence excessive loss of resources and associated degradation	• Create run-on zones (grooves or contour berms) • Stable and functional grooves will initiate the reserves of the topsoil stockpiles • These reserves may show some degree of natural revegetation from existing soil seed banks where available • The reserves should be complemented by gradually adding seeds and/or live plants of species of different functional groups and ensuring the successful establishment of perennial vegetation where necessary with short-term additional irrigation
• Gradual decrease in vegetation cover and signs of erosion	• Ensure the stability and biological activity of landscaped topsoil slopes • Maintain initial revegetation programs for at least five years to ensure the establishment of an acceptable mosaic of perennial vegetation cover • Monitor slopes continually during the entire operational phase up to 3 years past closure for signs of erosion and mitigate immediately where necessary

The aim of the first vegetation cover is to form a protective, relatively dense indigenous layer to slow runoff, increase moisture infiltration into the soil, and gradually change the soil nutrient status in order

for it to be more favourable for other desirable indigenous vegetation to become established (see also Figure 24).

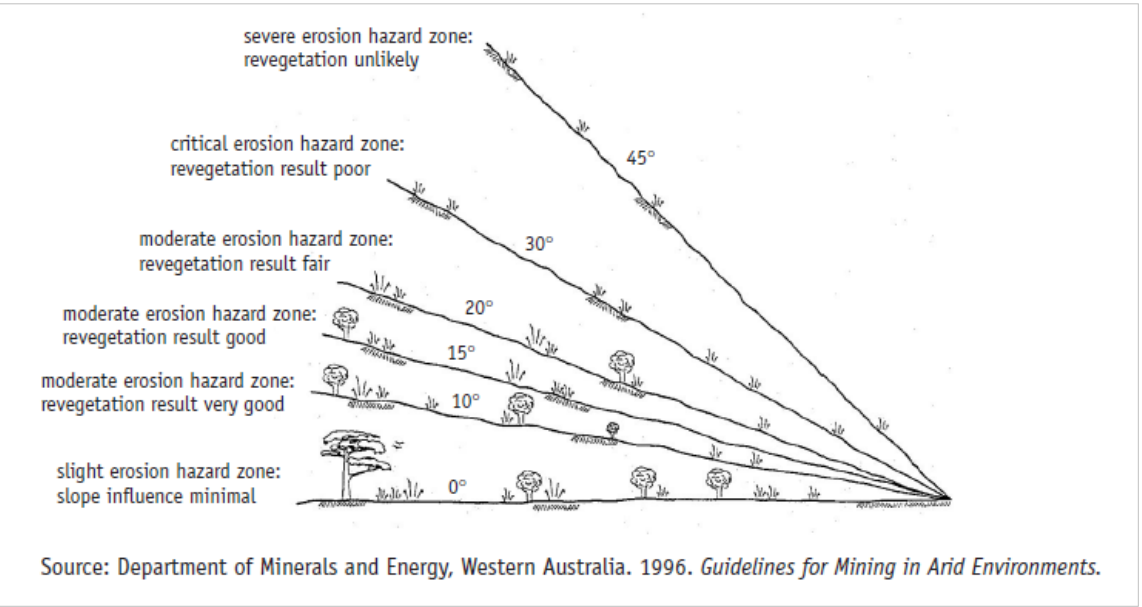

Figure 24: Influence of slope angle on erosion risk and success of revegetation

Project Component/s	Project components affecting the objective: • Access roads • Laydown areas • Protective fencing around development • Prospecting operations • Mining excavations, including safety berms
Potential Impact	• After rehabilitation, a change of plant species composition with lower productivity and grazing potential can be expected due to removal and long-term disturbance of vegetation and soil seed resources • A largely reduced vegetation cover on rehabilitated areas may cause such areas and the surrounding ecosystem to be more prone to highly accelerated erosion and irreversible degradation • Disturbance of indigenous vegetation creates opportunities for the establishment of invasive vegetation or creation of surfaces that do not support the permanent (re-) establishment of vegetation • Loss of natural regeneration potential of soils • Loss of agricultural (grazing) potential of soils.
Activities/Risk Sources	• Mining-related loss and damage to natural and semi-natural vegetation, esepcially: ○ Site preparation and earthworks

	○ Excavation of pits and safety berms ○ Construction of site access road
Mitigation: Target/Objective	• Recreate a non-invasive, acceptable vegetation cover that will facilitate the establishment of desirable and/or indigenous species • Prevent and accelerated erosion of ecosystem degradation

Mitigation: Action/Control	**Responsibility**	**Timeframe**
Rehabilitation of surface (also see Soil Specialist Report)		
Prior to the application of topsoil • subsoil shall be shaped and trimmed to blend in with the surrounding landscape or used for erosion mitigation measures • ground surface or shaped subsoil shall be ripped or scarified along the contour with a mechanical ripper or by hand to a depth of 15 – 20 cm • compacted soil shall be ripped along the contour to a depth of ± 30 - 50 cm and then trimmed by hand to prevent re-compacting the soil • any foreign objects, concrete remnants, steel remnants or other objects introduced to the site during the mining process shall be cleared before ripping, or shaping and trimming of any landscapes to be rehabilitated takes place • shaping will be to roughly round off cuts and fills and any other earthworks to stable forms, sympathetic to the natural surrounding landscapes	Contractor, ECO to control	Ongoing and on closure, as soon as areas can be rehabilitated
Application of topsoil, where available • topsoils shall be spread evenly over the ripped or trimmed surface, never deeper than the topsoil originally removed • the final prepared surface shall not be smooth but furrowed to follow the natural contours of the land (also on slopes) • the final prepared surface shall be free of any pollution or any kind of contamination • care shall be taken to prevent the compaction of topsoil	Contractor, ECO to control	Ongoing and on closure, as soon as areas can be rehabilitated
Soil stabilisation • mulch, if available from shredded woody vegetation, shall be applied by hand to achieve a layer of uniform thickness • mulch should be rotovated into the upper 10 cm layer of soil ○ this operation shall not be attempted if the wind strength is such as to remove the mulch before it can be incorporated into the topsoil	Contractor, ECO to control	Operational phase and to post closure, followed up until desired end state is reached, especially on all rehabilitated surfaces

Mitigation: Action/Control	Responsibility	Timeframe
• measures shall be taken to protect all areas susceptible to erosion by installing temporary and permanent drainage work or protective contour berms as soon as possible • additional measures shall be taken to prevent surface water from being concentrated in streams and from scouring slopes, banks or other areas • rills, gullies or other erosion channels developing shall be back-filled and restored to a proper condition ○ such measures shall be effected immediately before erosion develops at a large scale • where erosion cannot be remedied with available mulch, brush packing or rocks, additional items such as straw, geojute or other geotextiles should be used to curtail erosion		
Revegetation		

Slopes steeper than 6°
• Re-vegetation should be initiated after the onset of rains by incorporating a locally collected seed mixture (grasses, shrubs and trees) and/or commercially available seed of:
  ○ *Anthephora pubescens* (Borseltjiegras, Wool Grass)
  ○ *Digitaria eriantha* (Smuts Vinger, Common Finger Grass)
  ○ *Eragrostis curvula* (Weeping Love Grass)
• In the case where only commercial grass seed is available, it is further recommended that small plants of local shrubs be planted in scattered clumps across the rehabilitated area to establish a structural diversity of the vegetation, which will ensure the overall long-term stability of revegetated areas and a gradual onset of natural succession. Recommended species that should be cultivated for such purposes include:
  ○ *Combretum apiculatum* and *C. hereroense*
  ○ *Elephantorrhiza praetermissa*
  ○ *Kirkia wilmsii*
  ○ *Sclerocarya birrea*
  ○ *Searsia* species
  ○ *Terminalia prunioides*
• Where areas have been landscaped as desired and topsoil (even if with pebbles or rock fragments) can and needs to be removed from areas to be cleared, it is recommended that such soil be placed directly onto these re-landscaped slopes, as they will contain a vast amount of geophytes and soil seed banks that can result in a natural re-vegetation
• Exclusion of cattle from rehabilitated areas by means of access control or brush packing with thorny species may become necessary to prevent the continuous destruction of
	Contractor, ECO to control	Throughout operation and within one year of closure, as areas become available for final landscaping and rehabilitation

Mitigation: Action/Control	Responsibility	Timeframe
rehabilitation efforts, especially as the grasses will be very palatable and attractive to cattle • Compaction of newly landscaped soils must be avoided		
Revegetation on plains and undulating areas with a slope <6° • After general surface rehabilitation has been completed, at the onset of rains sow with a mixture of: o Hand collected seeds from indigenous grass and forb species o Commercially available grass species, focusing on: ▪ *Anthephora pubescens* ▪ *Digitaria eriantha* ▪ *Eragrostis curvula* o Desirable high shrub and tree species including: ▪ *Albizia anthelminthica* ▪ *Bolusia speciosa* ▪ *Boscia albitrunca* ▪ *Combretum hereroense* ▪ *Sclerocarya birrea* ▪ *Searsia* species ▪ These species could also be reared by community members and planted in scattered clumps • Monitor regularly to avoid the rapid establishment of indigenous invasive shrubs including *Acacia tortilis*, *Acacia mellifera* and *Dichrostachys cinerea*, as these will displace grazing and dense stands thereof will lead to long-term degradation of soils It is advisable to protect newly re-vegetated areas with a continuous layer of cut brush (brush packing) from non-seeding material of locally available indigenous invasive shrubs to avoid cattle and wildlife from denudating preferential grazing before it is thoroughly established	Contractor, ECO to control	Throughout operation and within one year of closure, as areas become available for final landscaping and rehabilitation
Traffic on revegetated areas • Designated tracks shall be created for pedestrian or vehicle traffic where necessary, all areas beyond such tracks will be regarded as No Go areas for machinery and vehicles • Disturbance of vegetation and topsoil must be kept to a practical minimum, no unauthorised off road driving will be allowed • All livestock shall be excluded from newly revegetated areas (brush packing as first option), until vegetation is well established	Contractor, ECO to control	Throughout operation and within one year of closure, as areas become available for final landscaping and rehabilitation
Monitoring and follow-up treatments		
Monitor success of rehabilitation and revegetation and take remedial actions as needed according to the respective plan	ECO during mining, suitable	Monitoring and maintenance of re-

Mitigation: Action/Control	Responsibility	Timeframe
• Erosion shall be monitored at all times and measures taken as soon as detected • Revegetation efforts must be monitored regularly and maintained until an indigenous perennial vegetation cover of approximately 40% grasses and 10% shrubs and trees is established • Where necessary, reseeding or replanting will have to be done if no acceptable plant cover has been created	designated person / contractor after that	vegetation must be done up to 3 years post closure or longer if the desired vegetation composition has not been achieved
Weeding (see also Alien Invasives Plan) • It can be anticipated that invasive species and weeds will germinate on rehabilitated soils o These should to be hand-pulled or manually uprooted before they are fully established and/or reaching a mature stage where they can regenerate o Where invasive shrubs re-grow, they will have to be eradicated according to the Working for Water specifications	Contractor, ECO to control	Throughout operation and up to 3 years post closure

Performance Indicator	• Natural or functional configuration of habitats as part of ecosystems is retained or recreated, thus ensuring a diverse but stable hydrology, substrate and general environment for species to be able to become established and persist • The structural integrity and diversity of natural plant communities is gradually recreated or maintained • Indigenous biodiversity continually improves according to the pre-determined desirable end state o This end state, if healthy, will be dynamic and able to recover by itself after occasional natural disturbances without returning to a degraded state • Ecosystem function of natural landscapes and their associated vegetation is improved or maintained
Monitoring	• An incident reporting system must record non-conformances to the EMPr. • Quarterly inspections and monitoring of the site by the ECO or personnel designated to the rehabilitation process until 80% of the desired plant species have become established o These inspections should be according to the monitoring protocol drafted as rehabilitation is initiated (possibly Landscape Functional Analyses) • Thereafter annual inspections according to the minimal monitoring protocol up to completion of decommissioning/closure

12.3 INVASIVE PLANT MANAGEMENT

OBJECTIVE: Manage and reduce the impact of invasive vegetation

Within the project area invasive species – indigenous and alien - occur, which all have a potential of reproducing to such an extent that the ecosystem within and beyond the project area could be impaired. Additional alien species grow along major transport routes to the area and thus could be potentially spread there as well.

Species that must be monitored and eradicated according to CARA and NEMBA:

- *Agave americana and A. sisalana*
- *Alternanthera pungens*
- *Argemone ochroleuca*
- *Datura stramonium*
- *Lantana camara*
- *Melia azedarach*
- *Morus alba*
- *Opuntia species*
- *Pennisetum setaceum*

Ruderal species that are easily distributed by vehicles or staff and should be eradicated when they become invasive:

- *Chenopodium species*
- *Laggera decurrens*
- *Setaria verticillata*
- *Tribulus terrestris*

Potentially invasive indigenous shrubs that will indicate degradation if reaching densities above 8 % canopy cover and will need to be eradicated from the development and associated infrastructure footprint to prevent their spread to neighbouring rangelands:

- *Acacia (Senegalia) mellifera s. detinens*
- *Acacia (Vachellia) tortilis*
- *Dichrostachys cinerea*
- *Terminalia prunioides*

It can be expected that more species may be added after the pre-commencement walk-through survey. A species-specific Invasives Management Plan needs to be drafted after this walk-through, and should be updated as necessary after each review of the closure plan. Operational standards must adhere to those set out by Working for Water. The use of chemicals may only commence with the approval of the relevant authorities.

Project Component/s	Project components affecting the objective: • Access roads • Laydown areas • Protective fencing around development • Prospecting operations • Mining excavations, including safety berms
Potential Impact	• Displacement of natural vegetation and loss of indigenous soil seed reserves • Degradation and/or alteration of topsoil • Loss faunal habitats • Degradation and loss of agricultural potential • Loss of natural regeneration potential of soils • Loss of agricultural (grazing) potential of soils.
Activities/Risk Sources	• Mining-related loss and damage to natural and semi-natural vegetation, especially: o Site preparation and earthworks o Excavation of pits and safety berms o Construction of site access road o Transport of materials • Uncontrolled Alien Invasives along major road as well as land beyond the footprint
Mitigation: Target/Objective	• To significantly reduce the presence of weeds and eradicate alien invasive species • To avoid the introduction of additional alien invasive plants to the project control area • To avoid further distribution and thickening of existing alien plants and invasive shrubs on the project area • To avoid degradation of the natural ecosystems due to alien invasive infestation

Mitigation: Action/Control	**Responsibility**	**Timeframe**
• Rehabilitate disturbed areas as quickly as possible to prevent such becoming target areas for alien invasive establishment • It is recommended that all non-seeding material from cleared invasive shrubs and other woody vegetation be shredded and used as mulch as part of the rehabilitation and revegetation plan or as dust control around infrastructure • Ensure that material from invasive plants that can regenerate – seeds, suckers, plant parts are adequately destroyed and not further distributed o Where possible, destroy seeding material of weeds and invasives by piling and burning (in designated areas or suitable containers)	Contractor, monitored by ECO	Throughout operation and up to 3 years post closure

Mitigation: Action/Control	Responsibility	Timeframe

• Do not import soil from areas with alien plants
• It can be anticipated that invasive species and weeds will germinate on rehabilitated soils
  o These need to be hand-pulled or manually removed before they are fully established and/or reaching a mature stage where they can regenerate
  o Where invasive shrubs re-grow, they will have to be eradicated according to the Working for Water specifications
• Risks from alien invasives do not only arise from invasives present within the footprint area, but also from alien invasives along the verges of the major transport routes, especially invasive grasses and smaller weeds. Similarly, invasives can be spread by mining processes to surrounding areas. To avoid the distribution of weeds and invasive plants, establish a routine amongst contractors/all staff to regularly check:
  o that clothing and shoes are free of mud and seeds
  o that foot wells inside vehicles and mats are cleared of weed seed
  o radiator and grill, along wheel trims, around wheels, mud flaps, undercarriage of vehicle or other moving machinery for mud and seed		

Communicate expert advice to land-owners on eradication and control programs, as this will create an ongoing risk for the liability of BCR	Contractor, ECO	Throughout operation

Performance Indicator	• Visible reduction of number and cover of alien invasive plants within the project area • No establishment of additional alien invasive species
Monitoring	• Ongoing monitoring of area by ECO/EO during operation • Audit every two to three years by a suitably qualified botanist to assess the status of infestation and success of eradication measures o Alternatively, include this in the annual review of the closure plan and associated risk assessment • If new infestations are noted these must be recorded. A comprehensive eradication programme following the operation standards of the WfW (Working for Water) Programme is advisable