

2016

# Sandham Farms Ecological Assessment



For Genet Manganese (Pty) Ltd  
EndemicVision Environmental Services  
2016/01/15

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## Declaration of Consultant Independence

This report has been prepared by EndemicVision Environmental Services (EV) with the trading name of EndemicVision Environmental Services (Pty) Limited, with all reasonable skill, care and diligence within the terms of the contract with the client.

EndemicVision Environmental Services Pty (Ltd) is a multidisciplinary environmental management and consulting company with more than 20 years of experience in field. The technical appointments for this project are detailed below.

Chrizette Neethling has over 18 years of broad based environmental experience with more than 50 projects completed in mining, biodiversity and development industries. She has a strong background in environmental management systems, reactive regulatory tools to address development and the pro-active conservation tools to enhance projects.

As a qualified ecologist and environmentalist, she present strong supporting skills and experience in project management, biophysical closure planning and management, risk management, auditing and natural resource management. Her geographical area of expertise is the arid zones of Southern Africa and her qualification as a Nature Conservator and experience in this field provides her with a foundation of understanding the biophysical environment as a general ecologist.

### The following qualifications are relevant:

- MSc – Biophysical Rehabilitation (Current)
- BSc –Honors (Cum Laude) Environmental Management
- BA with specialization in Environmental Management
- ND Nature Conservation Management
- NC Business Management

The author of this report, Chrizette Neethling, does hereby declare that she is an independent consultant on behalf of EV and has no business, financial, personal or other interest in the activity, application or appeal in respect of which she was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of the specialist performing such work. All opinions expressed in this report are her own.



**Signed: C.D. Neethling**

**Dated: 15 January 2016**

## 1 Executive Summary

This project is in the Northern Cape Province, Siyanda District Municipality, Tsantsabane local municipality and has an extensive land holding of approximately 9500 hectares. The project area consists of four farms namely Hartfell 172 Hay RD, Portion 1 and Remaining Extent; Sandham 171 Hay RD, Portion Remaining Extent; Bulls run 164 Hay RD, Portion 1, 2 and Remaining Extent.

The proponent is Genet Mining, who envisages the prospecting using non-intrusive and intrusive means to determine the availability and viability of iron, manganese and copper resources.

This assessment considers the ecological, fauna and flora characteristics of the site to ensure no adverse impacts take place that could result in long-term loss of the inherent features of the area.

The area consists of four vegetation types (Northern Upper Karoo, Gordonia Duneveld, Kuruman Mountain Bushveld and Olifantshoek plains thornveld). Five habitat types (Riverbeds, Open thornveld, plains thornveld, Karoo plains, Dune veld, Outcrops) occur on the site.

Primarily most of the area is well represented in the landscape and of low biodiversity sensitivity.

The more (moderately) biodiverse sensitive areas are outcrop and riverbed habitats.

The top five impacts that the prospecting project team should manage include ground water contamination, rehabilitation (positive impact), vegetation loss, soil loss and sensitive habitat loss.

The implementation of the mitigation measures reduces the total impact of the project to an impact index of 13 from an original score of 22.

## 2 Introduction

EndemicVision Environmental Service Pty (Ltd) has been appointed as independent environmental consultants responsible for conducting the ecological study required in support of the prospecting right amendment application on behalf of Genet Mining.

This report provides the results of the desktop review, site visit and assessment of data towards indicating the flora, fauna and biodiversity impacts of the above mentioned project.

This ecological assessment is presented in the form of an environmental baseline, impact assessment, sensitivity map and mitigation plan.

## 3 Terms of Reference

The assessment is conducted according to the EIA Regulations, published by the Department of Environmental Affairs and Tourism (April 1998) in terms of the Environmental Conservation Act No. 73 of 1989 as well as Environmental Impact Assessment Regulations 2014 - GNR 982 of 4 December 2014.

In support to the application of the regulation best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005) are also referred.

The Scope of Work (SoW) essential includes the following key activities:

- ◆ Site Evaluation
- ◆ Data Verification and Analysis
- ◆ Report Compilation
- ◆ Client Input and finalisation
- ◆ Final Report Submission

### 4 Project Orientation

The project is situated in the Northern Cape Province, Siyanda district municipality, Tsantsabanelocal municipality and has an extensive landholding of approximately 9500 hectares. The area under investigation (the site) is situated approximately 60km from the nearest main town, Groblershoop.

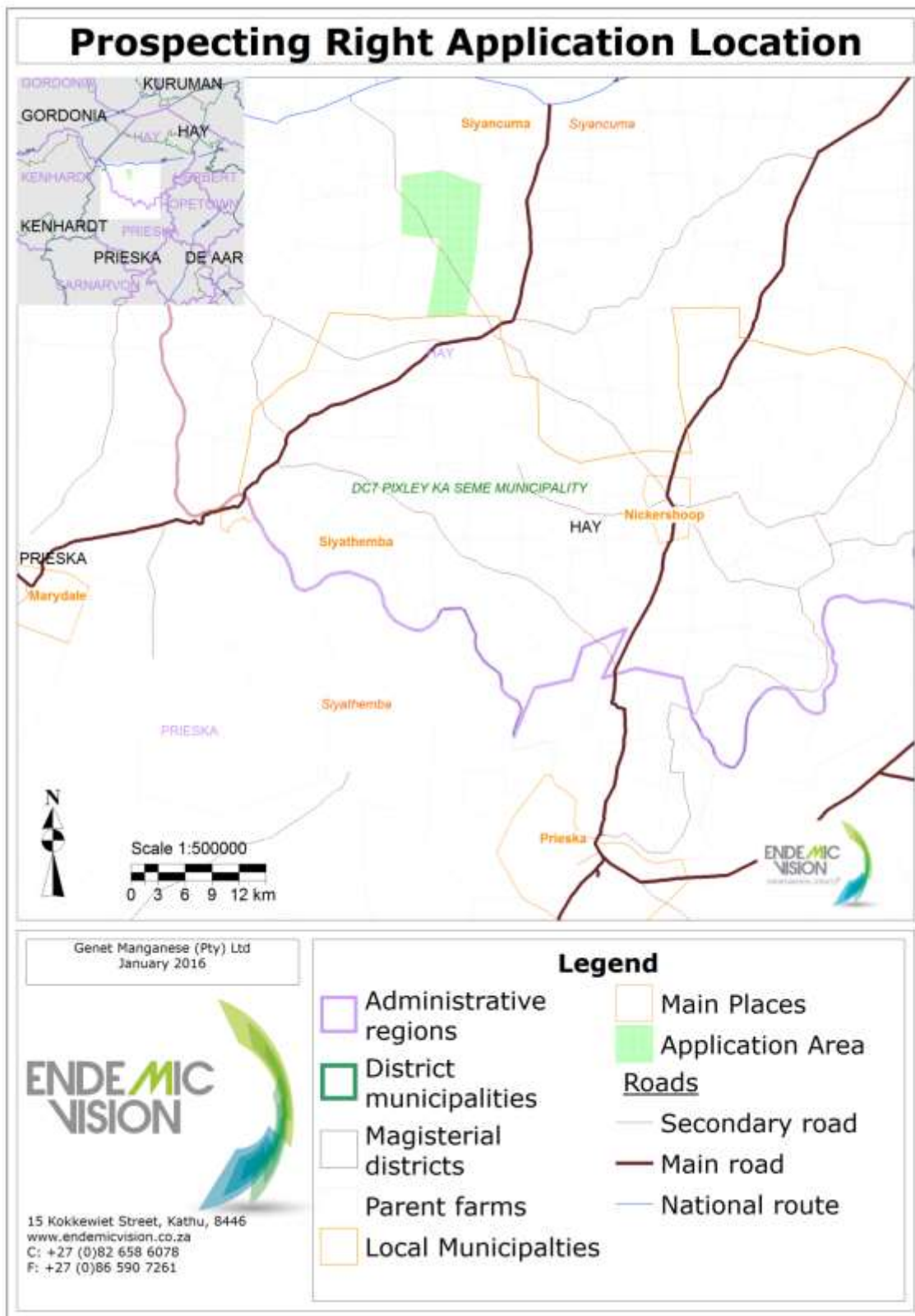


Figure 1: Project Location

The Genet South Africa Group is a diversified mineral resource, mining service provision and construction material supply entity. Genet Mining is continually investigating possible expansion opportunities. The most recent expansion opportunity is in the Northern Cape.

Genet Mining would like to access the right to prospect for copper, iron and manganese.

The prospecting project includes the following planned activities and infrastructure:

It is planned to determine the mineral resource and distribution for this project by means of non-invasive as well as invasive prospecting methods.

The information obtained during the initial non-invasive field survey and evaluation process of the geological maps and data, will then be used to determine the target area and planned positions of the intended invasive prospecting.

The entire prospecting programme will take place over a 60 month (5 year) period.

### **Invasive prospecting**

#### **- Trenching and pitting**

The planned prospecting would be performed by a Backhoe excavator. Dimensions will typically range between 15m length x 2m wide x 3m depth to 20m length x 2m width x 3m depth. Different trench positions would initially typically be planned at a spacing of 500m apart on the target areas during the exploration process. Once a body is exposed with a trench, a channel sample will be taken from the sidewall of the 3m trench wall for quality and analysis purposes as well as mapping of the strata. It is expected that there will be a total of 33 trenches will be excavated, sampled and then rehabilitated.

#### **- Triple-cube Core Drilling**

In conjunction with the trenching, diamond drilling will be applied in the exploration program. For this purpose drilling will make use of a triple-tube core barrel. It is envisaged that only one hole be drilled for each trench excavation position of depths of approximately 50 meters. Depending on the results from reconnaissance and geological mapping the drill holes will be laid out in a grid fashion to cover prospective ground. The amount of boreholes required at this stage is an estimate based on a preliminary assessment of the surface topography as well as a 44% discount for potential mineral surface area loss. It is expected that a total of 33 logs will be drilled, sampled and rehabilitated.

The position of the trenches and holes will be planned only after field reconnaissance on the property and detailed studying of geological information available on the area is completed. The current road infrastructure on the properties will be utilised as far as possible for gaining access to the drill-hole positions. A significant amount of well traversed roads currently exist on the properties. In this way the disturbance of the surface area will be kept to a minimum.

On completion of each drilled hole it will be rehabilitated during the closing and rehabilitation of the nearby trench. The sump will also be closed and rehabilitated at the same time by means of filling the hole with the original excavated material. At any time during the prospecting programme, no more than 1 trench and borehole and one campsite position will be left un-rehabilitated.

Bulk sampling is currently not planned, but if required the application will be amended accordingly.

Campsite positions are planned within a radius of 500m of each drilling site. Once a new campsite is developed the old campsite will be rehabilitated.



## 5 Trigger for Specialist Input

In accordance with the Department of Environmental Affairs and Development Planning Guideline for Biodiversity specialists (Brownlie, S. 2005) the following evaluation was used to determine the need for a specialist study.

A ‘trigger’ means a characteristic of either the receiving environment or the proposed project which indicates that biodiversity is likely to be a ‘key issue’ and may require the involvement of an appropriately qualified and experienced specialist.

**Table 1 : Specialist study trigger evaluation for prospecting project**

Site Trigger	Applicability to Prospecting Project
A relatively undisturbed or ‘natural’ site, with indigenous vegetation	<b>APPLICABLE</b> The site has no or limited historical impacts
Wetlands	<b>NOT APPLICABLE</b> No permanent or semi-permanent wetlands are present at site
River systems	<b>APPLICABLE</b> The site has two non-perennial rivers that include flood plain, embanked water and temporary ponds. Dry rivulet beds from outcrops on the site.
Other possible significant natural feature	<b>NOT APPLICABLE</b> No other significant features in terms of flora communities, fauna communities, ecosystems, micro-habitats were found on site. Individual protected species of significance were however found and is recorded as per legal requirement listed below.
Dune systems	<b>APPLICABLE</b> Dune system intrusions in-between outcrops
Legal Requirement in terms of biodiversity legislation	<b>APPLICABLE</b> This refers to legislation pertaining to the management of protected trees, protected fauna and flora and alien invasive species.
Lack of information about the receiving environment	<b>NOT APPLICABLE</b> Habitat types are generally known and previously investigated.
The presence of important biodiversity pattern	<b>APPLICABLE</b> The site is in the Griqua west centre of endemism.
The presence of important ecological processes	<b>APPLICABLE</b> The site has some outcrops functioning as minor local catchment areas and serve as up gradient transition areas between outcrop and plains. The site has two non-perennial rivers that include flood plain, embanked water and temporary ponds.

<p>The presence of important ecosystem goods and services;</p>	<p><b>NOT APPLICABLE</b></p> <p>The area does not serve as water supply for the community in any way. The main ecosystem service is grazing and ground water supply.</p>
<p>The potential of the specific project to pose a threat to biodiversity;</p>	<p><b>NOT APPLICABLE</b></p> <p>The site is well represented in terms of vegetation type, habitat and species composition. The general threat to biodiversity applies to the site, but specific biodiversity loss on regional scale is not applicable.</p>
<p>The potential of biodiversity and/or ecosystems to pose a threat to the proposed project</p>	<p><b>NOT APPLICABLE</b></p>
<p>The potential for making a significant contribution to biodiversity conservation objectives</p>	<p><b>NOT APPLICABLE</b></p> <p>The project has the potential to address biodiversity loss only in terms of certain protected species that can be replaced, but not in terms of regional biodiversity conservation objectives for the area.</p>

## 6 Project Approach and Methods

### 6.1 Site Evaluation

Site evaluation work was conducted during the second week of January 2016. The evaluation was completed during spring, but with very little rain since the previous rain season (March 2015) the veld condition was in sub-optimal condition and mostly in dormant state with a few exceptional species in flower.

The site was surveyed across the extent of the area and the directly adjacent landscape within the sphere of influence of the project (10km radius).

Thereafter, in depth evaluation of flora; fauna; ecosystems was undertaken to gather the following information:

The flora baseline data set including baseline species list; species diversity and vegetation cover estimates evaluated by means of on-site assessment.

Fauna information was obtained by extrapolating data from the literature review and actual mammal sightings and indirect evidence (burrows, pellets and carcasses on site) collected during the site assessment. Where appropriate, herpeto-fauna data will be incorporated using indirect data collection of available habitats and probable occurrence on site. All actual sightings of fauna will be captured. Data will be compared with probable SIBIS and DENC lists for the area.

Evaluation of ecological processes witnessed on site and listing the habitat types assessed; vegetation types and unique habitats for fauna / avifauna interactions.

Projections of impacts on the habitat were assessed in-field during this site evaluation.

### 6.2 Data Verification and Analysis

Data verification and analysis include the desktop review, which due to historic works in the area, has been done by EndemicVision for other projects. The desktop reviews incorporated into the report include:

1. All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological components in the study area;
2. Requirements regarding the fauna and flora survey as requested by the NC-DENC;
3. Legislation pertaining to the fauna and flora study as relevant;
4. Red data species list from the South African National Biodiversity Institute (SANBI);
5. Historic ecological studies and impact assessments of the area

Analysis is further taken forward to compile the impact statement as input to the EIA and provide management and mitigation measures for the protection of key biodiversity items.

## 7 Report Outline

The report considers the infrastructure; baseline environment; trigger for specialist input and legal context as a starting point. The environment is described in terms of climate, geology and soils, vegetation context, fauna context, ecological sensitive areas that is supported by on-site verification of the baseline environment.

The report include a description of the broad ecological characteristics of the site and its surrounds in terms of mapped spatial components of ecological processes and/or disturbance regimes, ecotones, buffering and ecological viability.

In terms of pattern assessment, the following is identified or described:

- ◆ Ecosystem Community Patterns
- ◆ Species level patterns for red data book species (fauna and flora)
- ◆ Ecosystem characteristic patterns in terms of unique landscapes, sensitive habitats and alien invasion.
- ◆ Land use patterns in terms of current, proposed and post closure land use.

In terms of process assessment, the following is identified or described:

- ◆ Key ecological drivers and their impacts
- ◆ Spatial processes and their impacts (e.g. corridors, water courses, wind corridors)

The summary has been adapted to include vegetation type, habitat type and planned infrastructure with the assessment of significance. The degree to which impact can be reversed, cause irreplaceable loss and proposed mitigation measures are outlined for each of the areas with significant impact.

## 8 Legal Overview

Legislation applicable to this project includes the following:

### **National Environmental Management Act (NEMA) (Act No 107, 1998):**

NEMA requires that measures are taken to “prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.”

In this context ecological degradation could take place if the catchment area is permanently altered from a functional sensitive ecological state to a polluted, impacted site. It should be noted that the riverine habitat is a perennial dry riverbed, currently disturbed by the road crossing, human and livestock use of the area.

### **Environment Conservation Act (ECA) (No 73 of 1989 Amendment Notice No. R1183 of 1997)**

ECA provides for the effective protection and controlled utilization of the environment. This Act has been largely repealed by NEMA, but certain provisions remain, in particular provisions relating to environmental impact assessments. The ECA requires that developers must undertake Environmental Impact Assessments (ESIA) for all projects listed as a Schedule 1 activity in the ESIA regulations.

In this context, the EMPR is complied with retrospectively and mitigation plans will apply to all current and future work as well as post construction maintenance.

### **National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004):**

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Act provides for listing of species as threatened or protected, fewer than one of the following categories:

- ◆ **Critically Endangered:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- ◆ **Endangered:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- ◆ **Vulnerable:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- ◆ **Protected species:** any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

### **National Forests Act (No. 84 of 1998):**

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: “no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated”.

In this context, the nationally protected species *Boscia albitrunca* (Witgat boom), *Acacia heamatoxylon* (False Camel thorn) and *Acacia erioloba* (Camelthorn Tree) were encountered.

### **Conservation of Agricultural Resources Act (Act 43 of 1983):**

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilization of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the flood line of water courses and wetlands.

In this context, encroaching species in the form of *Acacia melifera* were encountered and annual forb alien species were encountered. The alien forb species include, but is not limited to *Prosopis glandulosa*, *Amsinkia retrorsa*, *Bidens bipinnata*, *Nicotiana glauca*, *Pennesetum setaceae*.

**Northern Cape Nature Conservation Act, No. 9 of 2009:**

The Northern Cape Nature Conservation Act provides inter alia for the sustainable utilization of wild animals, aquatic biota and plants as well as permitting and trade regulations regarding wild fauna and flora within the province. The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (Schedule 1), Protected (schedule 2) to Common (schedule 3). The majority of mammals, reptiles and amphibians are listed under Schedule 2, except for listed species which are under Schedule 1. A permit is required for any activities which involve species listed under Schedule 1 or 2.

In this context some indigenous genus and protected species were found site and is included in the respective species lists.

## 9 Climatic Context

Climatic conditions are a key driver of biomes and weather patterns can impact on rehabilitation success. A short climatic and weather background is provided.

The climate data was obtained from the New Local Climate Estimator, developed by the Food and Agricultural Organisation of the United Nations in 2005. The climate can be considered to be semi-arid with hot summers and cool to cold winter temperatures. Temperatures vary between  $-9^{\circ}\text{C}$  and  $+42^{\circ}\text{C}$ , with an average of  $19.2^{\circ}\text{C}$ . In spring, summer and autumn months, the average rainfall varies between 19mm (October) and 74mm per month (March), while potential evapo-transpiration will be between 145mm (October) to 130mm (March) per month.

No or very little rain falls between June and September, while evapo-transpiration is never less than 60mm per month. This implies that the area has a precipitation deficit of 1075mm per year and a moisture index of -75% and can therefore be classified as a dry region (semi-arid) for agricultural purposes.

Wind in the area has been recorded to blow at a maximum speed of up to 6.48 km/h in the summer there is an average of 9.8 to 10.1 sunshine hours per day and average day lengths of 12 to 14 hours.

## 10 Geology and Soils

The interaction of re-vegetated plants with the physical, chemical and biological components of the soil environment, determine whether vegetation will persist on rehabilitated areas (van Rensburg, 2004).

The main geology consists of the Griqualand West Super group (contemporaneous with the Transvaal Super group). The Koegas Subgroup occurs in the Prieska area. It conformably overlies the Asbestos Hills Subgroup and is made up of mudstone, quartzite, jaspilite with crocidolite lenses, iron formation and dolomite.

Recent sedimentary elements of a tertiary and quaternary stratigraphy are visible as dune intrusions between the outcrops.

Arkose conglomerate sediments of the Waterberg group is within the zone of influence and can be seen in some substrates along the western areas of the site.

The main rock types are sedimentary rock types with dolomite, quartz, lime stone, iron formation and shale.

The main soil forms are Hutton Form and Prieska Form with a hardpan carbonate horizon in some places. Namib soil forms are present where dune intrusions occur.

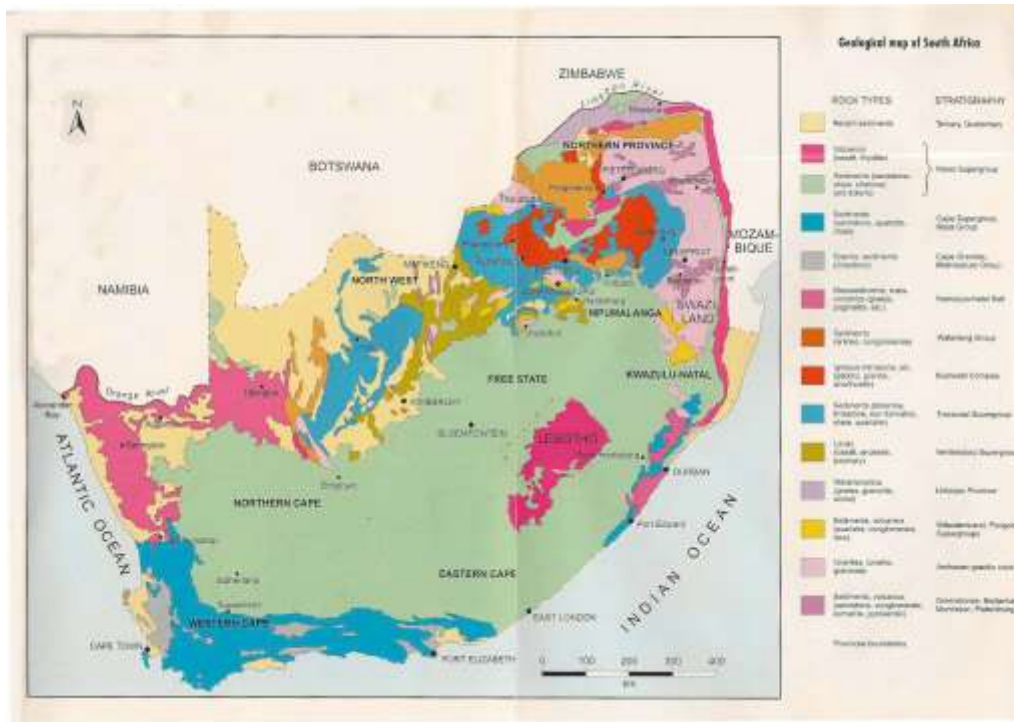


Figure 2: Geological layout (Source: Council of Geoscience)

## 11 Flora Context

The study area falls within the Eastern Kalahari Bush veld Bioregion of the Savannah Biome (Mucina & Rutherford 2006). This is seen as a relatively species-poor area. Less than 2.5% of the total species list of the southern Kalahari is regarded as endemic, while less than 6% of the plant species is regarded as near-endemic species (Van Rooyen & Van Rooyen 1998).

Furthermore, the project area lies on the edge of the Griqualand West Centre of Endemism (GWC), an area with an unusually high occurrence of species with very restricted distributions (Anderson, 2003). The GWC is one of 84 African centres of endemism and is one of 14 centres in Southern Africa. These centres have global conservation significance. *Searsia tridactyla* and *Tarchonanthus obovatus* are plant species recorded near Kathu that are regarded as endemic to the GWC.

This centre of endemism is important because it safeguard the greatest number of endemic plant species that are extremely vulnerable. A relatively small disturbance can impact range-restricted species situated here. The cumulative impact of numerous mining projects in the area threatens the ecological integrity of the area and continued biodiversity richness.

### 11.1 Vegetation Types

The site consists of numerous vegetation types with *Gordonia* Duneveld as the dominant vegetation type followed by Olifantshoek plains thornveldt and Northern Upper Karoo vegetation type. Kuruman mountain bush veld occurs on the outcrops. Koranna Langerberg mountain bushveld and Southern Kalahari salt pans occurring in the surrounding area, but not evident on site.

#### 11.1.1 *Gordonia* Duneveld

*Gordonia* is also known as Kalahari thornveld and Kalahari shrub bushveld (Acocks 1953) or as shrubby Kalahari Dune Bushveld (Low & Rebelo 1996). *Gordonia* dune veld consists of parallel dunes in open shrub land with ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dune slopes. Lower slopes and inter dune straaten are dominated with *Acacia melifera* and/or *Rhigozum trichotomum*.



Important trees include *Acacia heamatoxylon*; *Acacia melifera* subsp. *detinens*; Dominant shrubs include *Grewia flava*; *Rhigozum trichotomum*, *Aptosimum albomarginatum*, *Monechma incanum*, *Requienia sphaerosperma*, *Lycium bosciifolium*, *Lycium pumilum*, *Talinum cafferum*.

Biogeographically important grasses include *Schmidtia kalahariensis*, *Brachiaria glomerata*, *Bulbostylis hispidula*, *Centropodia glauca*, *Eragrostis lehmanniana*, *Stipagrostis ciliate*, *Stipagrostis obtuse*, *Stipagrostis uniplumis*, *Stipagrostis amabilis*, *Antheophora argentea*, *Megaloprotachne albescens*.

*Gordonia dune veld* is a least threatened vegetation type with a conservation target of 16%. 14% of this vegetation type is conserved in the Kgalagadi Transfrontier Park.

#### 11.1.2 Northern Upper Karoo

Northern Upper Karoo vegetation type is dominated by dwarf Karoo shrubs, grasses and low trees. Dominant species include *Acacia melifera* subsp. *detinens*.

The vegetation type is characterised specifically by protected species like *Acacia erioloba*, *Boscia albitrunca*, *Acacia heamatoxylon* and numerous *Aloe* species.

Important grasses include, but are not limited to *Aristida adscensionis*, *Aristida congesta*, *Aristida diffusa*, *Enneapogon desvauxii*, *Sporobolus fimbriatus*, *Stipagrostis obtuse*, *Eragrostis bicolor*, *Eragrostis porosa*, *Fingerhuthia africana*, *Heteropogon contortus*, *Stipagrostis ciliate*, *Themeda triandra*, *Targus berteronianus*, *Tragus koelerioides*, *Tragus racemosus*.

Tall shrubs of grazing and ecological value include *Lycium cinereum*, *Lycium horridum*, *Lycium oxycarpum*, *Lycium schizocalyx*, *Chrysocoma ciliata*, *Gnidia polycephala*, *Pentzia calcarea*, *Pentzia globosa*, *Pentzia incana*, *Rosenia humilis*.

Endemic taxa include *Lithops hookeri*, *Stomatium pluridens*, *Atriplex spongiosa*, *Galenia exigua* and *Manulea desericola*.

This vegetation type is least threatened with a target of 21% of which none is conserved in statutory conservation areas. About 4% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo). Erosion is moderate to low.

This vegetation type can be invaded, specifically by *Prosopis glandulosa*, regarded as one of the 12 agriculturally most important invasive alien plants in South Africa.

#### 11.1.3 Olifantshoek plains thorn veldt

Olifantshoek plains thornveldt vegetation type consists of plains that have open tree and shrub layers with a usually sparse grass layer.

Olifantshoek plains thornveldt is least threatened with a target of 16%. Only 0.3% is statutorily conserved in the Witsand Nature Reserve. 1% of the area has been transformed and erosion is very low.

The vegetation type is characterised specifically by protected species like *Acacia luederitzii*, *Acacia erioloba*, *Rhus tenuinervis*, *Boscia albitrunca*, *Acacia heamatoxylon*.

Important grasses include *Schmidtia papophoroides*, *Stipagrostis uniplumis*, *Aristida congesta*, *Brachiaria serrate*, *Digitaria eriantha*, *Melinis repens*.

Tall shrubs include *Rhigozum obovatum*, *Tarchonanthus camphoratus*, *Lessertia frutescens*, *Lycium hirsutum*.

Endemic taxon includes *Amphiglossa tecta*.

#### 11.1.4 Kuruman Mountain Bushveld

Kuruman Thornveld is characterised by flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-developed open tree stratum consisting of *Acacia erioloba*. Hills have gentle to moderate slopes and hill pediment areas with an open shrub veld with *Lebeckia macrantha* prominent in places. Grass layer is well developed (Mucina & Rutherford, 2011).

Important trees include *Rhus lancea*, *Diospyros austro-africana*, *Euclea crispa*, *Euclea undulate*, *Olea europaea*, *Rhus pyroides*, *Rhus tridactyla*, *Tarchonanthus camphoratus*, *Tephrosia longipes*.

Important shrubs include *Comphocarpus gruticosus*, *Thus ciliate*, *Anthospermum rigidum*, *Helichrysum zeyheri*, *Lantan rugosa*, *Wahlenbergia nodosa*.

Important grasses includes *Andropogon chinensis*, *Andropogon chirensis*, *anthephora pubescns*, *Aristida congesta*, *Digitaria eriantha*, *Themeda triandra*, *Triraphis andropogonoides*, *Aristida diffusa*, *Brachiaria nigropedata*, *Bulbostylis burchellii*, *Cymbopogon caesius*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis chloromelas*, *Eragrstis nindensis*, *Eustachys paspaloides*, *Heteropogon contortus*, *Melinis repens*, *Schizachyrium sanguineum*, *Trichoneura grandiglumis*.

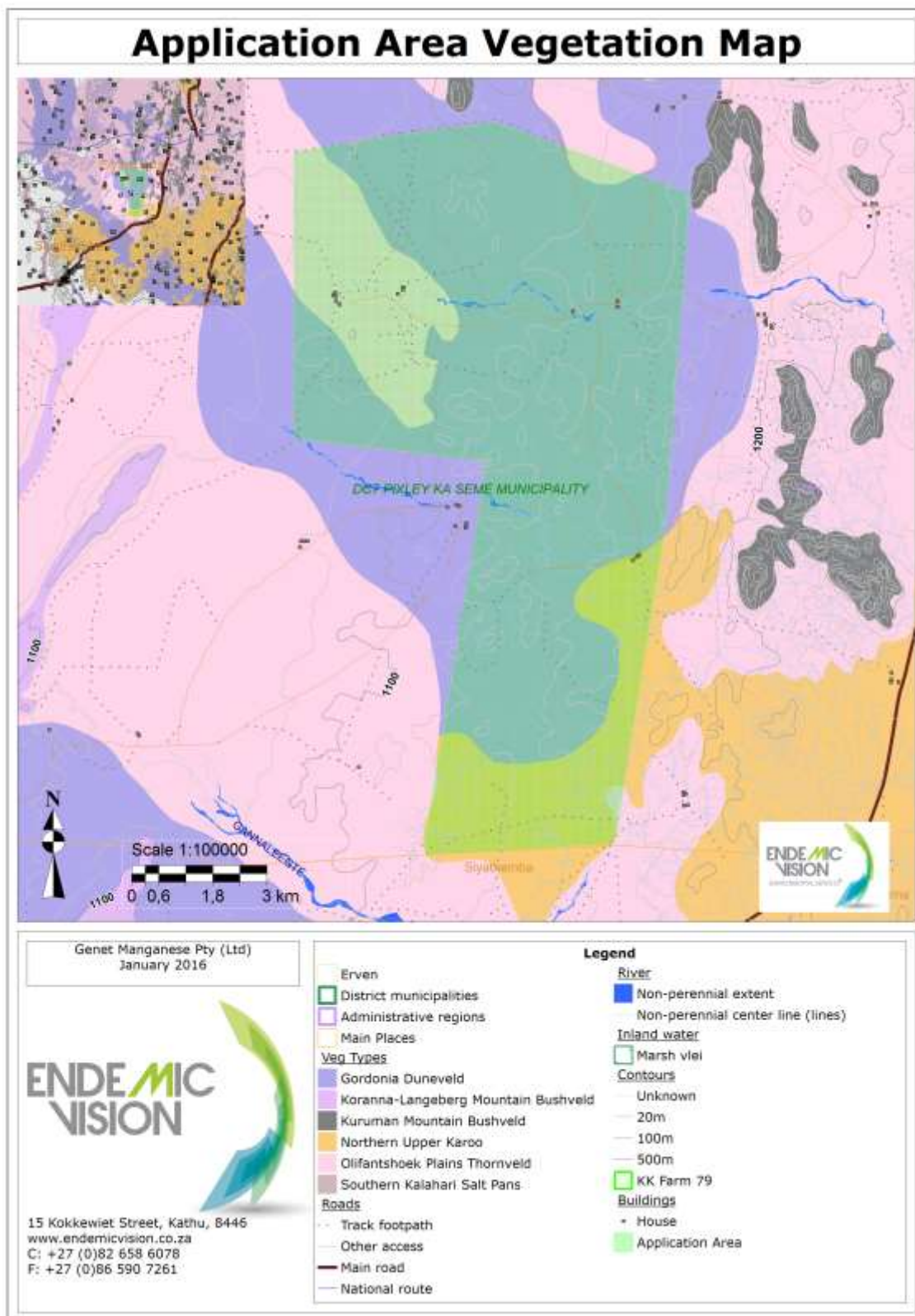


Figure 3: Vegetation Types (Mucina & Rutherford, 2011)

**11.1.5 Vegetation Diversity**

Listed species known to occur in the vicinity are extracted from national data bases. The Northern Cape Province has over 22 055 plant species. The expected species list for the area includes 1048 species according to the Quarter Degree Square checklist. The species diversity is considered relatively low with a homogenous vegetation constituency except for outcrop areas.

The alien plant species component of the vegetation profile is minor on site, with moderate potential; consist mainly of *Prosopis glandulosa* and some Cacti species.

## 12 Fauna Context

A wide range of fauna species could possibly occur in the area. The regional species diversity account for 56 fauna species. The area checklists for mammals, amphibian, reptiles and avi-fauna are attached as Appendix A of this report.

The actual number of fauna found by means of sightings and evidence of habitat use by the mammals is much less.

The species diversity, within a 10km radius zone of influence from the development, account for 13 species as listed below.

Listed mammals which may occur at the site include the Brown Hyena (*Hyaena brunnea*) (Near Threatened), Black-footed Cat (*Felis nigripes*) (Vulnerable), Honey Badger (*Mellivora capensis*) (Endangered), South African hedgehog (*Atelerix frontalis*) (Near Threatened) and Ground Pangolin (*Smutsia temminckii*) (Vulnerable). However, due to the fragmentation of the landscape and the relatively high human density in the area, it is not likely that many of these species would actually occur at the site on a regular basis.

It is probably only the Black-footed cat and South African Hedgehog which could be present at the site.

Avifauna species for the area include 156 bird species. Bird activity on the site was however low. The only listed species that could frequent the area is the Cape Vulture, Marshall Eagle and Kori bustard. Cape Vulture and Kori bustard was found on surrounding farms.

Listed reptile species could all occur on site, specifically because of the rocky nature of some portions of the site.

Most amphibians are protected, a total of 11 listed amphibian species could possibly be found on site, but would require a more intensive investigation. All species listed could possibly be in the zone of influence of the project, primarily because of the diverse habitats on site.

The only amphibian species of conservation concern which is known from the area is the Giant Bullfrog (*Pyxicephalus adspersus*) which breeds in temporary pans. There are riverbed depressions and floodplain areas in the vicinity of the site and it is therefore probable that the Giant Bullfrog occurs at the site.

## 13 Ecological Sensitive Area Context

The ecological status, considering the biotic and abiotic elements and the way they interact is considered for this assessment. The key driver to determine ecological sensitivity is unique diversity (high occurrence of species of special concern), habitat integrity and ecosystem services provided.

Specific habitats that affect flora and fauna interactions with the environment are found on the site including the dry rivulet beds and outcrops.

Neither the rivulets nor outcrops are significantly unique, but do provide alternative habitats.

Ecological sensitive areas are investigated and presented spatially to assist in the evaluation of the baseline area and possible impacts. Information is integrated by focusing on the following aspects:

- ◆ Areas deemed important in terms of area wide conservation planning
- ◆ Areas with unique habitats for important fauna species
- ◆ Areas of important plant species populations
- ◆ Areas of high ecological integrity
- ◆ Areas with important ecological processes and
- ◆ The degree of ecological connectivity between systems within a landscape matrix
- ◆ Key ecosystem services.

### 13.1.1 Non-perennial Rivers and Rivulets

All river systems are considered sensitive areas, primarily because of the ecosystem services, ecological processes, unique habitat features, and the fact that 82% of the rivers are threatened and the rest very poorly conserved (Driver, et al., 2005)

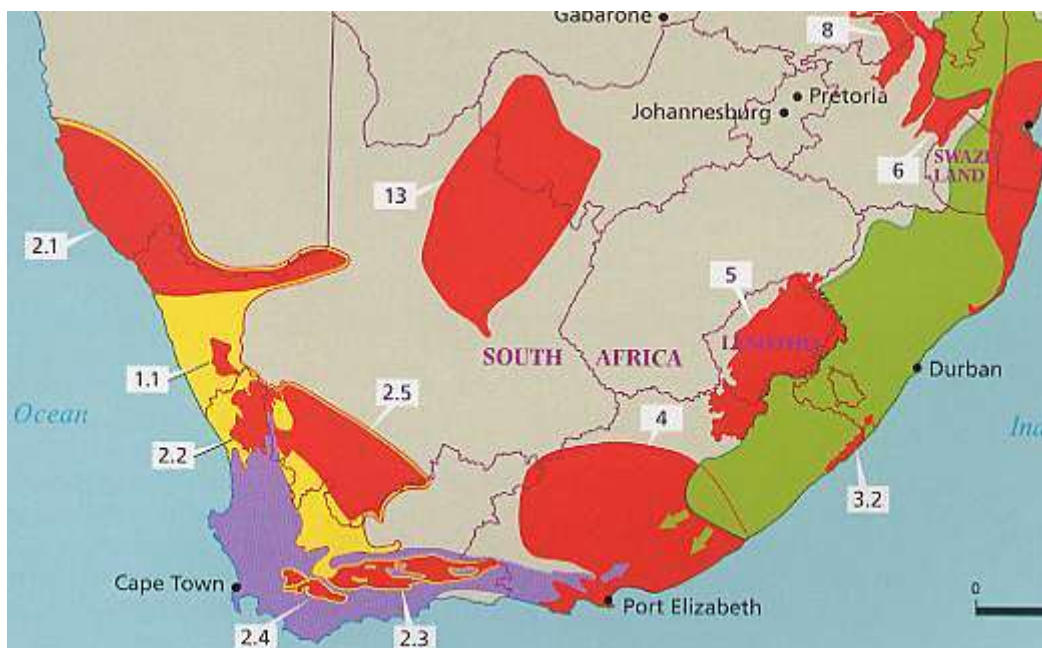
Non-perennial rivers occur on site, but are mostly dry riverbeds; dry-bed rivulets are also present from the outcrops.

The ecosystem services include, but are not limited to:

- ◆ recharge downstream aquifers,
- ◆ transporting sediments (rich in organic matter and nutrients),
- ◆ transportation of seeds, macro-invertebrate eggs,
- ◆ providing temporary breeding sites for amphibians
- ◆ provide niche habitats for large protected species, *Acacia erioloba*.

## 14 Biodiversity Management Context

Biodiversity management of the area must also be considered with this assessment. The nearest statutory protected area is the Witsand Nature Reserve, approximately 80km from the property. The property is situated in the Griqualand Centre of Endemism.



**Figure 4: Griqua West Centre of Endemism indicated as area 13**

The Griqualand West Centre of Endemism is an area with an unusually high occurrence of species with very restricted distributions. This center thus has global conservation significance. The Griqualand West Centre includes the Ghaap Plateau; an area identified by Cape Nature Conservation as a priority for conservation within the Northern Cape and is generally regarded as an ecologically sensitive habitat. The GWC is one of 84 African centres of endemism and is one of 14 centres in southern Africa. These centres have global conservation significance.

The Ghaap Plateau is characterized by a number of endorheic pans which fill with water for short periods after heavy rains. These wetlands make up 21% of South Africa’s wetlands and are afforded special protection. The project area has no endorheic pans.

## 15 Environmental Baseline Determination

### 15.1 Area status in terms of historic impacts

Historical impacts include grazing by goats, sheep and cattle, prospecting and bulk sampling for minerals, single track roads used to access the area, boundary fences constructed by the landowner. Public or shared farm roads, as well as telephone and power lines, occur on the site, some of these services are however not maintained anymore. In some areas bulk earthworks along the outcrop lower slopes have been constructed as soil conservation and water preservation measures.

An important ecological impact on the extent of the area is the provincial road that transverse and fragment the property into two portions.



**Figure 5: Historic bulk sampling on the property**

## 15.2 Baseline vegetation description

The baseline vegetation can be considered undisturbed for most part, with no crop production or hard transformation on the property besides the homestead footprint.

The vegetation is considered relatively homogenous with only two vegetation types and six habitat types of relatively low species diversity. The habitat types are considered transitional zones of the same vegetation type and not distinct areas.

### 15.2.1 Area status in terms of habitats

A habitat is the particular natural environmental or ecological area inhabited by organisms. A habitat is made up of physical factors such as soil, moisture, the range of temperature, availability of light, biotic factors such as the availability of food and the presence of predators (Bothma & du Toit, 2010).

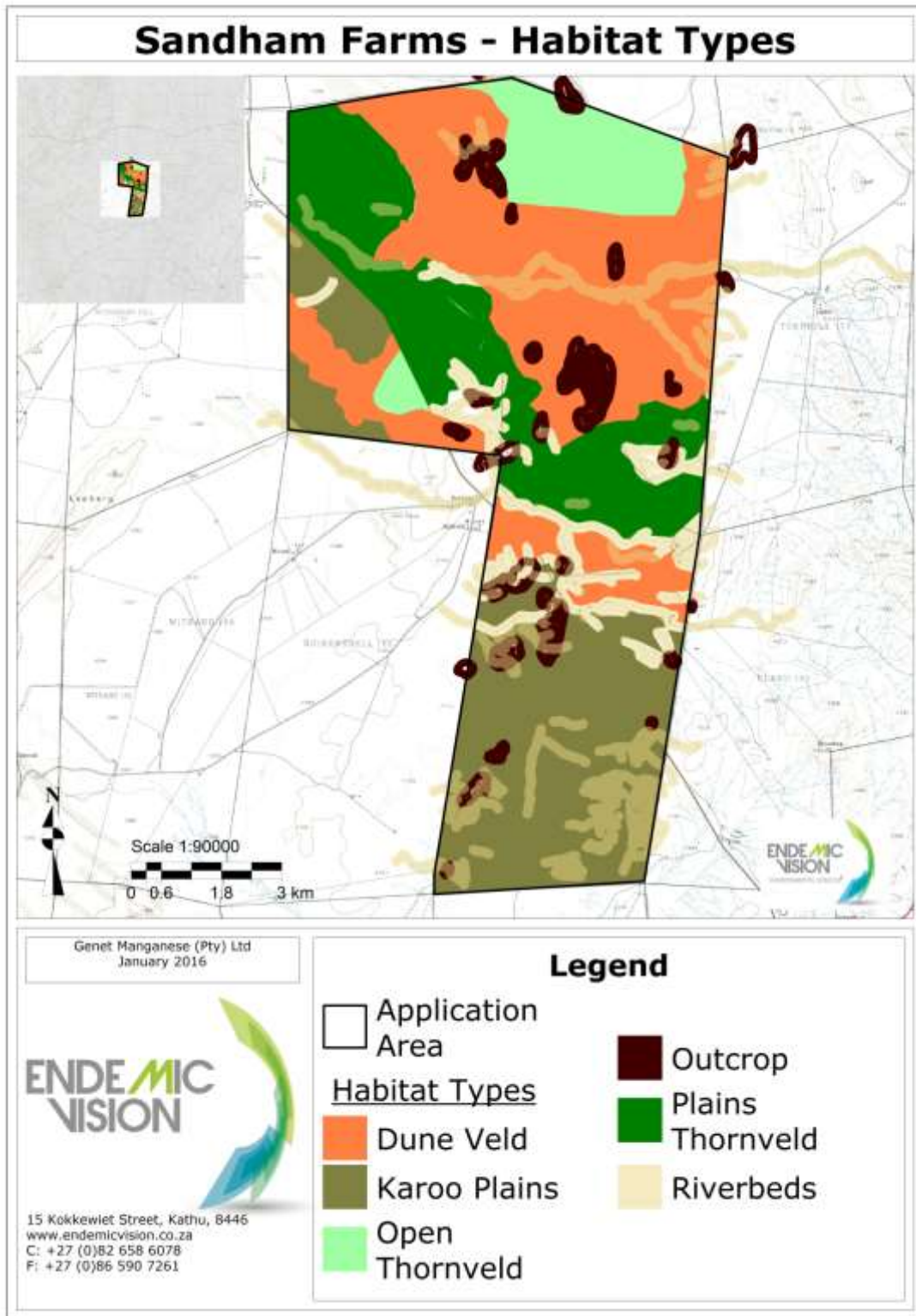
Four different habitat types were found on site namely:

1. Outcrops
2. Dune veld
3. Karoo Plains
4. Dry riverbeds
5. Open Thornveld

The site is dominated by Dune veld, Karoo plains and Outcrop.

The lower slope of most of the outcrops has black thorn thickets with sometimes adjacent Three-thorn thickets. There are also interspersed patches of black thorn thickets on the open thornveld and dune veld. Defined False Camel Thorn habitats could not be categorised, but the species are found as part of the dune veld.

The geographical distribution is mapped below and the visual depiction of the different habitats are presented in the below catalogue.



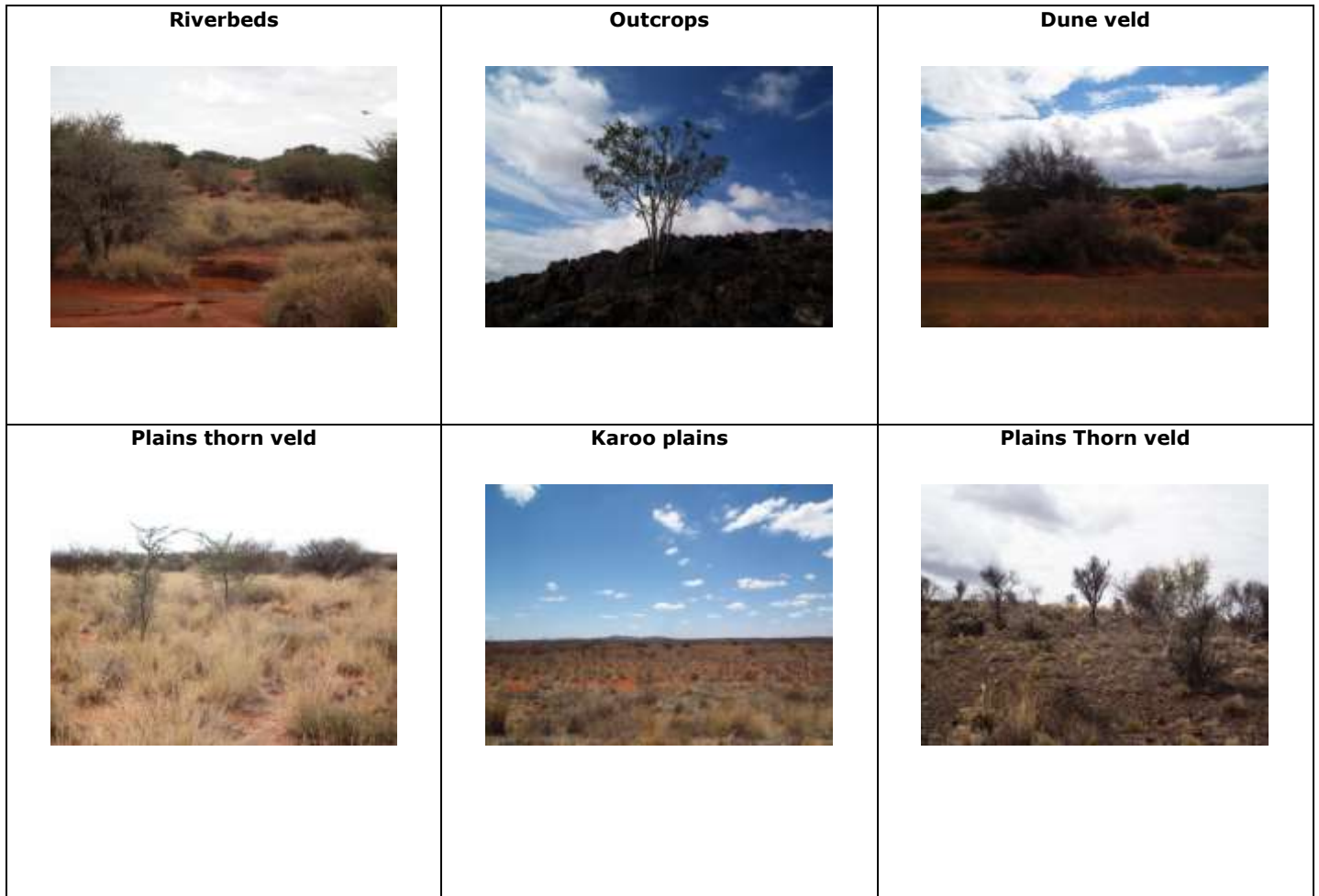
**Figure 6: Habitat type distribution for the site**

Rivulets are also indicated on the map and presented with a 100 meter buffer as the National Water Act requires that no infrastructure be constructed within this perimeter.



The Dune veld and Open Thornveld and Karoo plains are considered the most ecologically functional regarding vegetation structure, crown cover, composition and diversity. All three habitat types seem to be presented throughout the area.

Karoo plains are found important shrub element habitat type that supports highly palatable species valuable for grazing.



**Figure 7: Catalogue of habitat types**

The non-perennial rivers (unnamed) and rivulets are considered important in terms of unique species and ecological functioning. The rivulets can be seen as indications of soil erosion considering the narrow short extend of the rivulets. The non-perennial rivers are known to flood at times and have areas of water accumulation that could function as important avi-fauna and herpetofauna habitats.



**Figure 8: Riverbed habitats**

Outcrops are seen as unique habitats, many times serving as unique fauna and flora habitats. Not all the outcrops are deemed sensitive, however, and none of the outcrops are seen as significantly unique.

Although Lithop species are declared for the area and in some cases marginal habitats for this species could be found, no confirmation of historic known occurrence or site assessment confirmation of occurrence could be found.

Because of the time of year and extremely dry conditions before the site assessments on site verification of the species could not take place. Lithops bromfieldii (image below) is however recorded on the Précis data base for this area. The species is considered endemic and according to IUCN red list of Least Concern status; according to NEMBA lists, unknown status; according to CITES unknown status.



Figure 9: Lithops bromfieldii

**15.2.2 Area status in terms of vegetation diversity**

The area is considered to have relatively low species diversity and is homogenous within each habitat type. The highest diversity occurs on the outcrops and Karoo plains with unique shrub and succulent elements. Unique species are also found on the outcrops and in the river areas, presenting species not normally found in the plains and dune habitat types.

The total number of expected species for this area is 293 of which 114 was seen on site. The species lists of expected and assessed species are attached as appendix A of this report.

**15.3 Baseline Fauna Description**

**15.3.1 Mammals**

Of the 79 species that is expected to occur in the applicable quarter degree square only 18 was found on site. It should however be noted that only a superficial survey was completed in one season for a limited amount of time. Fauna activity was most evident in the river habitats and also in the grassland habitats. The following list of species frequent the area:

**Table 2 : Fauna species occurrence recorded by means of observation**

Steenbok	<i>Raphicerus campestris</i>
Springbok	<i>Antidorcas marsupialis</i>
Red Hartbees	<i>Alcelaphus buselaphus</i>
Kudu	<i>Tragelaphus strepsiceros</i>
Common Duiker	<i>Sylvicapra grimmia</i>
Small-spotted Genet	<i>Genetta genetta</i>
Rock Dassie	<i>Procavia capensis</i>

Slender Mongoose	<i>Galerella sanguinea</i>
Baboon	<i>Papio ursinus</i>
Black backed Jackal	<i>Canis mesomelas</i>
Grey Mongoose	<i>Herpestes edwardsii</i>
Cape Hare / Vlakhaas	<i>Lepus capensis</i>
Scrub hare / Kolhaas	<i>Lepus saxatilis</i>

**15.3.2 Herpeto-fauna**

Reptiles and amphibian data was collected by means of visual observation. Lizard species were found throughout the site with most seen on outcrops.

**15.4 Species of Special Concern**

Species of special concern are presented according to the listing notices that dictate their protection. The listing notices of the following legislation were used to indicate species of special concern for this study:

- ◆ Nature and Environmental Conservation Ordinance (No. 19 of 1974) listing species as indigenous, protected or specially protected.
- ◆ National Forests Act (NFA 1998),
- ◆ National Management Biodiversity Act (2004) listing threatened or species and exotic species
- ◆ The Red Data List of South African listing threatened plant species (i.e. critically endangered, endangered and vulnerable species)
- ◆ Endemic species (range-restricted species) listed in any of the above or by the South African National Biodiversity Institute (2007) are also species of special concern as their distribution may be very localized and they could be threatened by developments.

Protected species, which are mostly geophytes and succulent species, have more specialised habitat requirements. The succulent species in particular are habitat specialists and occur in very specific closed and isolated habitat patches.

Species of special concern are listed in the tables below and the possibility, probability and definite occurrence of the species on the site indicated.

The Outcrop areas have the highest incidents of the protected tree, *Boscia albitrunca*. *Boscia albitrunca* also occurs in the Open Thorn veld and Dune veld habitats. *Boscia albitrunca*, *Acacia erioloba* and *Acacia heamatoxylon* are considered nationally protected trees.



Figure 10: Nationally protected trees on site

Table 3: Flora listed species with special reference to the Griqualand West Centre of Endemism

Species	Conservation Status
Aizoon asbestinum	Endemic
Aloinopsis orpenii	Endemic
Aloinopsis wilmaniae	Endemic
Amphiglossa tecta	Endemic
Antimima lawsonii	Endemic
Aucampiae var. aucampiae	Endemic
Blepharis marginata	Endemic
Brachiaria dura var. pilosa	Endemic
Corchorus pinnatipartitus	Endemic
Crotolaria griquensis	Endemic
Digitaria polyphylla	Endemic
Ebracteola wilmaniae	Endemic
Euphorbia bergii	Endemic
Euphorbia inornata	Endemic
Euphorbia planiceps	Endemic
Euphorbia rectirama	Endemic
Euphorbia wilmaniae	Endemic
Gnaphalium englerianum	Endemic
Helichrysum arenicola	Endemic
Justicia puberula	Endemic
Lebeckia macrantha	Endemic
Lebeckia psiloloba	Endemic
Lithops aucampiae	Endemic
Lithops aucampiae var. koelemanii	Endemic
Lithops bromfieldii var. glaudinae	Endemic
Lithops lesliei ssp. burchellii	Endemic
Nuxia gracilis	Endemic
Orbea knobelii	Endemic
Panicum kalaharensense	Endemic
Prepodesma orpenii	Endemic

<i>Putterlickia saxatilis</i>	Endemic
<i>Rennera stellata</i>	Endemic
<i>Searsia tridactyla</i>	Endemic
<i>Sutera griquensis</i>	Endemic
<i>Tarchonanthus obovatus</i>	Near Endemic
<i>Vahlia capensis</i> var. <i>ellipticifolia</i>	Endemic
<i>Vahlia capensis</i> var. <i>nov.</i>	Endemic

Protected Species	Common Name	Conservation Status
<i>Acacia erioloba</i>	Camel Thorn	Protected
<i>Acacia haematoxylon</i>	Grey Camel Thorn	Protected (new)
<i>Aloe claviflora</i>	Kraalaalwyn	Protected
<i>Aloe grandidentata</i>	Bontaalwyn	Protected
<i>Aloe hereroensis</i>	Sandaalwyn	Protected
<i>Ammocharis coranica</i>	Berglelie, Gifbol	Protected
<i>Anacampseros</i> cf. <i>subnuda</i>	Hasieskos, Voelmis	Protected
<i>Babiana hypogea</i>	Bobbejaanuintjie	Protected
<i>Boophone disticha</i>	Sore Eye Flower, Gifbol	Protected
<i>Boscia albitrunca</i>	Shepherd’s Tree	Protected (new)
<i>Crinum bulbispermum</i>	Orange River Lily	Protected
<i>Fockea angustifolia</i>		Protected
<i>Haworthia</i> species	Kanniedood	Protected
<i>Huerniopsis decipiens</i>	Aasblom	Protected
<i>Lithops aucampiae</i> ssp. <i>aucampiae</i>	Stone Plant, Beeskloutjie	Protected
<i>Mestoklema arboriforme</i>	Donkievygie	Protected
<i>Nerine laticoma</i>		Protected
<i>Orbea knobelli</i>		Protected
<i>Orbeopsis lutea</i>	Geelaasblom	Protected
<i>Ruschia</i> species		Protected
<i>Stapelia olivacea</i>	Swartaasblom	Protected
<i>Trichodiadema</i> species	Hairy Nipple Vygie	Protected

Fauna species of concern include amphibian, reptile, mammal and avi-fauna species.

**Table 4: Amphibian Species list**

Amphibians	Scientific Name	Conservation Status	Occurrence
Boettger's dainty frog	<i>Cacosternum boettgeri</i>	Protected	Possible
Bubbling Kassina	<i>Kassina senegalensis</i>	Protected	Possible
Bushveld Rain Frog	<i>Breviceps adspersus</i>	Protected	Possible
Common or Angola River Frog	<i>Amietia angolensis</i>	Protected	Possible
Eastern Olive Toad	<i>Amietophrynus garmani</i>	Protected	Possible
Western Olive Toad	<i>Amietophrynus poweri</i>	Protected	Possible
Giant Bullfrog	<i>Pyxicephalus adspersus</i>	Protected	Possible
Guttural Toad	<i>Amietophrynus gutturalis</i>	Protected	Possible
Karoo Toad	<i>Bufo gariiepensis</i>	Protected	Possible
Ruacous Toad	<i>Amietophrynus rangeri</i>	Protected	Possible
Tremelo Sand Frog	<i>Tomopterna cryptotis</i>	Protected	Possible

**Table 5: Reptile Species list**

Reptiles	Scientific Name	Conservation Status	Occurrence
Cape Cobra	<i>Naja nivea</i>	Protected	Probable
Bibron's Blind Snake	<i>Afrotyphlops bibronii</i>	Protected	Probable
Spotted Sand Lizard	<i>Pedioplanis lineoocellata</i>	Protected	Definite
Bubbling Kassina	<i>Kassina senegalensis</i>	Protected	Probable
Water monitor / leguan	<i>Varanus niloticus</i>	Protected	Probable
Speckled rock skink	<i>Trachylepis punctatissima</i>	Protected	Definite
Variable skink	<i>Trachylepis varia</i>	Protected	Definite

**Table 6: Mammal species list**

Mammals	Scientific Name	Conservation Status	Occurrence
Aardvark	<i>Orycteropus afer</i>	Vulnerable	Possible
African Wild Cat	<i>Felis lybica</i>	Vulnerable	Possible
Black-footed Cat	<i>Felis nigripes</i>	Vulnerable	Possible
Honey Badger	<i>Mellivora capensis</i>	Endangered	Possible
South African hedgehog	<i>Atelerix frontalis</i>	Endangered	Unlikely
Ground Pangolin	<i>Smutsia temminckii</i>	Vulnerable	Unlikely
Lesser red musk shrew	<i>Crocidura hirta</i>	Protected	Possible
Scrub hare	<i>Lepus saxatilis</i>	Protected	Definite
Cape hare	<i>Lepus capensis</i>	Protected	Definite
Brown Hyaena	<i>Hyaena brunnea</i>	Near Threatened	Unlikely

**Table 7: Avi-fauna Species List**

<b>Avi-fauna</b>	<b>Scientific Name</b>	<b>Conservation Status</b>	<b>Occurrence</b>
Kori Bustard	<i>Ardeotis kori</i>	Vulnerable	Possible
Martial Eagle	<i>Polemaetus bellicosus</i>	Vulnerable	Probable
African Goshawk	<i>Accipiter tachiro</i>	Specially Protected	Possible
Cape Vulture	<i>Gyps coprotheres</i>	Specially Protected	Possible
Secretarybird	<i>Sagittarius serpentarius</i>	Specially Protected	Possible
Spotted Eagle-Owl	<i>Bubo africanus</i>	Specially Protected	Possible
Pearl-spotted Owlet	<i>Glaucidium perlatum</i>	Specially Protected	Possible
Blue Crane	<i>Anthropoides paradiseus</i>	Vulnerable	Unlikely
Lesser Kestrel	<i>Falco naumanni</i>	Vulnerable	Unlikely
Secretarybird	<i>Sagittarius serpentarius</i>	Vulnerable	Possible
Lesser Flamingo	<i>Phoenicopterus minor</i>	Vulnerable	Unlikely
Greater Flamingo	<i>Phoenicopterus ruber</i>	Vulnerable	Unlikely
Black Stork	<i>Ciconia nigra</i>	Vulnerable	Unlikely

## 16 Impact Assessment

### 16.1 Impact Assessment Approach

Standard evaluation methods are applied as defined below.

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need. Assessment of impacts will be based on DEAT's (1998) Guideline Document: EIA Regulations.

The significance of the aspects/impacts of the process will be rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrixes use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts.

The significance of the potential impacts will be determined through a synthesis of the criteria below:

**Probability: This describes the likelihood of the impact actually occurring.**

**Improbable:** The possibility of the impact occurring is very low, due to the circumstances, design or experience.

**Probable:** There is a probability that the impact will occur to the extent that provision must be made therefore.

**Highly Probable:** It is most likely that the impact will occur at some stage of the development.

**Definite:** The impact will take place regardless of any prevention plans.

**Duration: The lifetime of the impact.**

**Short term:** The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.

**Medium term:** The impact will last up to the end of the phases, where after it will be negated.

**Long term:** The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.

**Permanent:** Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

**Scale: The physical and spatial size of the impact**

**Site:** The impacted area extends only as far as the activity, e.g. footprint

**Local:** The impact could affect the whole, or a measurable portion of the above mentioned properties and adjacent properties.

**Regional:** The impact could affect the area including the neighbouring residential areas.



**Magnitude/ Severity: Does the impact destroy the environment, or alter its function.**

**Low:** The impact alters the affected environment in such a way that natural processes are not affected.

**Medium:** The affected environment is altered, but functions and processes continue in a modified way.

**High:** Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

**Significance:** This is an indication of the **importance of the impact** in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

**Negligible:** The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.

**Low:** The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.

**Moderate:** The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.

**High:** The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following scale is used to determine the significance of the impact.

Aspect	Description	Weight	Significance Rating	Weight
<b>Probability</b>	Improbable	1	(Duration, Scale, Magnitude) x Probability	
	Probable	2		
	Highly Probable	4		
	Definite	5		
<b>Duration</b>	Short term	1	Negligible	<20
	Medium term	3	Low	<40
	Long term	4	Moderate	<60
	Permanent	5	High	>60
<b>Scale/Extent</b>	Site	1		
	Local	2		
	Regional	3		
<b>Magnitude/Severity</b>	Low	2		
	Medium	6		
	High	8		

The activities and impacts associated with the project are listed below:

**Table 8: List of Activities associated with the prospecting project**

Activities
Drilling - noise, vibration and dust
Clearing of soils and overburden
Compaction of Soils
Construction of temporary camp and amenities
Construction of drill platforms and/or trenches
Erosion of topsoil (loss of ecological functioning and habitat fragmentation).
Generation and accumulation of hazardous waste
Generation and accumulation of general waste
Generation and accumulation of mineral waste (overburden, drill sludge, chips)
Haulage, loading & dumping causing fugitive dust
Material handling and earthworks
Movement of heavy vehicles

**Table 9: Expected Biodiversity Impacts**

Impacts
Changes to ecosystem services
Contamination of Soil - loss of soil function
Contamination of Water - loss of surface water function
Contamination of Water - loss of ground water function
Disturbance (light, noise, movement, dust) of fauna
Disturbance, transformation and loss of fauna habitat
Ecological process & function deterioration/ breakdown
Habitat fragmentation
Habitat Reduction
Hydrological functioning: Changing water runoff patterns.
Loss of genetic material
Loss of species of special concern
Loss of Topsoil
Loss of vegetation cover
Mineral Waste Deposition: Dirty water run-off & Dust
Persecution of fauna (hunting, roadkill, trapping)
Rehabilitation of Impacted Areas
Sensitive Habitat Loss
Species diversity loss
Species population reduction
Vegetation change: alien encroachment

## 16.2 Biodiversity Sensitivity Management Map

Sensitive habitats are evaluated in different degrees to which the habitat can withstand the development and/or the impact of the loss of the habitat on the greater landscape and/or the degree to which the habitat can be restored with rehabilitation after the impact.

The list below depicts the sensitivity categories Low (for low biodiversity impact), Medium or High (for high biodiversity impact).

### Low Sensitivity Rating

Low sensitive areas are degraded and highly disturbed/transformed systems with little ecological function and which are generally very poor in species diversity (most species are usually exotic or weeds)

- Low ecological sensitivity
- Previously disturbed areas
- Negligible impact on ecological processes and terrestrial biodiversity
- Extent of impact is little, temporal and insignificant in context of the extend of biodiversity

### Medium Sensitivity Rating

These are slightly modified systems which occur along gradients of disturbances of low medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species.

- Moderate ecological sensitivity
- Relatively undisturbed sites showing signs of extensive indirect disturbance (over grazing, excessive fires, trampling)
- Little ecological impact provided that all mitigation measures are fully complied with
- Secondary impacts of development will be low (like erosion, ground water plumes)

### High Sensitivity Rating

Highly sensitive areas are sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected.

- High ecological sensitivity and high biodiversity value
- Undisturbed, intact areas
- Development is undesirable here and should only proceed with caution where all other alternatives have been investigated and failed
- Ecological impact will be high with little possibility of recovering the area to its original state

### Critical Sensitivity Rating

Critical sensitive areas are essentially areas that should not be developed, but be retained for future generations and contribute to biodiversity resource as a whole in the area.

- Conservation priority or species priority area with unique habitat types or critical ecological services provided
- Undisturbed, intact areas of high biodiversity importance beyond the local scale
- Development should be avoided and area is essentially a no-go area

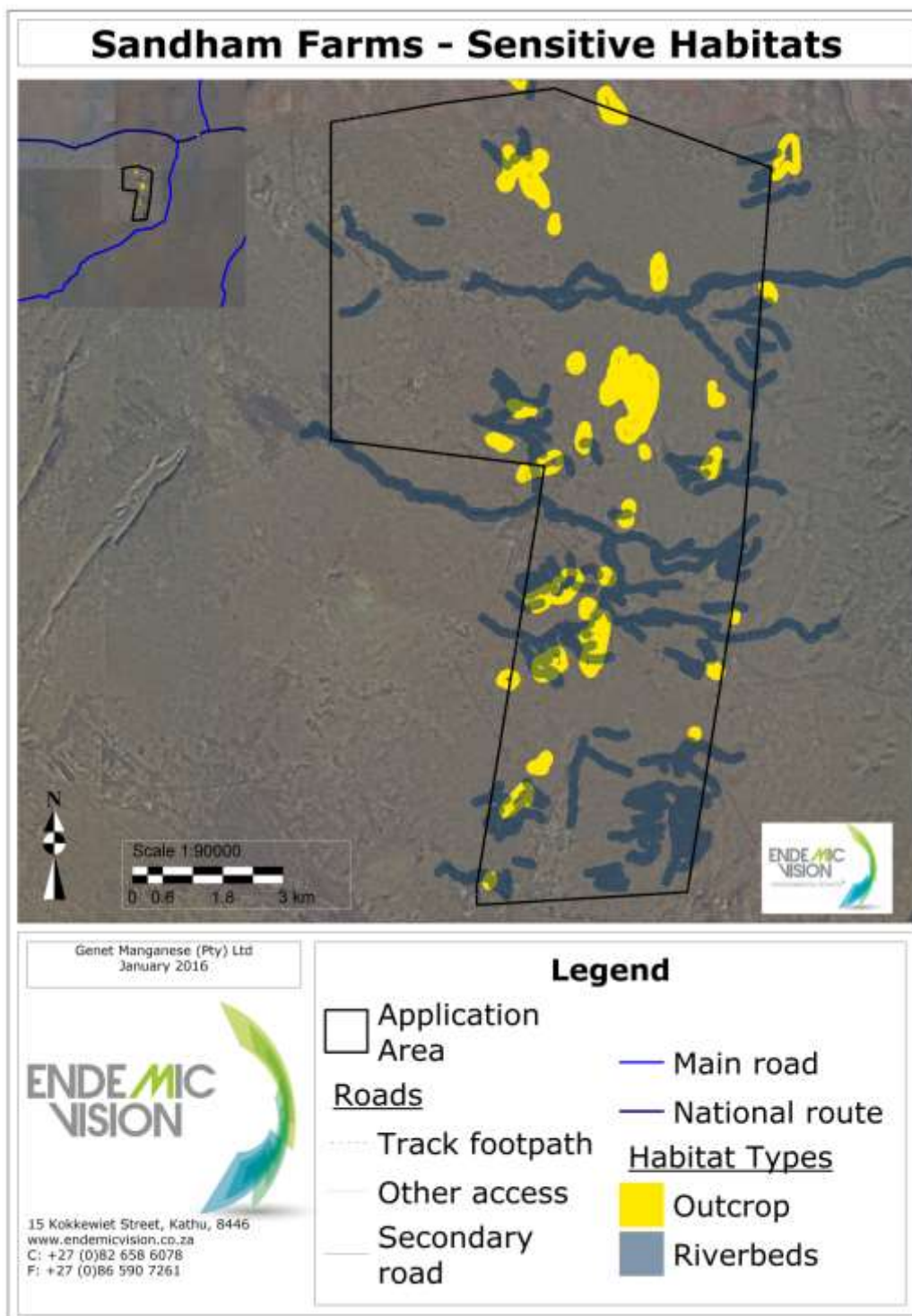
Using the biodiversity sensitivity criterion, the site habitats are categorized into low and moderate biodiversity values for this site. None of the habitat types is critically sensitive or highly sensitive. Two moderate habitat types are outcrops and riverbeds. The table of habitats and their sensitivity ratings are presented below.

**Table 10: Biodiversity Sensitivity Rating for habitat types**

<b>Habitat Type</b>	<b>Biodiversity Sensitivity</b>
1. Outcrops	Moderate
2. Dune veld	Low
3. Karoo Plains	Low
4. Dry riverbeds	Moderate
5. Open Thornveld	Low

None of the habitat types are critically sensitive or of high sensitivity. Two of the habitat types are moderately sensitive, Outcrops and riverbeds.

**Figure 11: Biodiversity Sensitivity Map**



### 16.3 Biodiversity Impact Assessment Score

The Biodiversity impact assessment score is a calculated index score between zero and eighty (0-80). The score is assessed for each biodiversity impact. Consequences can be positive and negative.

The biodiversity impact assessment of activities related to the prospecting project is tabled below. The greatest impacts without mitigation measures is the impacts on groundwater, specifically hydrocarbon pollution during drilling followed by sensitive habitat loss, specifically the Lithops habitat that is localized and can be destroyed in totality. The third highest impact is rehabilitation – this is a positive impact and is indicated here as a minimum requirement for additional mitigation measures added to increase this positive impact.

Loss of vegetation cover and loss of topsoil is two interrelated top five impacts. It is definite that these impacts will take place, albeit at small scale. The impact is considered long term in this ecosystem as soil loss may be permanent, and vegetation cover can take many years to return if it does return.

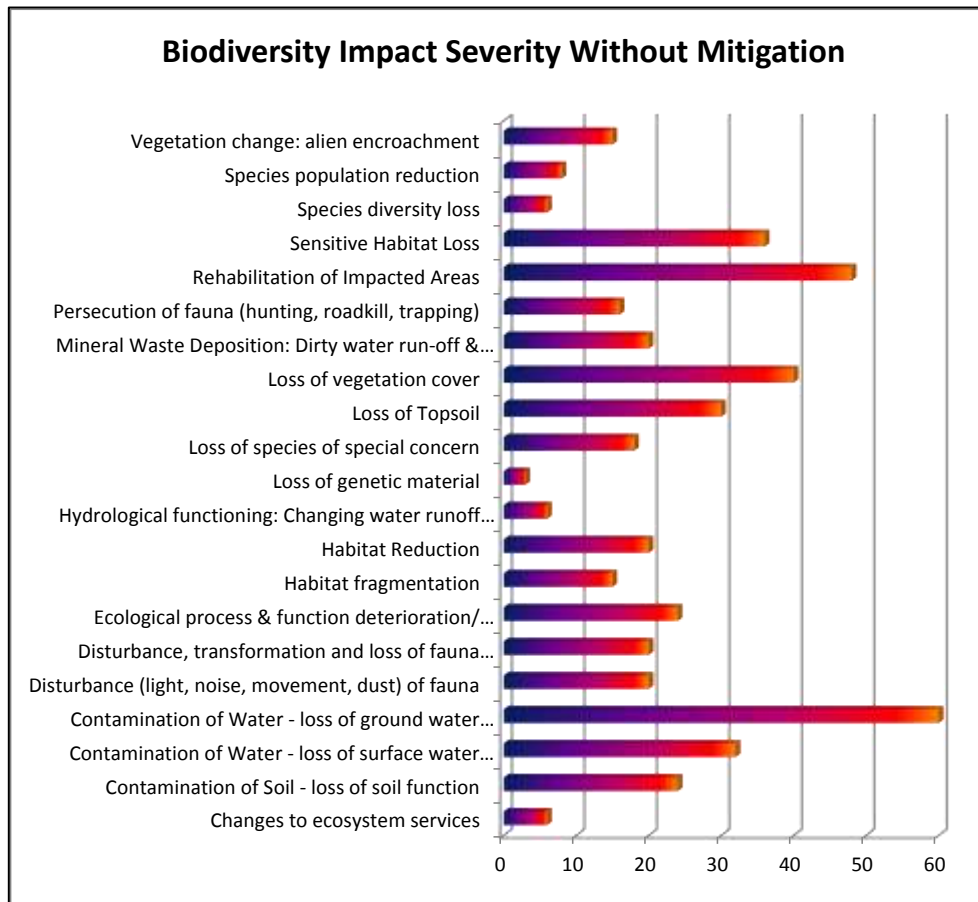


Figure 12: Biodiversity Impact Graph

**Table 11: Biodiversity Impact Assessment Detail**

IMPACT	CONSEQUENCE OF IMPACT			LIKELIHOOD
	Type	Duration	Scale	Severity
Changes to ecosystem services	1	1	1	2
Contamination of Soil - loss of soil function	2	1	3	4
Contamination of Water - loss of surface water function	3	1	4	4
Contamination of Water - loss of ground water function	5	1	6	5
Disturbance (light, noise, movement, dust) of fauna	1	1	2	5
Disturbance, transformation and loss of fauna habitat	1	1	2	5
Ecological process & function deterioration/ breakdown	3	1	2	4
Habitat fragmentation	2	1	2	3
Habitat Reduction	3	1	1	4
Hydrological functioning: Changing water runoff patterns.	1	1	1	2
Loss of genetic material	1	1	1	1
Loss of species of special concern	1	1	4	3
Loss of Topsoil	3	1	2	5
Loss of vegetation cover	4	1	3	5
Mineral Waste Deposition: Dirty water run-off & Dust	2	1	2	4
Persecution of fauna (hunting, roadkill, trapping)	1	1	2	4
Rehabilitation of Impacted Areas	3	1	8	4
Sensitive Habitat Loss	4	1	4	4
Species diversity loss	1	1	1	2
Species population reduction	1	1	2	2
Vegetation change: alien encroachment	1	1	3	3



## 17 Mitigation Measures

The significance of the impacts is directly affected by the success of the mitigation measures implemented and the concurrent rehabilitation success for the site. Recommendations to mitigate the impacts to the fauna, flora and ecosystems include the following:

### 17.1 Changes to ecosystem services

- ◆ Limited mitigation options are available to rectify ecosystem services, except to ensure the listed ecosystem services are returned to site as part of the rehabilitation objectives for the site.

### 17.2 Contamination of Soil - loss of soil function

- ◆ The implementation, monitoring and management of hydrocarbons on site are critical to prevent soil contamination.
- ◆ Where sludge or chip run-off and mineralization of soils take place because of drilling the mitigation measures is requires the protection and management of topsoil as if hard construction is planned. Topsoil should be removed, stored and replaced after impact.
- ◆ In order to minimize the disturbed area and disturbance impact the project should be completed as soon as possible and return to a state of recovery before the next rain season.
- ◆ The prospecting site and loose material will not be exposed to rain resulting in excessive erosion, siltation and general disturbance down slope.

### 17.3 Contamination of Water - loss of surface water function

- ◆ Avoid drilling within the 100 meter buffer area as required by the department of water affairs. Where these areas cannot be avoided, site specific impact and remediation plans should be compiled.
- ◆ Where sludge or chip run-off and mineralization of soils take place because of drilling the mitigation measures is requires the protection and management of topsoil as if hard construction is planned. Topsoil should be removed, stored and replaced after impact.
- ◆ In order to minimize the disturbed area and disturbance impact the project should be completed as soon as possible and return to a state of recovery before the next rain season.

### 17.4 Contamination of Water - loss of ground water function

- ◆ Indirect impacts on biodiversity because of ground water contamination successfully are mitigated.

### 17.5 Disturbance (light, noise, movement, dust) of fauna

- ◆ All species of special concern is retained as far as possible (avoid removing listed plants and trees).
- ◆ Where alien species are encountered they are removed.
- ◆ Existing roads should be used as far as possible.
- ◆ Drill camp establishment should not be allowed in the veld, but should be constructed temporarily at a demarcated area historically disturbed. Preferably areas used for similar function.
- ◆ All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises, as well as to minimize dust generation.

- ◆ Any fauna directly threatened by the construction activities should be removed to a safe location by the responsible person from the Environmental team.

### 17.6 Disturbance, transformation and loss of fauna habitat

- ◆ Mitigation measures for vegetation habitats apply to fauna habitats. The focus however is on fauna functional habitats such as the rivulets. Drilling in these areas should be avoided where possible.

### 17.7 Ecological process & function deterioration/ breakdown

- ◆ No fires should be allowed on-site.
- ◆ No fuel wood collection should be allowed on-site
- ◆ Where possible corridors dividing different habitat types should be retained as far as possible.

### 17.8 Habitat fragmentation

- ◆ Habitat fragmentation (by cross cutting any one habitat type) should be avoided as far as possible.
- ◆ Where possible corridors dividing different habitat types should be retained as far as possible.

### 17.9 Habitat Reduction

- ◆ All vehicles and machines to remain on demarcated roads and access routes.
- ◆ Avoidance and reduced activity (in terms of activities, extent and duration) should be applied to highly sensitive ecological areas as mapped on the sensitivity mapping.
- ◆ Similar habitats should be sought to compensate for the loss of sensitive habitats. Where this is not possible, avoidance should be the first course of action.

### 17.10 Hydrological functioning: Changing water runoff patterns.

- ◆ The runoff patterns at this site are seen as mobile and temporary in nature and are expected to continue after impact. Hydrological functioning will only be interrupted temporarily.
- ◆ The indirect impacts of changed hydrological impacts cannot be fully mitigated.
- ◆ The changed patterns should consider fauna habitat use and flora niche establishment in its design and ensure clean water runoff as quickly as possible.

### 17.11 Loss of genetic material

- ◆ Avoid the removing of sensitive species.
- ◆ Where listed and endemic species are removed, it is recommended that seed of all of the listed protected species should be collected and stored at a recognized seed bank for future access (Kew Gardens).

### 17.12 Loss of species of special concern

- ◆ Any nationally protected trees within close proximity of the development footprint to be identified as no-go areas or special permits obtained to remove the trees as soon as it becomes apparent the destruction of specimens cannot be avoided.
- ◆ No impact on specimens may take place before such permits are obtained. All obligations of such permits must be adhered to.

### 17.13 Loss of Topsoil

- ◆ Any temporary disturbance that will result in topsoil structure, chemical, texture changes should also be collected and stored.
- ◆ Along areas with deep sandy soils additional volumes of topsoil should be put aside and replaced after disturbance.
- ◆ A topsoil management procedure indicating demarcated areas, storage methods and maintenance plans should be compiled to ensure as much topsoil as possible is secured.
- ◆ This topsoil management procedure should be given to all staff on site to ensure compliance.

### 17.14 Loss of vegetation cover

- ◆ Vegetation loss results in numerous impacts downstream. Vegetation loss should be restored as quickly as possible on affected areas.
- ◆ A concurrent rehabilitation plan for permanent (permanent drill platforms or trenches) infrastructure and temporary infrastructure (laydown areas, trenches) should be in place, implemented and monitored for compliance.
- ◆ Vegetative material should be used for rehabilitation, as brush packing and seed dispersal mechanism where rehabilitation is taking place.

### 17.15 Mineral Waste Deposition: Dirty water run-off & Dust

- ◆ Mineral waste deposits (sludge and chips) should be covered with vegetative cover as soon as possible to ensure dust and dirty (high total dissolved solids and mineral content) water runoff impacts are reduced.

### 17.16 Persecution of fauna (hunting, road kill, trapping)

- ◆ The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden.
- ◆ Personnel should not be allowed to wander away from the construction area into the natural veldt.
- ◆ Perimeter of the site must be monitored for illegal trapping.

### 17.17 Rehabilitation of Impacted Areas

- ◆ Rehabilitation in itself can result in additional impacts.
- ◆ Rehabilitation should be done according to similar vegetation diversity, vegetation cover constituency as described by the baseline.
- ◆ Rehabilitation should be monitored using Landscape Functional Analysis to ensure the rehabilitation efforts can be quantified as successful.
- ◆ Rehabilitation maintenance is required until the rehabilitation is self-sufficient.
- ◆ It is required that palatable grazing seed is re-established on impacted areas where rehabilitation takes place.

### 17.18 Sensitive Habitat Loss

- ◆ The loss of the sensitive habitats must be avoided.

### 17.19 Species diversity loss

- ◆ All species of special concern is retained as far as possible and where alien species are encountered they are removed.
- ◆ Any nationally protected trees within close proximity of the development footprint to be identified as no-go areas or special permits obtained to remove the trees, meeting the obligations of such permits issued.

### 17.20 Species population reduction

- ◆ All species of special concern is retained as far as possible and impacts avoided as far as possible.
- ◆ Where areas are demarcated for known populations of listed species, the number of specimens that could be impacted should be declared. The mitigation plan to avoid and reduce the total impact should be presented before drilling.
- ◆ Any nationally protected trees within close proximity of the development footprint to be identified as no-go areas or special permits obtained to remove the trees, meeting the obligations of such permits issued.

### 17.21 Vegetation change: alien encroachment

- ◆ Alien vegetation monitoring and maintenance should be in place for the site during operation and during the rehabilitation phase of the project.
- ◆ During operation and rehabilitation directly impacted areas will be cleared of alien / encroaching vegetation.

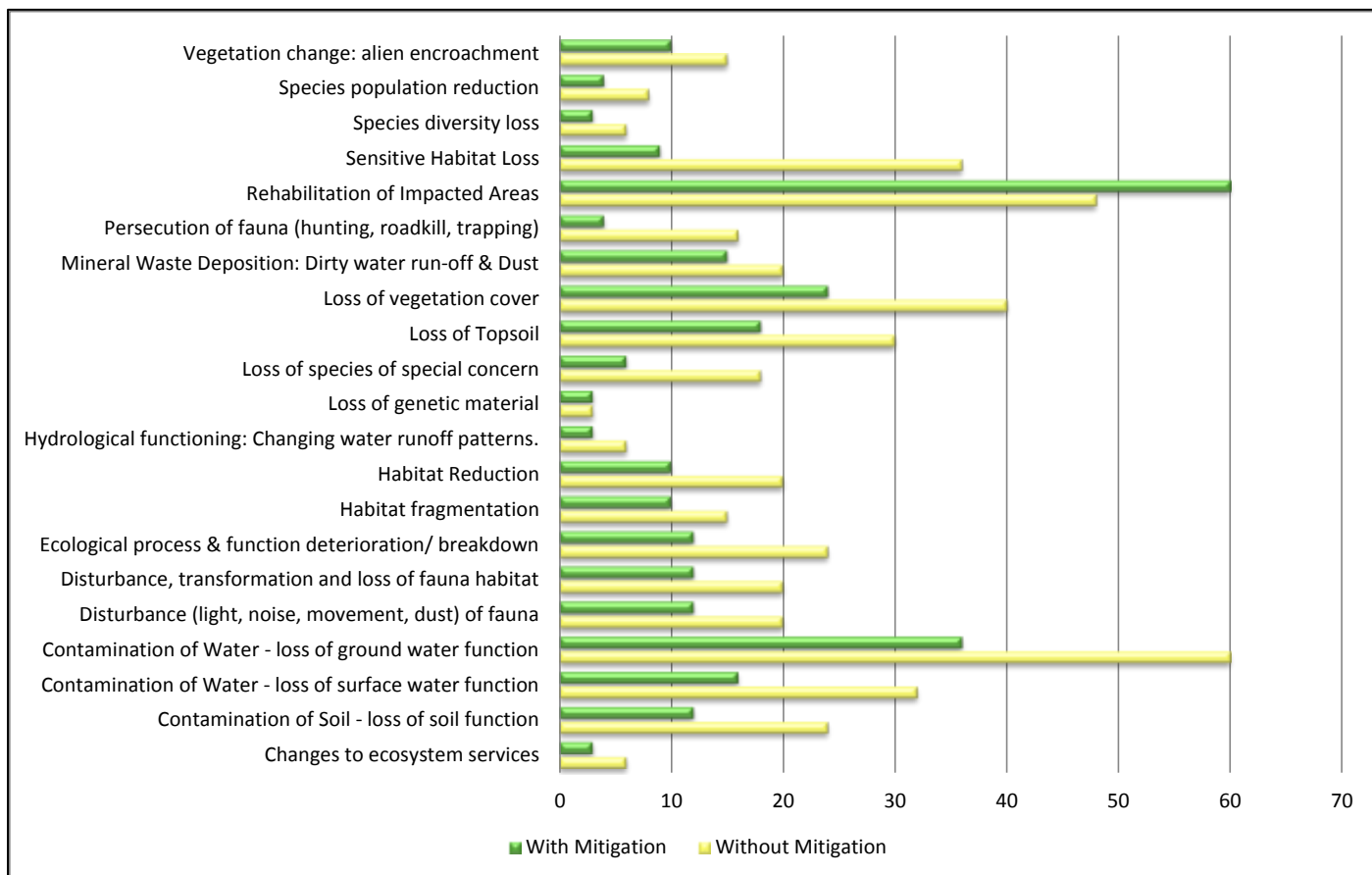
### 17.22 General Mitigation Conditions

- ◆ The selection of laydown areas will consider already disturbed areas first.
- ◆ All construction staff should undergo an environmental induction from a suitably qualified person regarding the importance of footprint management.
- ◆ Any rubble, waste, building materials and litter must be removed from the site as soon as possible.
- ◆ No temporary accumulation of materials or waste is allowed for more than 90 days.
- ◆ All hazardous materials should be stored in the appropriate manner to prevent contamination of the site.
- ◆ Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.

### 18 Impact Summary

The summary of the impact statement considering the above mitigation measures are applied is graphed and tabled below.

**Table 12: Comparative table indicating impacts with and without mitigation measures**



**Table 13: Summary of Impacts with mitigation measures successfully implemented**

IMPACT	SIGNIFICANCE
Type	With Mitigation
Changes to ecosystem services	3
Contamination of Soil - loss of soil function	12
Contamination of Water - loss of surface water function	16
Contamination of Water - loss of ground water function	36
Disturbance (light, noise, movement, dust) of fauna	12
Disturbance, transformation and loss of fauna habitat	12
Ecological process & function deterioration/ breakdown	12
Habitat fragmentation	10
Habitat Reduction	10
Hydrological functioning: Changing water runoff patterns.	3
Loss of genetic material	3
Loss of species of special concern	6
Loss of Topsoil	18
Loss of vegetation cover	24
Mineral Waste Deposition: Dirty water run-off & Dust	15
Persecution of fauna (hunting, roadkill, trapping)	4
Rehabilitation of Impacted Areas	60
Sensitive Habitat Loss	9
Species diversity loss	3
Species population reduction	4
Vegetation change: alien encroachment	10

## 19 Summary and Conclusion

Primarily most of the area is well represented in the landscape and of low biodiversity sensitivity.

The more (moderately) biodiverse sensitive areas are outcrop and riverbed habitats.

The top five impacts that the prospecting project team should manage include ground water contamination, rehabilitation (positive impact), vegetation loss, soil loss and sensitive habitat loss.

The implementation of the mitigation measures reduces the total impact of the project to an impact index of 13 from an original score of 22.

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