FLORAL, FAUNAL, WETLAND AND AQUATIC ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED CONSTRUCTION OF A FERROCHROME SMELTER NEAR NORTHAM, LIMPOPO PROVINCE

Prepared for

SLR Consulting (Africa) (Pty) Ltd.

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SECTION B – Floral Assessment

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, wetland and aquatic ecological assessment as part of the environmental assessment and authorisation process for the proposed construction of a new ferrochrome (FeCr) Smelter located immediately adjacent to the existing Union Section Mine on Portion 3 of the farm Grootkuil 409 KQ, in the Thabazimbi Local Municipality, Limpopo Province. The proposed Siyanda ferrochrome smelter (hereafter referred to as the 'Project Infrastructure Area'), which will in broad terms comprise a railway siding, a raw materials offloading area, two 70 MW DC furnaces, crushing and screening plant, slag dump and baghouse slurry dam, as well as related facilities such as material stockpiles, workshops, stores and various support infrastructure and services, is located within the western portion of Portion 3 of the farm Grootkuil 409 KQ. In addition, an overhead powerline as well as one access road is proposed, with two access road alternatives, namely Access Road Corridor Option 2 and Access Road Option 3, being considered for development. The proposed powerline will originate from the Spitzkop substation to the southeast of Portion 3 of the farm Grootkuil 409 KQ, run north towards the southeastern corner of Portion 3 of the farm Grootkuil 409 KQ and from there extend along the southern boundary of the property towards the Project Infrastructure Area. The proposed Project Infrastructure Area, together with the proposed powerline and the two access road alternatives, of which only one will be developed, are hereafter referred to as the 'project site' (Figures 1 & 2). As part of the ecological assessment, the remainder of Portion 3 of the farm Grootkuil 409 KQ was also assessed, and, together with the project site, is hereafter referred to as the 'study area'.

The Project Infrastructure Area is situated approximately 10km to the west of the R510 regional road and 8km to the northwest of the town of Northam, and approximately 1,5km to the south of the Brits Road. The Swartklip Mine Village (developed as part of the Union Section Mine) is located immediately to the southwest of the Project Infrastructure Area.

2 GENERAL SITE SURVEY

Two field assessments were undertaken, one during April 2015 (Autumn/ Late Summer) and one during August 2015 (Late Winter), in order to determine the ecological status of the Project Site and the remainder of Portion 3 of the farm Grootkuil 409, which together

comprise the study area. Additional field assessments were completed in December 2015 and July 2016 respectively to assess the two access road development alternatives, namely Access Road Corridor Option 3 and Access Road Option 2. A reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the study area and, following this, specific study sites were selected that were considered to be representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support floral Species of Conservational Concern (SCC). Sites were investigated on foot in order to identify the occurrence of the dominant plant species and habitat diversities.

3 FLORAL ASSESSMENT METHODOLOGY

3.1 Floral Species of Conservation Concern

Prior to the field assessment, a record of floral Red Data Listed (RDL) species and their habitat requirements was acquired from the South African National Biodiversity Institute (SANBI) for the 2427CC Quarter Degree Square (QDS) (available on request). According to the SANBI database, no RDL floral species are listed for this QDS and therefore the Probability of Occurrence (POC) for RDL floral species has not been determined.

Background to the international, national and provincial RDL floral species and other floral SCC is provided in the section below.

3.1.1 IUCN and SANBI RDL Categories

According to www.redlist.sanbi.org, South Africa uses the internationally endorsed International Union for the Conservation of Nature (IUCN) Red List Categories and Criteria in the Red List of South African plants. This scientific system is designed to measure species' risk of extinction, with the purpose of highlighting those species that are most urgently in need of conservation action.

The assessments contained in the Red List of South African plants are regional or national assessments, which mean that if a plant species is not endemic to South Africa, only that part of the species' distribution range falling within South Africa was evaluated in the assessment. Therefore, a species' status on the national Red List may differ from its global status on the IUCN Red List. Non-IUCN, national Red List categories for species not in

danger of extinction, but considered of conservation concern are also included, with the IUCN equivalent of these categories being Least Concern (LC).

Table 1: National Red List Categories – Version 2014.1 as supplied by SANBI.

Category	Definition
Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died.
Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
Critically Endangered, Possibly Extinct (CE PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
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.
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.
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.
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.
***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.
***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. The four criteria are as follows: • Restricted range: Extent of Occurrence (EOO) <500 km^2, OR • Habitat specialist: Species is restricted to a specialised microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km^2, OR • Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR • Small global population: Less than 10 000 mature individuals.
***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.
Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
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.
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.

*Categories marked with * are non-IUCN, national Red List categories for species not in danger of extinction, but considered to be of conservation concern. The IUCN equivalent of these categories is Least Concern (LC).

Threatened species are those species that are currently facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species.

SCC are species that have a high conservation importance in terms of conserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining, Data Deficient – Insufficient Information (DDD) and Data Deficient – Taxonomically Problematic (DDT) (www.redlist.sanbi.org).

3.1.2 National Environmental Management: Biodiversity Act (Act 10 of 2004) National Threatened or Protected Species Regulations, 2013

Chapter 4, Part 2 of the National Environmental Management: Biodiversity Act (NEMBA; Act 10 of 2004) provides for listing of Threatened or Protected Species (TOPS). If a species is listed as threatened, it must be further classified as critically endangered, endangered or vulnerable. The Act defines these classes as follows:

- Critically Endangered species: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future;
- Endangered species: 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 species: 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 will include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as Restricted Activities, are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling.

3.1.3 National Forests Act (Act 84 of 1998) Protected Tree Species

Section 15(1) of the National Forests Act (Act 84 of 1998) provides a list of protected tree species. According to this Act protected tree species may not be cut, disturbed, damaged or destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the Department of Water and Sanitation (DWS) or a delegated authority. Applications for such activities should be made to the responsible official in each province. Each application is evaluated on merit (including site visits) before a decision is taken whether or not to issue a licence (with or without conditions). Such decisions must be in line with national policy and guidelines.

3.1.4 Limpopo Environmental Management Act (Act 7 of 2003)

The Limpopo Environmental Management Act (LEMA; Act 7 of 2003) provides for the protection of indigenous plants. Under this Act no person may without a permit:

- Pick, be in possession of, sell, purchase, donate, receive as a gift, import into, export or remove from the Province, or convey:
  - A specially protected plant; or
  - A protected plant.
- Pick any indigenous plant:
  - On a public road;
  - On land next to a public road within 100m measured from the centre of the road;
  - Within an area bordering any natural watercourse, whether wet or dry, up to and within a distance of 50m from the high watermark on either side of the natural watercourse; or
  - In a Provincial Park, a site of Ecological Importance or a Protected Natural Environment.

Schedule 11 of the Act lists Specially Protected Pants and Schedule 12 lists Protected Plants for the Limpopo Province.

3.2 Vegetation Surveys

Vegetation surveys were undertaken by first identifying different habitat units and then analysing the floral species composition. Vegetation analyses were conducted within areas that were perceived to best represent the various floral communities. Species were recorded and a species list was compiled for each habitat unit. These species lists were also

compared with the vegetation expected to be found within the relevant vegetation type as described in Section A, which serves to provide an accurate indication of the ecological integrity and conservational value of each habitat unit.

As part of the vegetation survey, walkdowns of the proposed powerline alignment and new access road were conducted in order to identify floral SCC along these alignments.

3.3 Vegetation Index Score

The Vegetation Index Score (VIS) was designed to determine the ecological state of each habitat unit defined within an assessment site. This enables an accurate and consistent description of the Present Ecological State (PES) concerning the project area in question. The information gathered during the assessment also contributes towards the sensitivity mapping, leading to a more truthful representation of ecological value and sensitive habitats.

Each defined habitat unit is assessed using separate data sheets (Appendix A) and all the information gathered then contributes to the final VIS score. The VIS is derived using the following formulas:

VIS = [(EVC) + (SI x PVC) + (RIS)]

Where:

1. **EVC** is extent of vegetation cover;
2. **SI** is structural intactness;
3. **PVC** is percentage cover of indigenous species and
4. **RIS** is recruitment of indigenous species.

Each of these contributing factors is individually calculated as discussed below. All scores and tables indicated in blue are used in the final score calculation for each contributing factor.

1. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score						
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	Present state*	Perceived reference state**	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								
Clumped								
Scattered								
Sparse								

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS						
RIS Score	0	1	2	3	4	5

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

4 RESULTS OF FLORAL INVESTIGATION

Vegetation associated with the study area is comprised of four broad habitat units, namely the Bushveld Habitat Unit, the Wetland/ Riparian Habitat Unit, the Secondary Bushveld Habitat Unit and the Transformed Habitat Unit.

The Bushveld Habitat Unit covers the majority of the study area, specifically within Portion 3 of the farm Grootkuil outside of the Project Infrastructure Area and comprises vegetation that is in a largely natural condition. The most significant impact on the Bushveld Habitat Unit is grazing by livestock, which has particularly impacted on the graminoid layer. Due to differences in soil types and local topography within the study area, which play a role in determining floral species composition, four sub-habitat units have been identified within this habitat unit, namely:

- Sandy Thorn Bushveld. A high abundance of *Vachellia erioloba* (Camel thorn) trees is present within this habitat unit;
- Plains (low-lying) Thorn Bushveld, which plays an importance role in flood control and management within the study area;
- Turf Thorn Bushveld; and
- Mixed Bushveld (Figure 1).

The Wetland/ Riparian Habitat Unit is associated with various drainage lines within the study area, including a wetland feature within the west in the vicinity of the Proposed Infrastructure Area and two rivers, namely the Brakspruit (and its associated tributaries) and the Phufane Rivers located within the centre of the study area. In addition, an ephemeral depression is present, as well as several off-channel artificial dams.

The Secondary Bushveld Habitat Unit includes those areas that have been previously cultivated, but comprising vegetation that has since re-established naturally to some degree, while The Transformed Habitat Unit includes all areas within the study area that have been impacted by existing infrastructure development such as residential buildings, existing powerlines and access roads, as well as existing agricultural lands. No natural habitat is present within these areas and the Proposed Infrastructure Area is located largely within this habitat unit.

Each habitat unit mentioned above is described in detail in the sections below and the approximate localities of the various habitat units are illustrated in Figure 1 below.

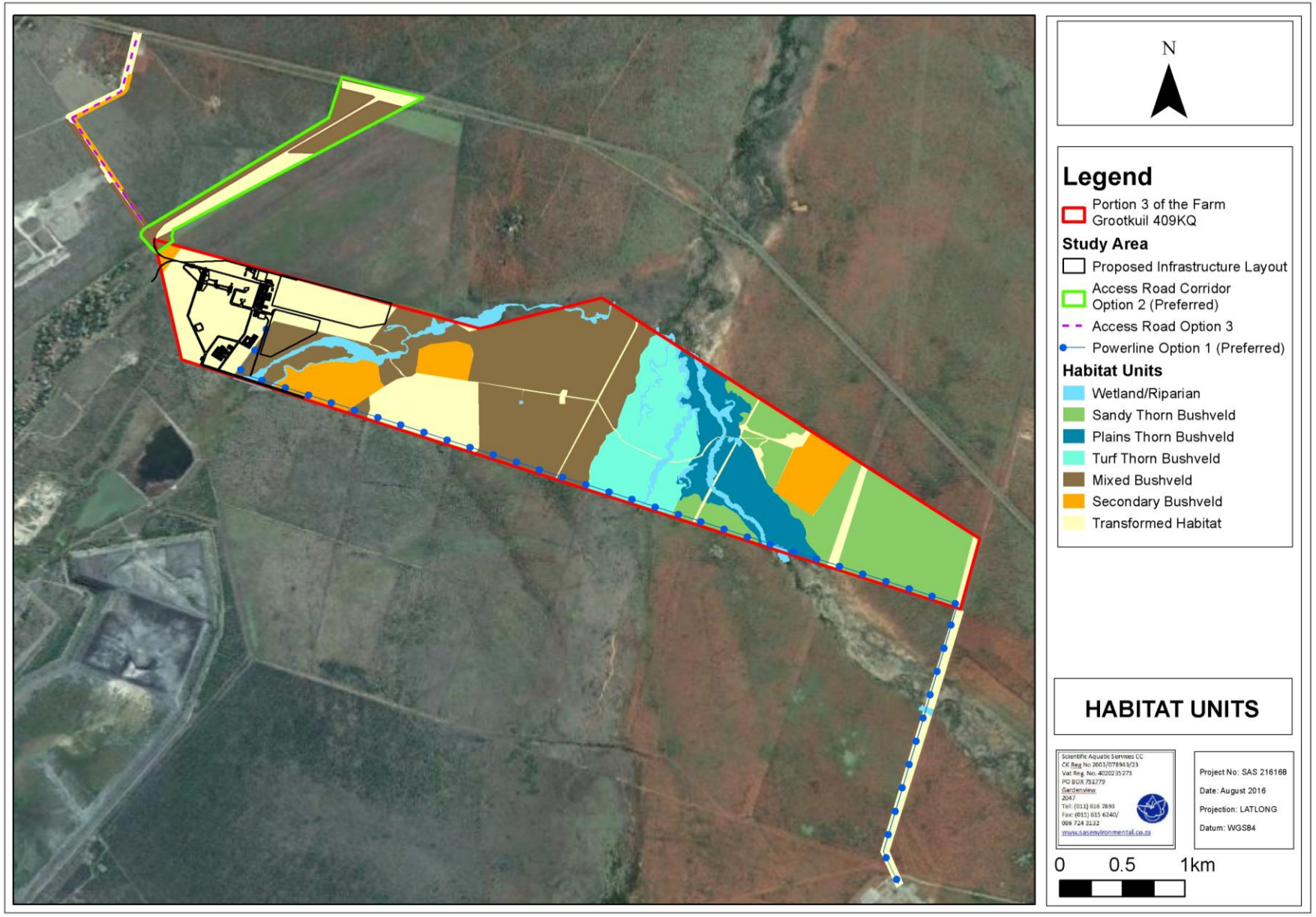

Figure 1: Habitat units identified within the study area.

4.1 Habitat Unit 1: Bushveld Habitat Unit

The Bushveld Habitat Unit, consisting of thornveld with an open savannah vegetation structure is representative of the majority of the study area. The proposed powerline alignment, as well as both access road alternatives, includes sections of this habitat unit, with the proposed Project Infrastructure Area marginally also encroaching into this habitat unit.

This habitat unit comprises areas with deep sandy soils, as well as areas with black turf soils, which has led to some variance in terms of floral species composition and vegetation structure within the habitat unit. The dominant floral species however remain consistent throughout the study area and therefore the species list provided in this section is for the entire habitat unit, with specific vegetation properties characteristics, which play a role in defining the ecological sensitivity of each sub-habitat unit described in the sections that follow (Section 4.1.1 – 4.1.4).

Dominant graminoid species present within the Bushveld Habitat Unit include *Digitaria eriantha, Cymbopogon plurinodis, Eragrostis curvula, E. lehmanniana* and *Heteropogon contortus,* as well as grasses such as *Chloris gayana, Dicanthium annulatum, Aristida bipartita* and *Melinis repens* within overgrazed areas.

The forb community present within this habitat unit includes species such as *Aloe greatheadii* var *davyana, Lycium cinereum, Ammocharis coranica, Asparagus suaveolens, Clematis brachiata, Commelina erecta, Crabbea hirsuta, Elephantorrhiza elephantina, Corbichonia decumbens* and *Commicarpus pentandrus* with alien floral species such as *Tagetes minuta, Sesbania bispinosa, Alternanthera pungens, Datura ferox, Opuntia ficus-indica, Tribulus terrestris, Zinnia peruviana* and *Hibiscus trionum* also present.

One floral SCC species listed in terms of LEMA (Act 7 of 2003), namely *Scadoxus puniceus* was encountered within the Bushveld Habitat Unit outside of the Project Site and it is highly likely that *Boophane disticha* (listed by SANBI as 'Declining') will be present within the remainder of Portion 3 of the farm Grootkuil 409 KQ. *B. disticha* is absent from the proposed Project Infrastructure Area, but should it be identified within the proposed powerline or access road footprint areas, it is recommended that relocation of such species to similar suitable habitat take place under the supervision of a qualified botanist. No floral SCC listed under the NEMBA TOPS species list were observed.

The woody layer is dominated by thorny, woody species of which the dominant species are *Vachellia karroo,* and *V. tortilis,* with *Senegalia mellifera* subsp. *detinens* also present in high abundance. Other woody species include *Ziziphus mucronata* and *Grewia flava.* Two species protected under the National Forests Act (Act 84 of 1998) were encountered within the Bushveld Habitat Unit, namely *Vachellia erioloba* and *Boscia albitrunca* with suitable habitat for *Sclerocarya birrea* subsp. *caffra* also present, although the latter species was not encountered.

The table below presents the dominant floral species encountered within the Bushveld Habitat Unit during the field assessment.

Table 2: Dominant species encountered in the Bushveld Habitat Unit. Alien species are indicated with an asterisk and floral SCC are indicated in bold.

Grass/sedge/reed species	Forb species	Tree/Shrub Species
Aristida bipartita	**Alternanthera pungens*	*Asparagus laricinus*
Aristida congesta subsp *congesta*	**Bidens pilosa*	***Boscia albitrunca***
Bothriochloa insculpta	**Datura ferox*	*Dichrostachys cinerea*
Chloris gayana	**Helianthus annuus*	*Erhetia rigida*
Cymbopogon plurinodis	**Opuntia ficus-indica*	*Euclea crispa*
Cynodon dactylon	**Sckhuhria pinnata*	*Gardenia volkensii*
Dichanthium annulatum	**Sesbania bispinosa*	*Grewia flava*
Digitaria eriantha	**Tagetes minuta*	*Searsia lancea*
Elionurus muticus	**Tribulus terrestris*	*Senegalia mellifera* subsp *detinens*
Eragrostis curvula	**Zinnia peruviana*	*Sesamothamnus lugardii*
Eragrotis lehmanniana	*Aloe greatheadii* var *davyana*	*Vachellia caffra*
Heteropogon contortus	*Ammocharis coranica*	***Vachellia erioloba***
Ischaemum afrum	*Asparagus suaveolens*	*Vachellia erubescens*
Ischaemum fasciculatum	*Clematis brachiata*	*Vachellia karroo*
Melinis repens	*Commelina erecta*	*Vachellia nilotica*
Panicum maximum	*Commicarpus pentandrus*	*Vachellia tortilis*
Setaria incrassata	*Corbichonia decumbens*	*Ziziphus mucronata*
Setaria sphacelata	*Crabbea hirsuta*	
Sorghum versicolor	*Cucumis hirsutus*	
Themeda triandra	*Dicerocaryum senecioides*	
Urochloa mosambicensis	*Elephantorrhiza elephantina*	
Diheteropogon	*Hemizygia pretoriae*	
Amplectens	*Gladiolus* sp.	
Sehima galpinii	*Indigofera* sp.	
Panicum coloratum	*Ledebouria revoluta*	
	Leonotis leonurus	
	Lycium cinereum	
	Mimulus gracilis	
	Rhynchosia minima	
	Searsia pyroides	
	Scadoxus puniceus	
	Solanum elaeagnifolium	
	Tephrosia purpurea	
	Vernonia oligocephala	
	Viscum rotundifolium	

Livestock grazing activities have impacted on the vegetation structure within the Bushveld Habitat Unit, throughout its extent, to varying degrees, with resulting trampling, exposure of underlying soils, localised bush encroachment and loss of the graminoid layer occurring. In addition, edge effects such as erosion and alien floral species encroachment from access roads and agricultural activities have also been noted, but not to a significant degree and limited to areas immediately adjacent to disturbances.

4.1.1 Sandy Thorn Bushveld

The Sandy Thorn Bushveld habitat (Figure 2) is located within the eastern portion of the study area, outside of the Project Site. The graminoid layer associated with this habitat has been impacted by grazing activities, however overall ecological functioning is considered to be intact. The habitat is dominated by *Grewia flava* and *Vachellia tortilis*, with other floral species such as *Gardenia volkensii*, *V. erubescens* and *Boscia albitrunca* (protected under the National Forests Act (Act 84 of 1998) largely restricted to this habitat. The protected tree, *V. erioloba*, although occurring elsewhere within the Bushveld Habitat Unit, occurs in high abundance within the Sandy Thorn Bushveld habitat.

Figure 2: Representative photographs of the Sandy Thorn Bushveld habitat identified within the study area.

Due to this intact habitat provided by the Sandy Thorn Bushveld habitat, few alien species being present and the high abundance of floral SCC, this habitat is considered to be of an increased (Moderately High) ecological sensitivity. The proposed smelter infrastructure development is unlikely to impact on this habitat and impact from the proposed powerline development will be limited to a linear footprint of 30m in width along the southern border of the study area in the vicinity of the existing boundary fence. *V. erioloba* trees along this alignment was marked through the use of Global Position System (GPS) and in order to

remove these species a permit has to be obtained from the Department of Forestry and Fisheries (DAFF) in terms of the National Forests Act (Act 84 of 1998).

4.1.2 Plains Thorn Bushveld

The Plains Thornveld Bushveld habitat (Figure 3) is primarily associated with the lower-lying valley bottom areas associated with the Phufane River within the centre of the study area. The vegetation within this habitat is less dense than within adjacent bushveld areas and is characterised by bare soils in places with the dominant floral species present including *Ziziphus mucronata*, *Vachellia tortilis* and *Lycium cinerea*.

Figure 3: Representative photographs of the Plains Thorn Bushveld habitat identified within the study area.

Although the Plains Thorn Bushveld habitat is not considered sensitive from a floral perspective, this habitat plays an important role in flood control within this area and is therefore also considered to be of Moderately High ecological sensitivity. The proposed smelter infrastructure development is unlikely to impact on this habitat and impact from the proposed powerline development will be limited to a linear footprint of 30m in width along the southern border of the study area in the vicinity of the existing boundary road. Placement and material selection of powerline support structures within this habitat should be carefully considered, taking occasional flooding into consideration.

4.1.3 Turf Thorn Bushveld

The Turf Thorn Bushveld (Figure 4), located on black, more clayey soils is located within the centre of the study area, in the immediate vicinity of the Brakspruit River and its tributaries. The graminoid layer associated with this sub-habitat unit include is dominated by perennial grass species occurring in a dense sward, including *Ischaemum afrum, Setaria incrassata,*

Sehima galpinnii, and Panicum coloratum. A number of tree species such as *Vachellia tortilis* and *V. karroo,* as well as *Combretum erythorophyllum*, closely associated with the Brakspruit River, occur in this habitat.

Figure 4: Representative photographs of the Turf Thorn Bushveld habitat identified within the study area.

The vegetation structure within the Turf Thorn Bushveld habitat is considered to be largely intact, with few areas of bush encroachment, typical of overgrazing, noted. As a result of this, the increased habitat value for faunal species due to its dense graminoid cover and the location of the Turf Thorn Bushveld to drainage lines, the habitat is considered to be of moderate ecological importance and sensitivity.

The proposed project is unlikely to impact on this habitat and impacts from the proposed powerline development will be limited to a linear footprint of 30m in width along the southern border of the study area in the vicinity of the existing boundary road.

4.1.4 Mixed Bushveld

The Mixed Bushveld habitat (Figure 5) dominates the Bushveld Habitat Unit within the western portion of the study area, in the vicinity of the two access road alternatives as well as in the area surrounding the Proposed Infrastructure Area. The vegetation within this habitat is dominated by *Vachellia* spp., *Grewia flava* and *Ziziphus mucronata*, with occasional protected *V. erioloba* trees also present.

Figure 5: Representative photographs of the Mixed Bushveld habitat identified within the study area.

The Mixed Bushveld habitat has been impacted by grazing activities, in many instances resulting in exposed soils, as well as localized bush encroachment by *V. karroo* in particular, as well as edge effects from adjacent access roads and other disturbances and crop activities. This habitat is considered to have a lowered ecological sensitivity and conservation value due to the alteration of floral species composition and vegetation structure as a result of the abovementioned impacts.

The proposed project may have a limited impact on the Mixed Bushveld Habitat due to this habitat bordering the Proposed Infrastructure Area (with a portion also included), whereas impacts from the proposed powerline development will be restricted to a linear footprint of 30m in width along the southern border of the study area, in the vicinity of the existing boundary road and extending north within this habitat towards the infrastructure area. Development of either of the access road alternatives is also likely to have a limited impact on this habitat unit. The Mixed Bushveld habitat is however well represented within the

region and the proposed project will not significantly impact on floral conservation in the region.

4.2 Habitat Unit 2: Wetland/ Riparian Habitat Unit

The Wetland/ Riparian Habitat Unit (Figures 6 - 8) is associated with various drainage lines within the study area, including two riparian features, namely the Brakspruit River and its associated tributaries and the Phufane Rivers, both located within the centre of the study area and a wetland feature, with several in-channel impoundments located within its course, in the west.

An ephemeral depression feature, as well as several artificial dams are also located within the study area.

Figure 6: Representative photographs of the Brakspruit River.

Figure 7: Representative photographs of the Phufane River.

Figure 8: Representative photographs of the Wetland feature within the west of the study area.

The vegetation associated with the Brakspruit and Phufane Rivers is of a distinct riparian nature and is dominated by woody species including *Vachellia karroo*, *Combretum erythrophyllum*, *Gymnosporia senegalensis, G. buxifolia, Heteromorpha arborescens, Searsia lancea* and *S. pyroides.* Although not encountered, there is a possibility that the tree species, *Combretum imberbe* (protected under the National Forests Act (Act 84 of 1998)) is present within this habitat unit, as suitable habitat for this species is available.

Forb species encountered within the riparian areas include *Geigeria burkei* var. *elata*, *Gladiolus* sp. and *Nidorella hottentotica*, with the floral SCC *Crinum macowanii* also occurring throughout this habitat unit in relatively low abundance. This species is listed by SANBI as 'Declining' and should this species be encountered within the proposed powerline alignment footprint area in the vicinity of stream crossings, it is recommended that these species be relocated to similar suitable habitat under the supervision of a qualified botanist.

Graminoid species present within the riparian areas include *Heteropogon contortus, Panicum maximum* and *Setaria sphacelata*.

Woody species associated with the temporary zone of the wetland feature within the west of the study area include *Diospyros lycioides*, *V. karroo* and *V. tortilis*. Woody species are largely absent from the permanent and seasonal wetland zones, which is dominated by the graminoid species *Sorghum versicolor* and *Cynodon dactylon*, with several sedges also present. *Sorghum versicolor* , a species associated with disturbance and moist, clay soils, is particularly dominant within the artificial portion of the wetland feature Alien species are prevalent within the wetland habitat and include *Achyranthes aspera, Hibiscus trionum, Persicaria lapathifolia, Rumex crispus, Sesbania bispinosa* and *Verbena bonariensis.*

The dominant floral species encountered within the Wetland/ Riparian Habitat Unit during the field assessment is listed in the table below.

Table 3: Dominant species encountered in the Wetland and Riparian Habitat Unit. Alien species are indicated with an asterisk.

Grass/sedge/reed species	Forb species	Tree/Shrub Species
Aristida bipartita	**Achyranthes aspera*	*Asparagus laricinus*
Brachiaria brizantha	**Conyza bonariensis*	*Coombretum erythrophyllum*
Brachiaria eruciformis	**Datura ferox*	*Diospyros lycioides*
Cymbopogon plurinodis	**Hibiscus trionum*	*Grewia flava*
Cynodon dactylon	**Persicaria lapathifolia*	*Gymnosporia buxifolia*
Cyperus sp.	**Rumex crispus*	*Gymnosporia senegalensis*
Dicanthium annulatum	**Sesbania bispinosa*	*Heteromorpha arborescens*
Digitaria eriantha	**Verbena bonariensis*	*Searsia lancea*
Diplachne fusca	*Acalypha astro-australis*	*Searsia pyroides*
Eragrostis chloromelas	*Becium obovatum*	*Senegalia mellifera* subsp *detinens*
Eragrostis curvula	*Crinum macowanii*	*Tarchonanthus camphoratus*
Fuirena pubescens	*Dicoma anomala*	*Vachellia karroo*
Hemarthria altissima	*Geigeria burkei* var. *elata*	*Vachellia tortilis*
Hyparrhenia hirta	*Gladiolus* sp.	*Ziziphus mucronata*
Panicum maximum	*Nidorella hottentotica*	
Setaria incrassata	*Nymphaea* sp.	
Setaria sphacelata		
Sorghum versicolor		
Sporobolus africanus		

The Wetland and Riparian Habitat Unit is considered to be in a moderately modified condition, with system modifiers including erosion due to grazing, adjacent agricultural activities and road crossings, loss of vegetation cover in places and alien vegetation encroachment, particularly within the wetland feature.

The Wetland and Riparian Habitat Unit is however considered to be of high ecological sensitivity due to the contribution of the various drainage features to faunal migratory connectivity, wetland eco-services provision and the niche habitat provided for faunal and floral species. It is therefore recommended that the wetland and riparian areas and associated buffer zones be considered during the project, with particular reference to stream crossing and the management of edge effects in the vicinity of the proposed smelter.

4.3 Habitat Unit 3: Secondary Bushveld Habitat Unit

The Secondary Bushveld Habitat Unit (Figure 9) is present within the west and east of the study area and with portions of Access Road Option 3 and is associated with historically cultivated land in various stages of succession, with subsequent dominance of secondary bushveld (referring to the reestablishment of indigenous vegetation after clearing/ disturbance of original vegetation has occurred) and altered vegetation composition.

Woody species such as *Vachellia karroo, V. tortilis* and *Senegalia mellifera* subsp. *detinens* dominate this habitat unit with the graminoid layer being characterised by similar grass species as occurring within the Mixed Bushveld habitat.

Figure 9: Representative photographs of the Secondary Bushveld Habitat Unit identified within the study area.

Historical vegetation clearing has led to localised bush encroachment and the presence of alien floral species within this habitat unit, with current grazing activities by livestock also taking place within this area. The Secondary Bushveld Habitat Unit is considered to have a low ecological sensitivity and conservation value due to the alteration of floral species composition and vegetation structure as a result of the abovementioned impacts.

4.4 Habitat Unit 4: Transformed Habitat Unit

A number of transformed areas (Figure 10), primarily associated with existing agricultural activities, residential buildings and outbuildings, livestock camps and access roads are present throughout the study area and also along the proposed access road alternatives to the west and the proposed powerline alignment where it runs in a south-north direction towards the southeast of the study area. Existing access roads and powerlines are present in the latter two areas, which have affected the vegetation structure due to clearing of land for servitudes and maintenance roads.

Typical agricultural weeds including *Datura ferox, Bidens pilosa, Tagetes minuta*, as well as pioneer grass species and grass species associated with disturbance such as *Sorghum versicolor, Cynodon dactylon, Aristida bipartita* and *Heteropogon contortus* dominate existing fallow agricultural lands.

Vegetation in the vicinity of the main residential building within the study area has been significantly transformed, with current vegetation dominated by typical alien garden plants, including *Melia azedarach*, *Schinus mollis, Pinus* spp., *Brachychiton* sp, *Yucca gloriosa*, *Bambusa* sp., and *Agave* spp. In addition to these species, several large protected *V. erioloba* trees are present and care should be taken not to disturb these trees, particularly should access roads in this area be upgraded.

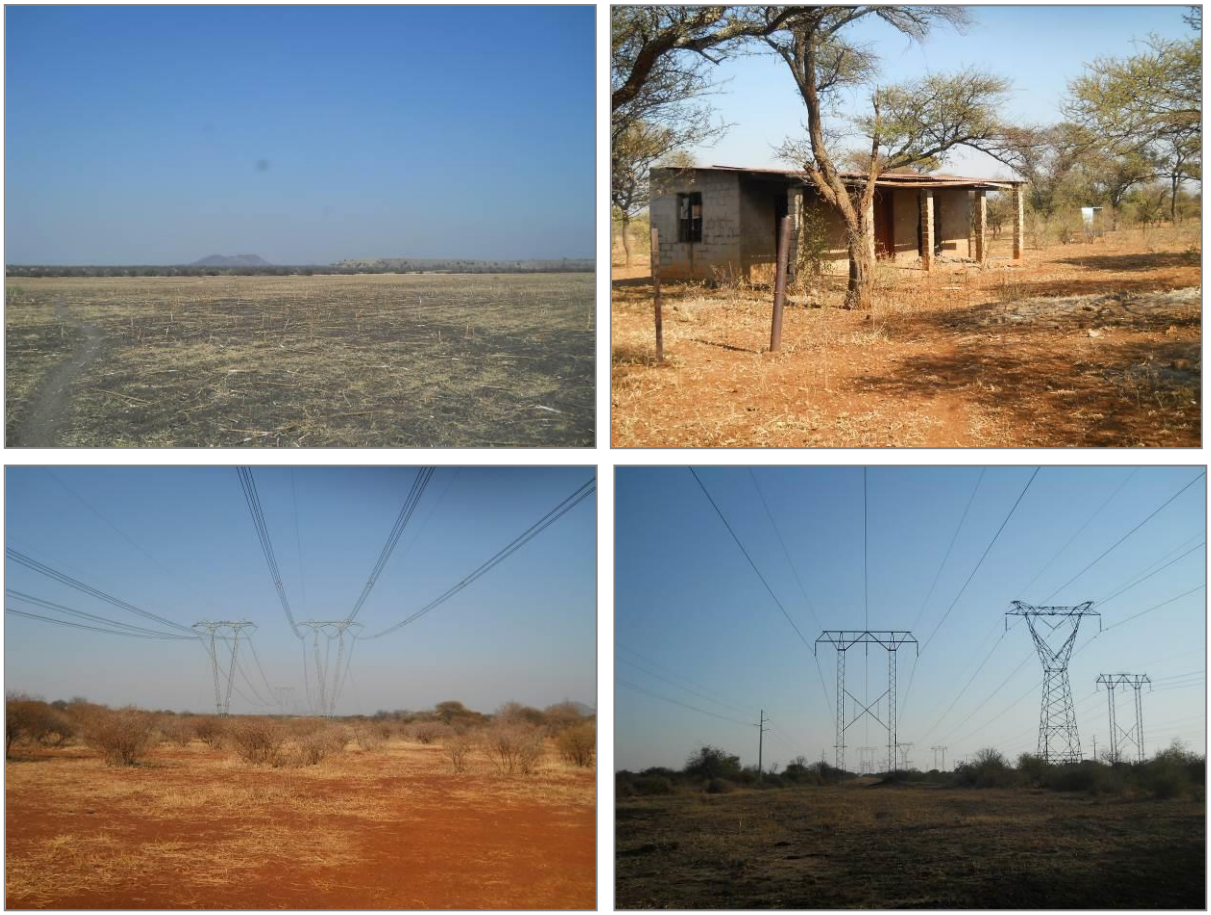

Figure 10: Representative photographs of the Secondary Bushveld Habitat Unit identified within the study area.

The vegetation structure and species composition of the Transformed Habitat Unit have been completely altered, and apart from the occurrence of *V. erioloba* provides limited natural habitat for floral species as such, has low conservation value and ecological sensitivity from a floral perspective.

4.5 Floral Species of Conservation Concern Assessment

An assessment considering the presence of any floral RDL species and other floral SCC, as well as suitable habitat to support any such species, was undertaken. The complete Pretoria Computer Information Systems (PRECIS) RDL floral lists for the QDS references 2427CC

were acquired from SANBI whereby it was found that no RDL species were listed for the QDS.

Two SANBI RDL floral species, listed as 'Declining', namely *Vachellia erioloba* (Camel thorn) and *Crinum macowanii*, were encountered within Portion 3 of the farm Grootkuil 409 KQ and within the proposed powerline development footprint area, but not within the Project Infrastructure Area of within either of the two access road alternatives. *V. erioloba* trees occur scattered, but in low abundance throughout the Bushveld Habitat Unit but is present in high abundance within the Sandy Thorn Bushveld Habitat Unit. No *V. erioloba* trees were encountered within the Project Infrastructure Area or either of the two access road alternatives, but a number of these species have been encountered within the proposed powerline footprint area (Figure 11). All *V. erioloba* trees located along the 30m powerline servitude have been marked through the use of GPS and their locations are indicated in Figure 12 below. It is unlikely that *V. erioloba* will be successfully relocated and should it not be possible to avoid these trees during construction, permits have to be obtained from the Department of Forestry and Fisheries (DAFF) in order to remove all identified trees located within the proposed powerline alignment footprint area. *V. erioloba* is also protected under the National Forests Act (Act 84 of 1998).

Crinum macowanii was encountered within the Wetland/ Riparian Habitat Unit, but was not found within the proposed Project Site. If however, specimens are encountered within the vicinity of the stream crossings associated with the proposed powerline these species should be relocated to nearby suitable, similar riparian or wetland habitat.

One other SANBI RDL floral species that was not encountered within the study area, namely *Boophane disticha* (also listed as 'Declining'), has a high likelihood of occurring within the Bushveld Habitat Unit. Due to the proposed Project Infrastructure Area being located almost in its entirety within the Transformed Habitat Unit, it is unlikely that *B. disticha* will be encountered within this area. If *B. disticha* is however encountered within the proposed powerline alignment or within either of the two access road alternatives, where it is more likely to occur, it is recommended that this species be relocated to similar suitable habitat in the vicinity of the study area, under the supervision of a qualified botanist.

In addition to *V. erioloba*, one other tree species, namely *Boscia albitrunca*, also protected under the National Forests Act (Act 84 of 1998), was encountered within the Sandy Thorn Bushveld habitat. This species is however not located within the proposed Project Site and is therefore unlikely to be impacted by the project. Other protected tree species that have not been encountered within the study area, but which may occur due to suitable habitat being

available within the Wetland/ Riparian and Bushveld Habitat units are *Combretum imberbe* and *Sclerocarya birrea* subsp. *caffra*. These species were not noted within the Project Site and, if present within the remainder of the study area, will not be impacted by the proposed project.

Figure 11: *Vachellia erioloba* trees occurring throughout the Sandy Thorn Bushveld habitat, which occur within the eastern portion of the Bushveld Habitat Unit.

One provincially protected floral species, as stipulated in Section 12 of the LEMA (Act 7 of 2003), namely *Scadoxus puniceus*, was encountered within the Bushveld Habitat Unit. This species is however located outside of the proposed Project Site. No protected floral species as listed under Section 56 (1) d) of the TOPS Regulations under NEMBA (Act 10 of 2004) were encountered in the study area.

Due to the location of the proposed Project Infrastructure Area associated with the smelter almost in its entirety within the Transformed Habitat Unit, it is highly unlikely that these species will be present within its development footprint and none were encountered. However should any species protected under LEMA (Act 7 of 2003) or NEMBA (Act 10 of 2004) have been overlooked during the field assessment and be encountered within the proposed powerline alignment or within the selected access road alternative, authorisation to relocate such species must be obtained from the Limpopo Department of Economic Development, Environment and Tourism (LEDET) or the Department of Environmental Affairs (DEA) respectively.

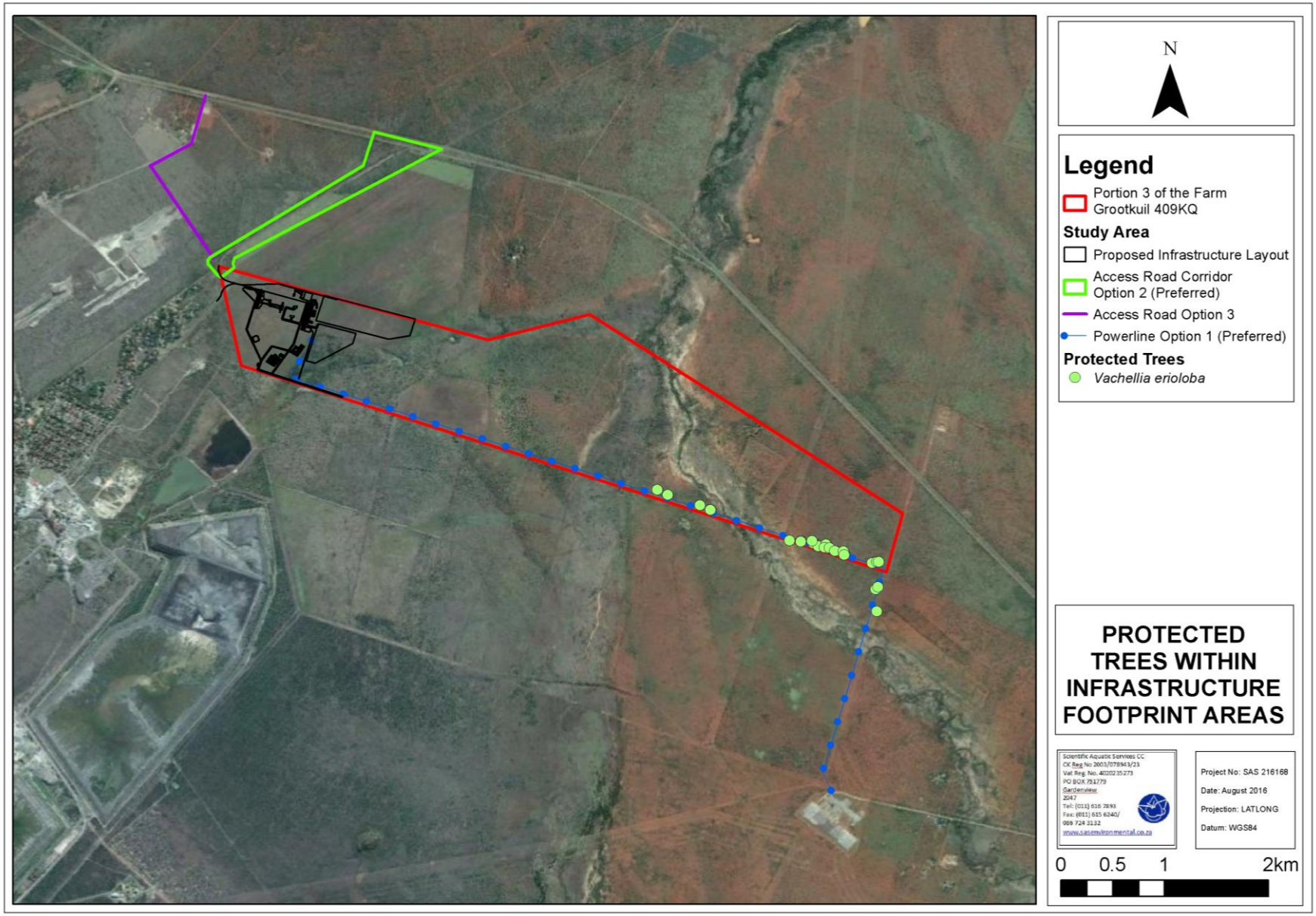

Figure 12: The location of *Vachellia erioloba* trees identified along the proposed powerline alignment.

4.6 Vegetation Index Score

The information gathered during the assessment of the project area was used to determine the Vegetation Index Score (VIS) - see Appendix A for calculations. Due to variation between the different habitat units, the habitat units were assessed separately. The table below indicates the results of the VIS calculations for each habitat unit.

Table 4: Vegetation Index Score.

Habitat unit	Score	Class	Motivation
Bushveld Habitat Unit	18	**Class C – Moderately Modified**	Overall, this vegetation structure and composition with of this habitat unit is relatively intact. Disturbances include edge effects from adjacent agricultural fields and infrastructure as well as ongoing grazing and trampling by livestock.
Wetland/ Riparian Habitat Unit	18	**Class C – Moderately Modified**	The functioning of this habitat unit is largely intact, although some impacts from erosion and vegetation clearance are present.
Secondary Bushveld Habitat Unit	13	**Class D – largely modified**	This habitat unit has been historically under cultivation and is currently in various stages of recovery. Impacts include bush encroachment, alien invasive species encroachment and ongoing grazing and trampling by livestock.
Transformed Habitat Unit	5	**Class E – The loss of natural habitat extensive**	This habitat unit is associated with existing disturbance including agricultural fields and infra and related infrastructure. The ecological functionality and habitat integrity of the Transformed Habitat Unit is regarded as being extremely limited.

4.7 Alien and Invasive Floral Species

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

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing:

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures and
- Increased agricultural input costs (Bromilow, 2001).

During the floral assessment, all alien and invasive floral species were identified and are listed in the table below.

Table 5: Dominant alien vegetation species identified during the field assessment.

Species	English name	Origin	NEMBA Category*
Trees/ Shrubs			
Opuntia ficus-indica	Sweet prickly pear	Central America	1b
Forbs/ Sedges			
Achyranthes aspera	Burweed	Uncertain	N/L
Alternanthera pungens	Khakiweed	South America	N/L
Bidens pilosa	Common blackjack	South America	N/L
Conyza bonariensis	Flax-leaf fleabane	Americas	N/L
Datura ferox	Large thorn-apple	Eurasia	1b
Hibiscus trionum	Bladder hibiscus	Meidterranean	N/L
Persicaria lapathifolia	Spotted knotweed	Europe	N/L
Rumex crispus	Curly dock	Europe	N/L
Schkuhria pinnata	Dwarf marigold	South America	N/L
Sesbania bispinosa	Spiny sesbania	Asia, North Africa	N/L
Tagetes minuta	Tall khakiweed	South America	N/L
Tribulus terrestris	Devil's thorn	Indigenous	N/L
Verbena bonariensis	Purple top	South America	1b
Zinnia peruviana	Redstar zinnia	South America	N/L

N/L = Not Listed and not categorised

*** National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2016**

Category 1a – Invasive species that require compulsory control.

Category 1b – Invasive species that require control by means of an invasive species management programme.

Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

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

From the table above it is clear that although a moderate diversity of alien floral species occur within the study area, the majority of species are not listed as declared invaders, with the exception of *Datura ferox*, *Verbena bonariensis* and *Opuntia ficus-indica* that are listed as Category 1b invaders that require mandatory eradication. Most alien floral species occur throughout the study area with the majority being present within the Wetland/ riparian Habitat Unit and within transformed areas.

4.8 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The table below presents a list of plant species with traditional medicinal value, plant parts traditionally used and their main applications, which were identified during the field assessment. These medicinal species are all commonly occurring species and are not confined to the study area. Floral SCC with medicinal value, such as *Vachellia erioloba* and *Crinum macowanii*, are however considered to be declining in numbers.

Table 6: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009).

Species	Name	Plant parts used	Medicinal uses
Aloe greatheadii var *davyana*	Aloe	Stems and leaves	Decoction of powdered stems and leaf bases is taken orally twice a day after delivery to cleanse the system.
Boscia albitrunca	Shepherd's tree	Root, leaves, fruit	The root is pounded to make porridge. It is commonly used as a substitute for coffee or chicory. The root is also used to make a beer and to treat haemorrhoids. The leaves are nutritious and are often browsed by cattle, although the milk is then said to be tainted. An infusion of the leaves is used to treat eye infections in cattle. The fruits are used in traditional dishes and the flower buds as caper substitutes in pickles. It is said that if the fruits wither before the millet crop is ripe, the harvest will be a failure. Household utensils are made from the wood. If the wood is burnt, it is believed that cows will produce only bull calves.
Crinum macowanii	Crinum	Bulbs and leaves	Remedy for scrofula, micturition and rheumatic fever. Also used for blood cleansing, kidney and bladder diseases, glandular swelling, fever and skin problems.
Datura sp.	Thornapple	Leaves and green fruit	Mainly used to relieve asthma and to reduce pain. Weak infusions are used as hypnotics by the elderly and as aphrodisiacs by adults.
Dichrostachys cinerea	Sickle bush	Root and often stems bark, leaves and pods	Root infusions have been used to treat body pain, backache, toothache, elephantiasis, syphilis, leprosy and as a styptic, diuretic, purgative and aphrodisiac.
Elephantorrhiza elephantina	Elandsbean	Underground rhizomes	Traditional remedy for a wide range of ailments, including diarrhoea and dysentery, stomach disorders, haemorrhoids and perforated peptic ulcers, and as emetics. It is popular for the treatment of skin diseases and acne.
Heteromorpha arborescens	Parsley tree	Mostly roots, sometimes stem bark and leaves	The main use of the plant is to treat scrofula, abdominal pains and colic. It is also widely used to treat nervous system and mental disorders, headaches, fever, shortness of breath, asthma, coughs, dysentery, infertility, weakness and intestinal worms, and for purifying the blood, stomach and kidneys.
Leonotis leonurus	Wild dagga	Mainly the leaves and stems, but also the roots	Widely used as a remedy for snakebite and to treat other bites and stings. Externally, decoctions have also been applied to treat boils, eczema, skin diseases, itching and muscular cramps. Internally, decoctions are also used for coughs, colds and influenza, and also for bronchitis, high blood pressure and headaches.
Rumex sp.	Dock	Roots, sometimes leaves	Traditional remedy for internal parasites. The whole plant is used for vascular diseases and internal bleeding. Applied externally to abscesses, boils and tumours.
Scadoxus puniceus	Snake lily	Bulb	Widely used in traditional medicine to treat coughs and gastro-intestinal problems. It has also traditionally been used as part of a medicine taken regularly during pregnancy to ensure a safe delivery.

Species	Name	Plant parts used	Medicinal uses
Tagetes minuta	Tall khaki bush	Leaves, flowers	The repellent properties of essential oil have been known for a long time and were found to be effective in preventing sheep from becoming infected with blowfly larvae. Many gardeners use warm water extracts of the fresh plant to keep roses and other garden plants free from insects and fungal diseases. The essential oil is used in perfumery and as a flavourant in food, beverages and tobacco.
Tarchonanthus camphoratus	Wild camphor bush	Leaves and twigs	This plant is used to treat stomach trouble, abdominal pain, headache, toothache, asthma, bronchitis and inflammation.
Vachellia erioloba	Camel Thorn	Pods, gum, roots	Dry powdered pods can be used to treat ear infections. The gum can be used for the treatment of gonorrhoea and the pulverized, burned bark can be used to treat headaches. The root can be used to treat toothache. To treat tuberculosis, the root is boiled for a few minutes and the infusion is swirled around in the mouth and spat out (http://www.plantzafrica.com/plantab/acaciaeriol.htm).
Vachellia karroo	Sweet thorn	Bark, leaves and gum	Remedy for diarrhoea and dysentery.
Vernonia oligocephala	Groenamara	Leaves and twigs	Infusions are taken as stomach bitters to treat abdominal pain and colic
Ziziphus mucronata	Buffalo thorn	Roots, bark or leaves used separately or in combination.	Warm bark infusions (sometimes together with roots or leaves added) are used as expectorants (also as emetics) in cough and chest problems, while root infusions are a popular remedy for diarrhoea and dysentery. Decoctions of roots and leaves (or chewed leaves) are applied externally to boils, sores and glandular swellings, to promote healing and as an analgesic.

5 SENSITIVITY MAPPING

Sensitivity mapping

A sensitivity map (Figure 13) was created with the use of the floral and faunal integrity and diversity encountered during the assessment of the study area, as well as taking consideration of the location and extent of wetland and riparian features traversing the area (Figure A). The Wetland/ Riparian Habitat Unit is regarded as being of high ecological sensitivity due to the contribution of the various wetland and riparian features to faunal migratory connectivity, wetland eco-services provision and habitat provision for faunal and floral species. A 32m statutory zone of regulation is also indicated and any activity within this zone will trigger a listed activity in terms of the National Environmental Management Act (NEMA; Act 107 of 1998). As part of the project, the proposed powerline will be required to cross various drainage lines, and in this regard care should be taken to ensure that these infrastructure components cross at existing crossings where possible, to avoid further

impacts on the drainage features. Where this is not possible, it must be ensured that crossings span as far as possible at right angles to the features, with no infrastructure to be placed within the active riparian channels or within the delineated extent of the wetland feature.

The Bushveld Habitat Unit comprises the majority of Portion 3 of the farm Grootkuil 409KQ, which is in a largely natural condition, while the Project Infrastructure Area, as well as the two alternative road alignments are being located predominantly within the Transformed Habitat Unit.

Due to differences in soil types and local topography within the area, which determines species composition, four sub-habitat units have been identified within the Bushveld Habitat Unit, with differing ecological importance, as follows:

- Sandy Thorn Bushveld: this habitat provides largely intact habitat and a high abundance of floral SCC occur in this area. This habitat is considered to be of a Moderately High ecological sensitivity;
- Plains (low-lying) Thorn Bushveld: this habitat plays an important role in flood control within this area and is therefore also considered to be of Moderately High ecological sensitivity;
- Turf Thorn Bushveld: This habitat is considered to be largely intact, provides good habitat for floral and faunal species and is considered to be of Moderate ecological importance and sensitivity; and
- Mixed Bushveld: This habitat is considered to have a lowered ecological sensitivity and conservation value due to the alteration of floral species composition and vegetation structure as a result of the abovementioned impacts.

Both the Secondary Bushveld and the Transformed Habitat Units are considered to have Low ecological sensitivity.

One protected tree species namely *Vachellia erioloba* was encountered along the proposed powerline alignment. The positions of this species, in addition to ecologically sensitive habitat identified, are also presented in the site sensitivity map below.

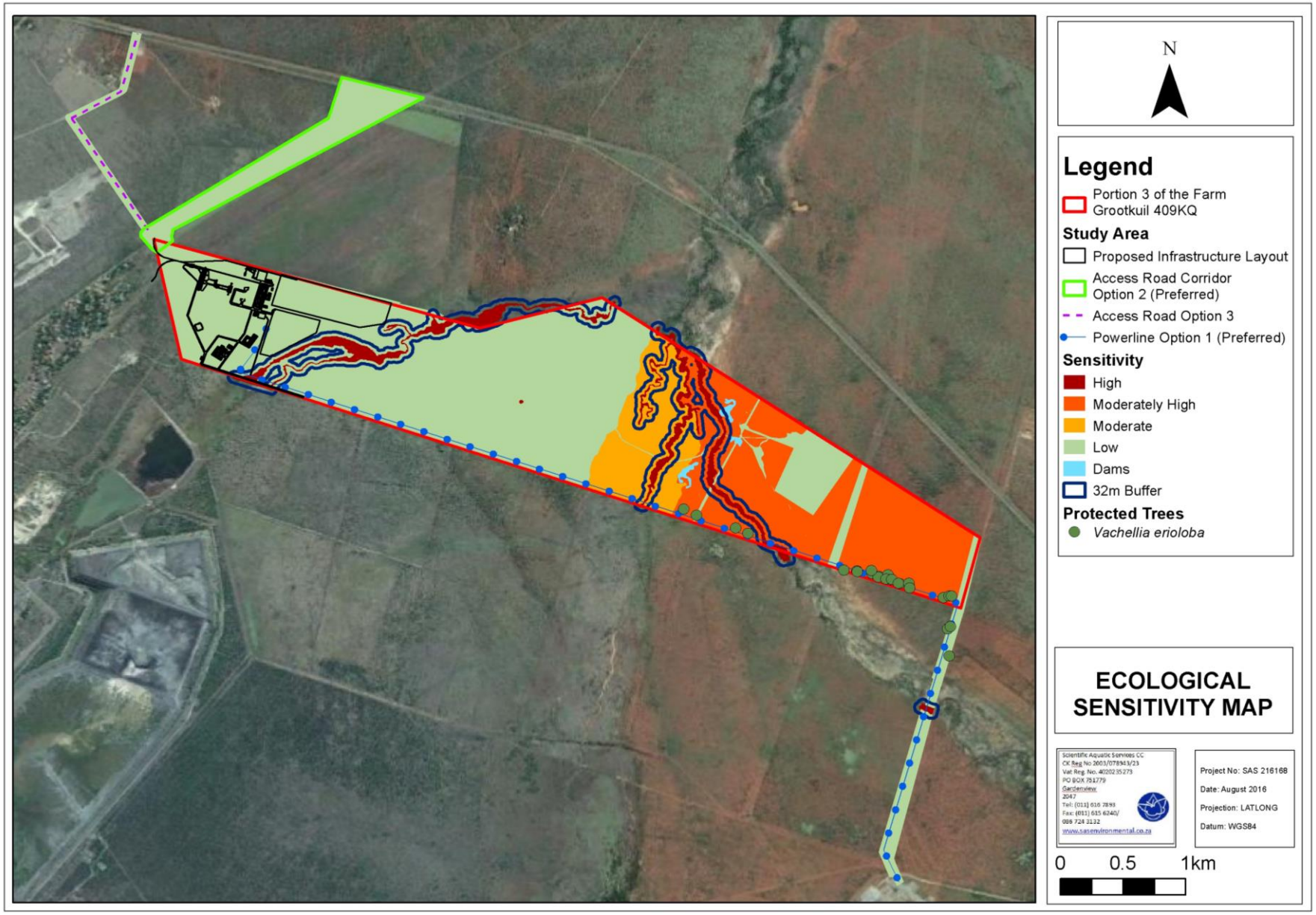

Figure 13: Sensitivity map for the study area.

6 IMPACT ASSESSMENT

The tables below serve to summarise the significance of potential impacts on floral species and habitat that may result due to the proposed development activities. A summary of all potential pre-construction, construction, operational and decommissioning and closure phase impacts is provided after the impact discussion. The sections below present the impact assessment according to the method described in Section A.

In addition, it also indicates the required mitigatory and management measures needed to minimise potential ecological impacts and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures, assuming that they are fully implemented.

General management and good housekeeping practices

- Appropriate sanitation facilities must be provided for the duration of the proposed construction activities and all waste removed to an appropriate facility;
- No dumping of construction materials and soil within Wetland/ Riparian Habitat Unit areas or associated buffers may take place;
- No indiscriminate fires should be allowed within the construction area;
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced to prevent the ingress of hydrocarbons into the topsoil; and
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.

6.1 Impact 1: Impact on Floral Habitat

Activities and aspect registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Design of infrastructure, leading to a larger than expected infrastructure footprint	Site clearing and the removal of vegetation leading to a loss of floral habitat	On-going disturbance of soils due to general operational activities leading to altered floral habitat	Ineffective rehabilitation of exposed and impacted areas and failure to implement a comprehensive alien floral control plan
Inadequate design of infrastructure	Encroachment of construction activities beyond the extent of the proposed project footprint	Increased introduction and proliferation of alien plant species and further transformation of natural habitat	Disturbance of soils as part of demolition activities
	Site clearing and the disturbance and compaction of soils leading to loss of floral habitat	Risk of discharge and contamination from all operational facilities may pollute receiving environment	On-going seepage from operational facilities such as the slag dump may affect the groundwater regime beyond closure
	Movement of construction vehicles and access road construction beyond the project footprint leading to a loss of floral habitat	Runoff and seepage from operational facilities such as the slag dump may lead to habitat loss	On-going risk of discharge from slag dump facilities beyond closure
	Dumping of material outside designated areas leading to loss of floral habitat	On-going disturbance may lead to erosion and sedimentation	Potential contamination from decommissioning of the project facilities
	Edge effects such as erosion and alien species proliferation leading to loss of floral habitat in the surrounding areas		Ineffective monitoring of rehabilitation and failure to implement an alien vegetation control plan
	Increased fire frequency during construction leading to a loss of adjacent floral habitat		
	Dust generation during construction leading to a loss of floral habitat		

Placement of infrastructure within the Bushveld and Wetland/ Riparian habitat will result in permanent removal of vegetation. Natural habitat within the vicinity of the proposed Project Infrastructure Area is however limited, while the proposed powerline and access road alternatives will be development close to existing access roads/ railway lines where existing vegetation has already been impacted. By keeping development footprint areas to a

minimum and placing of the majority of the smelter infrastructure within already transformed habitat, as planned, the impact on indigenous vegetation may be reduced.

Unmanaged	Intensity	Duration of impact	Extent	Consequence	Probability	Significance
Construction phase	L	L	L	L	M	M
Operational phase	L	H	L	M	L	M
Decommissioning and closure phase	L	L	L	L	L	L

Essential construction phase mitigation measures:

- No areas falling outside of the development footprint area may be cleared for construction purposes.
- As planned, smelter infrastructure should be placed within existing transformed habitat and the proposed powerline and access road must be constructed within disturbed habitat as far as possible (close to existing access roads).
- The proposed development footprint areas should remain as small as possible.
- The boundaries of the development footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas.
- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect adjacent bushveld and wetland/ riparian habitat within surrounding areas, need to be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made to Category 1b species identified within the study area, namely *Verbena bonariensis, Datura ferox* and *Opuntia ficus-indica*.
- Alien vegetation eradication recommendations include:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species; and
  - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.
- All soils compacted as a result of construction activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas.
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced to prevent the ingress of hydrocarbons into the topsoil.
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- As far as possible, existing access roads should be utilised to access the project areas.
- Adequate stormwater management must be incorporated into the design of the proposed development throughout all phases in order to prevent erosion of topsoil and the loss of adjacent floral habitat. In this regard, special mention is made of containment of runoff of the facilities.

Recommended construction phase mitigation measures:

- Construction footprint areas may be fenced to contain all activities within designated areas.
- During the construction phase erosion berms may be installed to prevent gully formation and siltation of the wetland resources. The following points should serve to guide the placement of erosion berms:
  - Where the track has a slope of less than 2%, berms every 50m should be installed;
  - Where the track slopes between 2% and 10%, berms every 25m should be installed;
  - Where the track slopes between 10%-15%, berms every 20m should be installed; and
  - Where the track has a slope greater than 15%, berms every 10m should be installed.
- It is recommended that all temporary access roads and construction areas be regularly sprayed with water in order to curb dust generation, if deemed necessary.
- Construction personnel, should be informed about fire control and prevention measures to reduce the frequency of uncontrolled veld fires in areas surrounding and within the study area.
- It is recommended that all construction personnel be educated in environmental awareness.
- All areas affected by construction should be rehabilitated upon closure of the smelter. Areas should be reseeded with indigenous grasses and the addition of indigenous bushveld tree species as required.

Essential operation phase mitigation measures:

- It must be ensured that operational related activities are kept strictly within the development footprint.

- Ongoing alien and invasive vegetation control should take place throughout the operational phase of the development, and the project perimeters should be regularly checked for alien vegetation proliferation to prevent spread into surrounding natural areas.
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced to prevent the ingress of hydrocarbons into the topsoil.
- Vehicles must be restricted to travelling only on designated roadways to limit the ecological footprint of the operational activities.

Essential decommissioning and closure phase mitigation measures:

- All development footprint areas and areas affected by closure and decommissioning of the project should remain as small as possible and should not encroach onto surrounding more sensitive bushveld and wetland/ riparian areas and the associated buffer zones. It must be ensured that these areas are off-limits to construction vehicles and personnel.
- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the decommissioning footprint in order to comply with existing legislation (NEMBA Alien and Invasive Species Regulations, 2014), throughout all development phases including the closure/decommissioning phases. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on rehabilitation, also has to be controlled.
- Upon closure and decommissioning of smelter facilities, reseeding with indigenous grasses and addition of indigenous bushveld trees should be implemented in all affected areas.
- All areas of disturbed and compacted soils need to be ripped and reprofiled.
- All rehabilitated areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated.

Managed	Intensity	Duration of impact	Extent	Consequence	Probability	Significance
Construction phase	L	VL	VL	VL	L	L
Operational phase	L	L	VL	L	VL	L
Decommissioning and closure phase	L	VL	VL	VL	VL	VL

Probable latent impacts:

- Loss of floral habitat may lead to altered floral biodiversity.
- Ineffective rehabilitation may lead to permanent transformation of floral habitat and species composition.

6.2 Impact 2: Impact on Floral Diversity

Activities and aspects registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Failure to initiate the development of rehabilitation plan (including alien floral control measures) during the pre-construction phase	Site clearance and removal of vegetation leading to a loss of floral diversity in the vicinity of the project footprint	An increase in alien plant species leading to altered plant community structure and composition	Ineffective rehabilitation of exposed and impacted areas and failure to implement alien floral control
Insufficient design of infrastructure leading to pollution of soils and ground water	Construction of infrastructure and access roads through natural areas leading to a loss of plant species diversity	Erosion and sedimentation as a result of operational activities leading to a loss of floral species diversity	Erosion and sedimentation as a result of closure and decommissioning activities leading to a loss of species diversity
	Increased fire frequency and intensity, as well as uncontrolled fires due to increased human activity may impact on floral communities	On-going edge effects from smelter operations impacting on plant species diversity	Failure to monitor rehabilitation efforts and implement the alien floral control plan
	Loss of surrounding floral biodiversity through invasion of alien species in disturbed areas	Indiscriminate movement of operational vehicles through adjacent bushveld and riparian/ wetland areas	
	Erosion as a result of development activities and storm water runoff leading to a loss of floral diversity	Increased fire frequency and intensity, as well as uncontrolled fires during operational activities due to increased human activity impacting on floral	
	Indiscriminate movement of construction vehicles and access road construction through surrounding floral habitat	On-going disturbance of soils and resultant erosion and sedimentation due to operational activities leading to altered floral diversity	
	Compaction of soils reducing efficiency of floral re-establishment in surrounding areas	Risk of seepage affecting soils and the groundwater regime leading to altered floral diversity	
	Removal or collection of medicinal floral species beyond the project footprint area		

Floral diversity within the smelter footprint area has already been significantly decreased as a result of historic cultivation activities, with vegetation disturbance along the two access road alternatives also noted. The species diversity along the proposed powerline is however higher, particularly within area such as the Sandy Thorn Bushveld and Turf Thorn habitat, as

well as within the Wetland/ Riparian Habitat Unit. As the proposed smelter infrastructure is located within an area that has already undergone habitat transformation, any significant impacts on floral diversity are unlikely, and with implementation of mitigation measures the impact significance may be further reduced. Similarly, should the proposed powerline footprint areas also be kept to a minimum and located as close as possible to existing disturbed areas, such as access roads and transformed habitat, this impact will be low once mitigation measures have been implemented.

Managed	Intensity	Duration of impact	Extent	Consequence	Probability	Significance
Construction phase	M	L	L	M	L	M
Operational phase	L	M	L	L	L	L
Decommissioning and closure phase	L	L	L	L	L	L

Essential construction phase mitigation measures:

- All essential mitigation measures for the construction phase as detailed in the table above remain applicable and must be adhered to.
- Prohibit the collection of plant material for firewood or for medicinal purposes.

Recommended construction phase mitigation measures:

- As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils.

Essential operation mitigation measures:

- All essential mitigation measures for the operational phase as detailed in the table above remain applicable and must be adhered to.
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any drainage lines and areas susceptible to erosion. Stockpiles should be placed away from areas known to contain hazardous substances such as fuel and if any soils are contaminated, it should be stripped and disposed of at a registered hazardous waste dumping site.

Recommended operational mitigation measures:

- It is recommended that the collection of plant material, beyond areas to be cleared for construction purposes, for firewood or for medicinal purposes be prohibited.

Essential decommissioning and closure phase mitigation measures:

- All essential mitigation measures for the decommissioning and closure phase as detailed in the table above remain applicable and must be adhered to.

Managed	Intensity	Duration of impact	Extent	Consequence	Probability	Significance
Construction phase	L	VL	VL	L	VL	L
Operational phase	VL	L	VL	VL	VL	VL
Decommissioning and closure phase	VL	VL	VL	VL	VL	VL

Probable latent impacts:

- Permanent loss of floral diversity within areas where construction has taken place or immediately adjacent thereto.
- Alien and invasive species proliferation and bush encroachment may occur in disturbed areas.
- Ineffective rehabilitation may lead to permanent loss of floral biodiversity.

6.3 Impact 3: Impact on Floral SCC

Activities and aspects registry

Pre-Construction	Construction	Operational	Decommissioning & Closure
Infrastructure placement and design leading to overall loss of floral SCC and medicinal species	Site clearance and removal of vegetation leading to a direct loss of floral SCC and medicinal species and fragmentation of populations	An increase in alien plant species leading to loss of floral SCC and medicinal species by outcompeting these species	Ineffective rehabilitation of exposed and impacted areas and failure to implement a comprehensive alien floral control plan leading to on-going loss of medicinal plants
Inadequate design of infrastructure leading to pollution of soils and ground water which may lead to a loss of floral SCC and medicinal species	Construction of infrastructure and access roads through sensitive habitat leading to a loss of floral SCC and medicinal species	Increased anthropogenic activity and an increase in the collection of plant material for medicinal purposes and felling of trees for firewood	
Failure to apply for permits for remove protected trees in terms of the National Forests Act (Act 84 of 1998)	Vehicles accessing site through sensitive habitat leading to direct loss of floral SCC	Erosion and sedimentation as a result of operational activities leading to a loss of floral SCC, including medicinal species	
	Poor control of vehicular movement and management of edge effects leading to impacts on protected floral species within the bushveld habitat surrounding the study area	Ongoing edge effects from developed areas on surrounding more natural areas leading to impacts on protected floral species within the bushveld habitat surrounding the study area	

The protected trees species, *Vachellia erioloba* was identified within the proposed powerline alignment and the probability that some of these trees will have to be removed for construction of the powerline is high. This impact may be lowered by ensuring that the number of trees removed for this purpose remains limited and that no trees are needlessly destructed.

Managed	Intensity	Duration of impact	Extent	Consequence	Probability	Significance
Construction phase	M	L	L	M	H	H
Operational phase	L	L	VL	L	L	L
Decommissioning and closure phase	L	L	VL	L	L	L

Essential construction mitigation measures:

- The footprint area cleared for the proposed powerline infrastructure should be kept as small as possible.
- Permits must be obtained for the removal/ destruction of *V. erioloba* under the National Forests Act (Act 84 of 1998) prior to the construction phase.
- The number of *V. erioloba* removed for construction of the powerline should be kept to a minimum and no trees should be needlessly destroyed.
- Should any other floral SCC, including SANBI RDL species, such as *Crinum macowanii* or *Boophane disticha*, be encountered within the development footprint, these species are to be relocated as appropriate.
- Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a botanist.
- The collection of plant material for medicinal purposes or collection of firewood should be prohibited.
- Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area.

Essential operational phase mitigation measures:

- It must be ensured that operational related activities are kept strictly within the development footprint.
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- The collection of plant material for medicinal purposes or collection of firewood should be prohibited.

Essential decommissioning and closure phase mitigation measures:

- Should any other floral SCC, including SANBI RDL species, such as *Crinum macowanii* or *Boophane disticha*, be encountered within the decommissioning footprint, these species are to be relocated or permits for their destruction be obtained, as appropriate.
- Should any floral species protected under LEMA (Act 7 of 2003), such as *Scadoxus puniceus* or NEMBA (Act 10 of 2004) be encountered within the proposed powerline or access road alignments, authorisation to relocate such species must be obtained from LEDET or DEA respectively.

Managed	Intensity	Duration of impact	Extent	Consequence	Probability	Significance
Construction phase	L	VL	VL	VL	H	M
Operational phase	VL	VL	VL	VL	VL	VL
Decommissioning and closure phase	VL	VL	VL	VL	VL	VL

Probable latent impacts:

- A decrease in medicinal floral species diversity may lead to a loss of species richness over time within the region.
- A decrease in *V. erioloba* within the region is likely to occur.

6.4 Impact Assessment Conclusion

Based on the above assessment it is evident that there are three possible impacts which may affect the floral ecology within the project area. The table below summarise the findings indicating the significance of the impacts for all development phases before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

Table 7: A summary of the impact significance of the construction phase.

CONSTRUCTION PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on floral habitat	M	L
2: Impact on floral diversity	M	L
3: Impact on floral SCC	H	M
OPERATIONAL PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on floral habitat	M	L
2: Impact on floral diversity	L	VL
3: Impact on floral SCC	L	VL
DECOMMISSIONING AND CLOSURE PHASE		
Impact	**Unmanaged**	**Managed**
1: Impact on floral habitat	L	VL
2: Impact on floral diversity	L	VL
3: Impact on floral SCC	L	VL

7 ALTERNATIVES ASSESSMENT

A map indicating the location of the various infrastructure site layout alternatives is included in Section A: Figure 3 of this report.

Project Infrastructure Area

As a site layout alternative to Project Infrastructure Area Option 1 (preferred), which has been included as part of this assessment, Project Infrastructure Area Option 2 has been identified. As with Project Infrastructure Area Option 1 (with the exception of the southeastern portion of the Proposed Infrastructure Area, where no or very limited infrastructure is expected to be placed), Project Infrastructure Area Option 2 is located in its entirety within the Transformed Habitat Unit with Low ecological value, due to no natural habitat remaining in this area. The ecological impact in terms of floral ecology should this alternative be developed is therefore expected to be similar to that of Option 1.

Access Road

Two of the three Access Road Alternatives have been considered as part of this assessment, namely Access Road Corridor Option 2 (preferred) and Access Road Option 3. Both these access road alternatives are located within areas comprising transformed habitat due to the presence of existing roads and fencing, as well Mixed Bushveld habitat impacted by surrounding historical agricultural land and other disturbances. No floral SCC were encountered within either Access Road Corridor Option 2 or Access Road Option 3 and the ecological impact in terms of floral ecology should either alternative be developed is therefore expected to be similar.

The protected tree species, *Vachellia erioloba,* is known to occur within the Access Road Option 1 alignment along an existing access road. This alignment is however similar to that of Powerline Option 1 (preferred) and is therefore unlikely to lead to any additional impacts, should the preferred powerline alternative be developed. Should this however not be the case, with Powerline Option 1 not being developed, the overall impact is expected to be somewhat higher than that of Access Road Corridor Option 2 and Access Road Option 3 due to the various watercourse crossings which will then take place.

Powerline

In addition to Powerline Option 1 (preferred), three other alternatives have been identified, namely Powerline Option 2, Powerline Option 3 and Powerline Option 4. Although a number of *V. erioloba* trees fall within the vicinity of Powerline Option 1, which has been considered as part of this assessment, and also therefore within the Power Option 3 footprint area, it is also likely that such trees will fall within the footprint areas of Powerline Options 2 and 4. All four powerline alignments also cross various watercourses and are largely situated along existing access roads and resulting impacted areas, with the exception of Powerline 2; the latter which is therefore the least desirable alternative.

8 CONCLUSION AND RECOMMENDATIONS

Based on the findings of the ecological assessment it is the opinion of the ecologists that from a floral perspective, the proposed project be considered favorably. However, all essential mitigation measures and recommendations presented in this report should be adhered to in order to ensure the floral ecology within the study area remains intact, with particular mention of avoiding encroachment into the Wetland/ Riparian Habitat Unit (apart

from at stream crossings where this cannot be avoided) and bushveld habitat of increased ecological sensitivity.

Implementation of the following recommendations should be strongly considered:

Development footprint

- No areas falling outside of the immediate development footprint areas may be cleared for construction purposes;
- As planned, smelter infrastructure should be placed within existing transformed habitat and the proposed powerline and access roads must be constructed within disturbed habitat as far as possible (close to existing access roads);
- The proposed development and operational footprint areas should remain as small as possible;
- The boundaries of the development and operational footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas; and
- As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils.

Floral SCC

- Permits must be obtained for the removal/ destruction of *V. erioloba* under the National Forests Act (Act 84 of 1998) within the proposed powerline alignment, prior to the construction phase;
- The number of *V. erioloba* removed for construction of the powerline should be kept to a minimum and no trees should be needlessly destroyed;
- Should any other floral SCC, including SANBI RDL species, such as *Crinum macowanii* or *Boophane disticha* be encountered within the development footprint, these species are to be relocated;
- Should any floral species protected under LEMA (Act 7 of 2003), such as *Scadoxus puniceus* or NEMBA (Act 10 of 2004) be encountered within the proposed powerline or access road alignments, authorisation to relocate such species must be obtained from LEDET or DEA respectively;
- Floral SCC are to be handled with care and the relocation of these plant species to nearby suitable similar habitat is to be overseen by a suitably qualified botanist;
- The collection of plant material for medicinal purposes or collection of firewood should be prohibited;
- Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area;

- It must be ensured that operational related activities are kept strictly within the development footprint; and
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

Alien vegetation

- Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect adjacent bushveld and wetland/ riparian habitat within surrounding areas, need to be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made to Category 1b species identified within the study area, namely *Verbena bonariensis, Datura ferox* and *Opuntia ficus-indica*; and
- Ongoing alien and invasive vegetation control should take place throughout the operational and closure/ decommissioning phases of the development, and the project perimeters should be regularly checked during the operational phase for alien vegetation proliferation to prevent spread into surrounding natural areas.

Rehabilitation

- All soils compacted as a result of construction activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Any natural areas, including wetland and riparian areas, beyond the development footprint, that have been affected by the construction activities, must be rehabilitated using indigenous grass species and the addition of indigenous bushveld tree species. All rehabilitated areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated.

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APPENDIX A
Vegetation Index Score

Vegetation Index Score –Bushveld Habitat Unit

1. *EVC=[[(EVC1+EVC2)/2]*

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score					X	
EVC 1 score	0	1	2	3	4	5
EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score					X	
EVC 2 score	5	4	3	2	1	0

2. *SI=(SI1+SI2+SI3+SI4)/4)*

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								X
Clumped	X	X						
Scattered			X	X	X	X		
Sparse							X	

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. *PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))*

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		X				
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			X			
PVC score	0	1	2	3	4	5

4. *RIS*

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS					X	
RIS Score	0	1	2	3	4	5

VIS = [(EVC)+((SIxPVC)+(RIS))] = 18

Vegetation Index Score – Wetland/ Riparian Habitat Unit

1. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score						X
EVC 1 score	0	1	2	3	4	5
EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score				X		
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous		X						X
Clumped	X		X				X	
Scattered				X	X	X		
Sparse								

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			X			
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			X			
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS					X	
RIS Score	0	1	2	3	4	5

VIS = [(EVC)+((SIxPVC)+(RIS))] = 18

Vegetation Index Score – Secondary Bushveld Habitat Unit

1. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score				X		
EVC 1 score	0	1	2	3	4	5
EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score					X	
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								X
Clumped		X			X		X	
Scattered	X		X	X		X		
Sparse								

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			X			
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		X				
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS					X	
RIS Score	0	1	2	3	4	5

VIS = [(EVC)+((SIxPVC)+(RIS))] = 13

Vegetation Index Score – Transformed Habitat Unit

5. EVC=[[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score		X				
EVC 1 score	0	1	2	3	4	5
EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						X
EVC 2 score	5	4	3	2	1	0

6. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		**Shrubs (S2)**		**Forbs (S3)**		**Grasses (S4)**	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								X
Clumped		X			X			
Scattered				X		X	X	
Sparse	X		X					

Present State (P/S) = Currently applicable for each habitat unit

Perceived Reference State (PRS) = If in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

7. PVC=[(EVC)-((exotic x 0.7) + (bare ground x 0.3))

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %					X	
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %					X	
PVC score	0	1	2	3	4	5

8. RIS

Extent of indigenous species recruitment	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
RIS		X				
RIS Score	0	1	2	3	4	5

VIS = [(EVC)+((SIxPVC)+(RIS))] = 5