BOTANICAL IMPACT ASSESSMENT REPORT

SPECIALIST STUDY

July 2015

Prepared by:

DIZOLUX CC
Reg no. 2011/056151/23

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DISCLAIMER

The shareholders, employees and professional consultants of Dizolux CC hereby declare that random sampling methods of the study area and structured scientific observations were used in the compilation of this report.

This study does not encompass detailed investigations relating to future changes in biodiversity and attributes other than the time during which this project was conducted.

All descriptions, results and/or findings, recommendations and conclusions contained in this report are treated with confidentiality. Dizolux CC shall not be held liable for any ambiguous findings concluded from this scientific assessment, as requested for the purpose of this report.

Dizolux CC further reserves the right to alter (at any stage) the content of this report including, but not limited to the recommendations and conclusions, should any relevant and/or significant findings become evident in any capacity or form.

Also take note that a survey of the entire route could not be conducted as a result of time and budget constraints. Sensitive areas were thus identified during the desktop study, and representative sites were visited to ground truth the sensitivity and identify the species present in these areas. Identification of inconspicuous sites such as small non-perennial streams may therefore have been overlooked, but should be taken into account during the planning phase.

The shareholders, employees and professional consultants of Dizolux CC can, as a result of these limitations not be held accountable or liable for any damages or losses suffered in relation to the study.

DECLARATION OF INTEREST

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Basic Assessment for the proposed 132 kV Nkwe Eskom substation and ± 28km power line with associated infrastructure

Specialist:	Dizolux CC		
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4.2 The specialist appointed in terms of the Regulations_

I, Therèsè Rautenbach , declare that --

General declaration:

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

Signature of the specialist:

Dizolux CC
Name of company (if applicable):

2 October 2013
Date:

SCOPE OF WORK

Enpro Industries
Environmental Consulting,
Auditing and Authorization

Attention: Mrs. Tess Rautenbach **Date: 12/06/2015**

SPECIALIST TERMS OF REFERENCE: BOTANICAL IMPACT ASSESSMENT

PROJECT: Basic assessment for the proposed 132 kV Nkwe Eskom substation and two ±22km power lines with associated infrastructure in Steelpoort, Limpopo (Nkwe BA).

Introduction

The registration for the proposed project was submitted to the competent authority, Department Environmental Affairs (DEA) on 24 October 2013. It is expected that the Department will approve the application and that the specialist impact assessment process may proceed.

A Botanical Impact Assessment is required as part of the Basic Assessment for the proposed development. Details of the development can be viewed in the attached document: NkweBA_Background.docx. Also attached are .kmz files of the proposed/alternative route/site.

Enpro Industries will produce the final combined maps for the project. Therefore the shape files/GPS coordinates generated by the specialist will need to be forwarded to Enpro Industries.

The specialist must comply with all relevant requirements of the National Environmental Management Act, 2008 (Act 107 of 2008) and any specific environmental management Act.

It is important to note that the expertise of the specialist must be included in the report. Please refer to Section 32 of GN R543 published in GG 33306 of 18 June 2010, for additional guidelines on the report.

Scope of Work

The Scope of Work is as follows:

1. Undertake a site visit.
2. Outline the study approach and identify assumptions and sources of information.
3. Identify all relevant and affected plant species with focus on conservation status, level of endemism, rarity and declared weeds and invaders.
4. Perform a sensitivity analysis and indicate sensitive areas on a map, with potential "no go" areas if necessary.
5. A complete impact assessment in terms of Regulation 22(2)(i) of GN R.543 must be included in the report.
6. Propose mitigation measures and management options for all relevant impacts giving detailed descriptions of how it should be implemented. Residual impacts after mitigation should be included.
7. Provide a detailed monitoring program for mitigation measures and project implementation activities, explaining what should be monitored, when, how, how often and by whom.
8. Advise on alternative project options e.g. layout changes and routing recommendations, including the "no-go" option.
9. Compile a report encompassing all the findings of the desktop assessment, field survey and mapping.
10. **Ensure the following information is provided in the report:**

I. ***Ground cover***: Indicate the types of groundcover present on the site. The location of all identified rare or endangered species or other elements should be accurately indicated on the site plan(s).

Natural veld - good condition	Natural veld with scattered aliens	Natural veld with heavy alien infestation	Veld dominated by alien species	Gardens
Sport field	Cultivated land	Paved surface	Building or other structure	Bare soil

II. ***Land use character of surrounding area***: Does the proposed site (including any alternative sites) fall within any of the following:

Critical Biodiversity Area (as per provincial conservation plan)	YES	NO
Core area of a protected area?	YES	NO
Buffer area of a protected area?	YES	NO
Planned expansion area of an existing protected area?	YES	NO

Existing offset area associated with a previous Environmental Authorisation?	YES	NO
Buffer area of the SKA?	YES	NO

If the answer to any of these questions is YES, a map indicating the affected area must be included in an appendix.

III. ***Biodiversity***: Indicate the applicable biodiversity planning categories of all areas on site and indicate the reason(s) provided in the biodiversity plan for the selection of the specific area as part of the specific category)

Systematic Biodiversity Planning Category				If CBA or ESA, indicate the reason(s) for its selection in biodiversity plan
Critical Biodiversity Area (CBA)	Ecological Support Area (ESA)	Other Natural Area (ONA)	No Natural Area Remaining (NNR)	

IV. ***Biodiversity***: Indicate and describe the habitat condition on site

Habitat Condition	Percentage of habitat condition class (adding up to 100%)	Description and additional Comments and Observations (including additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc).
Natural	**%**	
Near Natural (includes areas with low to moderate level of alien invasive plants)	**%**	
Degraded (includes areas heavily invaded by alien plants)	**%**	
Transformed (includes cultivation, dams, urban, plantation, roads, etc)	**%**	

V. ***Biodiversity***: Complete the table to indicate the type of vegetation, including its ecosystem status, present on the site:

Terrestrial Ecosystems	
Ecosystem threat status as per the National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	Critical
	Endangered
	Vulnerable
	Least Threatened

VI. Please provide a description of the vegetation type present on site, including any important biodiversity features/information identified on site (e.g. threatened species and special habitats)

Regards

ENPRO INDUSTRIES

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EXECUTIVE SUMMARY

Eskom requires the construction and operation of a new 132 kV substation and two power lines of approximately 22 km each, from the existing Leseding station to the proposed Nkwe substation. The associated infrastructure includes an access road to the Nkwe substation of approximately 720 m. Two power line corridors and two substation site alternatives were identified for investigation. The purpose of this study was to identify the affected vegetation, sensitive areas, as well as the impact of the development on the botanical environment and provide mitigation measures for said impacts.

The proposed development is located near Steelpoort (Sekhukhuneland), Limpopo. This region is known for its biodiversity and high level of endemism. However, the routes selected for the development lies within an area heavily disturbed by surrounding villages and mines, overgrazing, cultivation and erosion.

The desktop study and field surveys revealed that 24 Red List species can be expected to occur in the study area, with 1 species (*Searsia batophylla* – Vulnerable) confirmed on site. Several other protected species were also recorded on site e.g. *Scadoxus puniceus*, *Combretum imberbe*, *Sclerocarya birrea* subsp. *caffra* and *Acacia erioloba*. Numerous alien and invasive species were also found in the study area e.g. *Agave sisalana, Opuntia ficus-indica, Melia azedarach, Zinnia peruviana* and *Xanthium strumarium*.

Seven broad vegetation types were identified during the assessment i.e. plains bushveld, mountain bushveld, rocky outcrops, riparian vegetation, erosion dongas, cultivated land and built environments. Sensitivity and impact analysis revealed that Alternative 1 for the power line routes represents a less sensitive option with a lower impact on the vegetation (when mitigation measures are accounted for). Though the results indicated that the difference is relatively small, the use of Alternative 1 is recommended for the power lines.

In terms of the substation alternatives, both are on old cultivated land with similar habitat conditions and species composition. The sensitivity and impacts of these were thus similar and no one site is preferable.

DEFINITIONS AND TERMINOLOGY

Alien species:	Defined by the National Environmental Management: Biodiversity Act, Act no. 10 of 2004 as a species that is not an indigenous species or an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
Alternative 1:	Preferred site (either power line route or substation site) as per the Scope of Work.
Alternative 2:	Alternative site (either power line route or substation site) as per the Scope of Work.
Bush encroachment:	Means stands of plants of the kinds specified in column 1 of Table 4 of CARA legislation, where individual plants are closer to each other than three times the mean crown diameter. These are indigenous plants with the tendency to become overly abundant and can indicate to poor land management.
CARA:	Conservation of Agricultural Resources Act 1983, Act no. 43 of 1983. Category 1 plant: Declared weed. Invader plants must be removed and destroyed immediately. Category 2 plant: Declared invader. Invader plants may be grown under controlled conditions in permitted zones. Category 3 plant: Invader plants may no longer be propagated or sold. Existing plants do not need to be removed.
Dogleg:	Doglegs refer to an alternate route circumventing a specific location.

GPS:	Coordinates are given in the decimal minutes format i.e. hdddo mm.mmm’
Indigenous species:	Defined by the National Environmental Management: Biodiversity Act, Act no. 10 of 2004 as a species that occurs, or has historically occurred, naturally in a free state in nature within the borders of the Republic, but excludes a species that has been introduced in the Republic as a result of human activity.
Invasive species:	Defined by the National Environmental Management: Biodiversity Act, Act no. 10 of 2004 as any species whose establishment and spread outside of its natural distribution range - (a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species and (b) may result in economic or environmental harm or harm to human health.
NEM:BA	National Environmental Management: Biodiversity Act, Act no.10 of 2004 Listed invasive species: Any invasive species listed in terms of section 70(1).
SANBI:	South African National Biodiversity Institute

1. INTRODUCTION

Eskom is continuously improving and developing electricity infrastructure to support the increasing demand for power supply. For the current project Eskom requires the construction of a 132 kV substation and two 132 kV power lines of approximately 22 km each, with associated infrastructure near Steelpoort, Limpopo. Dizolux CC. was appointed as an independent consultant to conduct a Botanical Impact Assessment for the proposed development, as part of the Basic Assessment Process.

Two power line corridors and two substation site alternatives have been identified for investigation. The purpose of this study was to identify the affected vegetation, identify sensitive areas and the potential impact of the development on the botanical environment. The investigation included both alternatives proposed for the power line routes and substations, as well as an opinion on the preference of the alternatives with respect to the vegetation.

Desktop research was corroborated with a site investigation. To identify all relevant and affected plant species and habitat types, random transects were evaluated along the proposed corridors. Potentially sensitive areas identified during the desktop study, not represented by the random transects, were also surveyed to ensure their inclusion in the assessment. This was followed by a sensitivity analysis and impact assessment, as well as mitigation and monitoring measures.

The region in which the proposed development will take place is known for its biodiversity and high levels of endemism. The site is within the Sekhukhuneland Centre of Endemism and the majority of the study area falls within Sekhukhune Plains Bushveld, which has been identified as a Vulnerable vegetation type. However, the routes selected for the development lies within an area heavily disturbed by surrounding villages and mines, overgrazing, cultivation and erosion. Bush encroachment was also noticed on site and numerous alien species and invaders were recorded e.g. *Agave sisalana, Opuntia ficus-indica, Medlia azedarach, Zinnia peruviana* and *Xanthium strumarium*.

In spite of the few natural areas remaining in the study area the presence of several protected and rare species were confirmed e.g. *Scadoxus puniceus*, *Combretum imberbe* (Leadwood), *Searsia batophylla* (Bramble current), *Sclerocarya birrea* subsp. *caffra* (Marula) and *Acacia*

erioloba (Camel thorn). Furthermore, the desktop study revealed that more protected and rare species can be expected to occur in the area.

Seven broad vegetation types were identified during the assessment i.e. plains bushveld, mountain bushveld, rocky outcrops, riparian vegetation, erosion dongas, cultivated land and built environments. The sensitivities of the vegetation were determined and used to establish which route would be a less sensitive option. Though it suggested low sensitivity variation between Alternative 1 and 2, Alternative 1 represented a slightly less sensitive option for the route alignment.

The impact analysis showed that habitat destruction, clearing of natural vegetation, removal of rare and protected species, vegetation disturbance, the spread and increase of alien vegetation, increased soil erosion, pollution and increased risk of veld fires are the main impacts associated with the development. By implementation of the recommended management options and mitigation measures some of these impacts can be prevented and most can be minimised. The analysis also suggested preference towards Alternative 1, with Alternative 1 representing a lower impact than Alternative 2, with the inclusion of mitigation measures.

Insignificant variation of the substation Alternatives in sensitivity and botanical impacts does not provide a clear preferred option, owing to the proximity of these areas to one another and the resulting overlap in species composition and habitat condition (old cultivated land).

2. SITE DESCRIPTION

2.1. Location

The proposed development is in the Limpopo Province in the Greater Tubatse District Municipality (Greater Sekhukhune District Municipality). See Figure 1 for the project location.

The study area lies to the east of the Leolo Mountains, within the 2430AC and 2430CA quarter-degree grid squares. The proposed power lines will run from the existing Leseding substation (24°26'21.74"S; 30°1'2.46"E) to the proposed Nkwe substation (Alternative 1 being 24°35'11.40"S; 30°4'54.60"E and Alternative 2 being 24°35'21.82"S and 30°4'59.12"E), covering a distance of approximately 22 km (Alternative 1) to 27 km (Alternative 2). The power lines will

thus be 20 km North of Steelpoort and 5 km West of Driekop, running parallel with the R37 towards Polokwane.

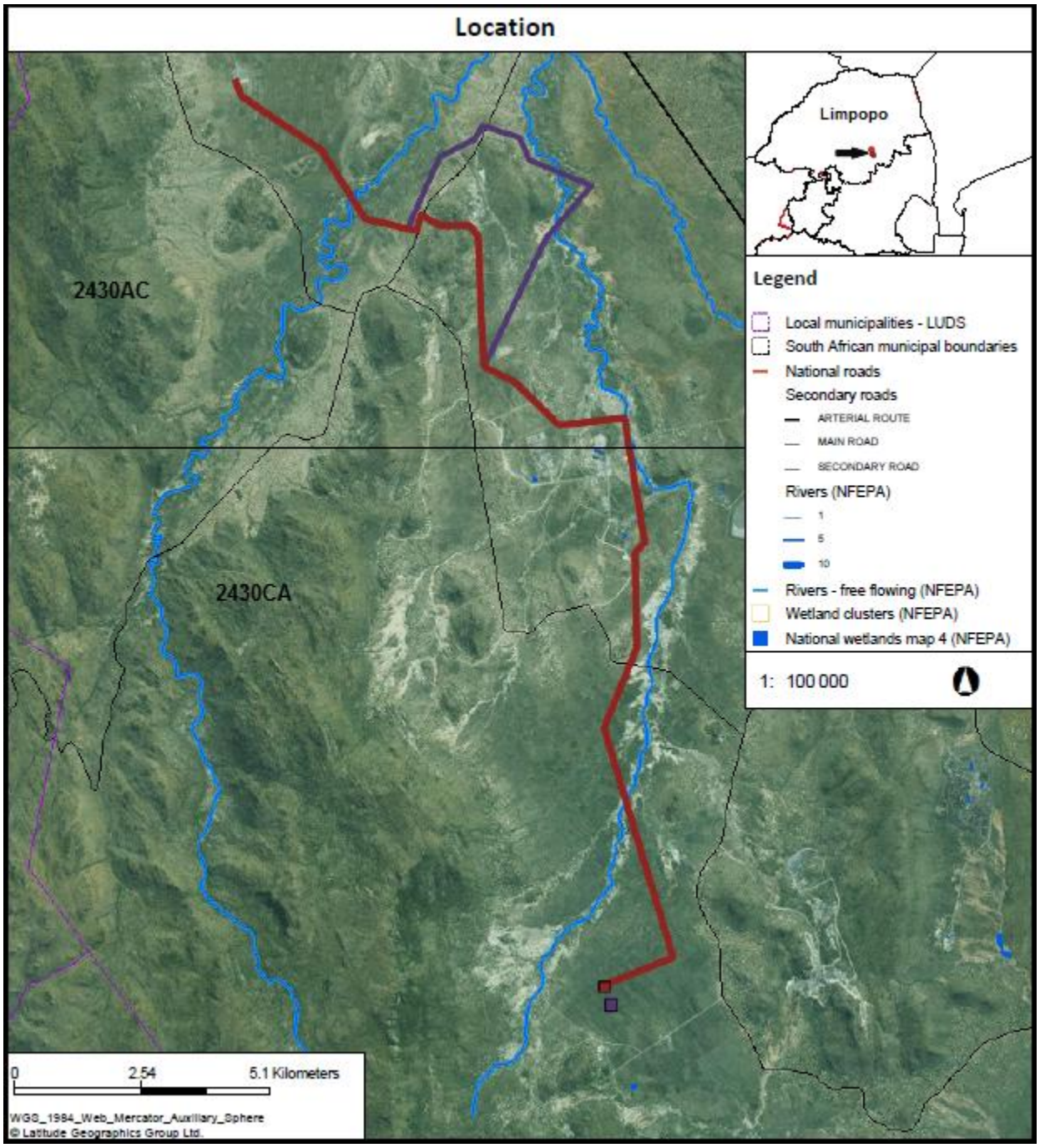

Figure 1 The proposed location of the Eskom development. The red line and square represent Alternative 1 for the power lines and substation respectively, whereas the purple line and square provide the locations of Alterative 2 (modified from SANBI BGIS Land Use Decision Support Tool).

2.2. Terrain

The study area has an uneven topography with the mountainous terrain and ridges interspersed with plains and undulating valleys. The proposed site is largely situated in a valley plain, to the east of the Leolo Mountains, crossing smaller hills and ridges in some areas. The altitude ranges from 795 m to 985 m a.s.l. at the lowest and highest recorded points respectively.

The national soil class of the majority of the study area is swelling clay soils, associated with melanic and red structured soils. Swelling clay soils are known to have high levels of natural fertility. In addition to its significant plasticity and stickiness, it also holds high swelling and shrinking potential. The remaining area consists largely of rocks, with limited soils and with restricted land use options (Biodiversity GIS SANBI, downloaded 5 February 2014).

The study area is traversed by the Motse and Moopetsi Rivers both feeding the Olifants River. The area is known to experience extensive erosion forming active and fossil erosion dongas (Mucina & Rutherford 2006).

2.3. Climate

The area receives summer rainfall and experiences extremely dry winters, with infrequent frost. The rainfall ranges from 400-700 mm per annum. The average daily temperature ranges from a minimum of -0.9°C to a maximum of 37.3°C in the Steelpoort area (Mucina & Rutherford 2006), with an average of approximately 21°C.

3. METHODS

3.1. Literature study

The purpose of the desktop study was to establish the environmental conditions, identify the habitat types and status, as well as identify all relevant plant species that can be expected in the affected area.

The National Vegetation Types were identified and described using The Vegetation of South Africa, Lesotho and Swaziland by Mucina & Rutherford (2006). Identification of vegetation units and

their respective distances were determined by using SANBI BGIS Land Use Decision Support (LUDS) Tool, Google Earth Satellite imagery and corroboration with field assessments. Further habitat analysis included the PhD dissertation by Siebert (2001) on the vegetation of the Sekhukhuneland Centre of Endemism. Note that the species of special concern mentioned in the habitat descriptions only include those confirmed on site and not those expected from previous studies and SANBI POSA quarter-degree grid squares.

Identification of the plant species that may occur in the study area included the 2430AC and 2430CA quarter-degree grid squares species lists from SANBI POSA (download from POSA (http://posa.sanbi.org) on June 22, 2015). SANBI POSA also provides the IUCN Red List status of the species, which was used as baseline information for the species of special concern to be expected in the study area. The likelihood of species of special concern occurring in the study area was determined by means of previous studies conducted in the area (Siebert 2001), distribution maps (SANBI National Assessment: Red List of South African Plants version 2014.1.) and habitat compatibility information. Species not included in the above mentioned grid squares but recorded on site were also included as species of special concern after consultation with the relevant legislation.

Plant names are provided from the SANBI POSA website. For this reason the previous classification of *Acacia* species was used, instead of the new genus names i.e. *Vachiella* and *Senegalia*. Additional information such as habitat, growth form and maximum height was obtained from Palgrave (2005), Retief & Herman (1997) and the SANBI POSA website.

The maps provided in the report were made with the SANBI BGIS Land Use Decision Support Tool, as well as image overlay techniques using Google Earth Satellite imagery (for the identification of Critical Biodiversity Areas).

3.2. Site investigation

The area under assessment includes the preferred power line routes of approximately 22 km long, 18 m on the outside of each line and a 15 m buffer area between the two lines. The 132 kV Nkwe Eskom substation site will be 200 m by 200 m of which the substation will cover an area of 100 m by 100 m. The assessment included the survey of the alternative route, which included an additional 5 km, and the alternative substation site.

Two site visits were undertaken to ground-truth and add to the desktop analysis i.e. November 2013 to June 2014.

The data collected during the site visits included the following:

Transect data. Four (4) random transects of 200 m by 31 m (0.62 ha) was assessed to identify all relevant and affected plant species. This data were used to provide an account of the species present in the study area, as well as their conservation status and whether they are declared weeds and invaders.

Line data. Representative sites of important habitat types i.e. potentially sensitive areas identified during the desktop study were also surveyed to describe the different habitat types, as well as to provide an account of the dominant species in each habitat type.

3.3. Analysis

The methods used for the sensitivity analysis and impact assessments are provided in Sections 5 and 6 of this report respectively.

3.4. Assumptions and limitations

The following assumptions, uncertainties and gaps in knowledge were encountered during the assessment.

- A survey of the entire route could not be conducted as a result of time and budget constraints. Sensitive areas were thus identified during the desktop study, and representative sites were visited to ground truth the sensitivity and identify the species present in these areas. Inconspicuous sensitive sites e.g. small non-perennial streams may therefore have been overlooked, but should be taken into account during the planning phase in for example the placement of power line tower positions.
- In terms of wetlands, this study includes the identification of riparian vegetation where clearly present; however it does not include formal wetland delineation and identification.
- Species identification was limited by the seasonal absence of plant reproductive parts and the limitation of the investigation to only one visit per site e.g. geophytes such as *Ledebouria* spp. and succulent, perennial herbs such as *Orbea* spp.
- Species detection was limited by the possible presence of rare and inconspicuous plants e.g. geophytes.

- Sekhukhuneland has a high level of endemism and biodiversity, and is known to house species not formally described and deficient in distribution and habitat data (Siebert *et al*. 2001).

4. RESULTS

4.1. Vegetation units

The area is located in the Savanna Biome of South Africa. There are two vegetation types (Figure 2) relevant to this proposed development i.e. Sekhukhune Plains Bushveld and Sekhukhune Mountain Bushveld (Mucina & Rutherford 2006). The former was classified by Acocks (1988) as Mixed Bushveld and the latter as Sourish Mixed Bushveld.

Siebert (2001) classified the northern part of the study area as Arid Bushveld and the southern part as Mountain Bushveld i.e. Open Mountain Bushveld and Closed Mountain Bushveld. Wetland and rock outcrop vegetation occurs within these vegetation types. The wetland vegetation is typically located on valley stream banks, mountain slope drainage lines and mountain plateau wetlands. Though present, the rocky outcrop vegetation is not well represented in the study area. Finally, naturally occurring erosion dongas cover relatively large patches of the study area with heavily eroded soils and sparse vegetation cover (Siebert *et al.* 2001).

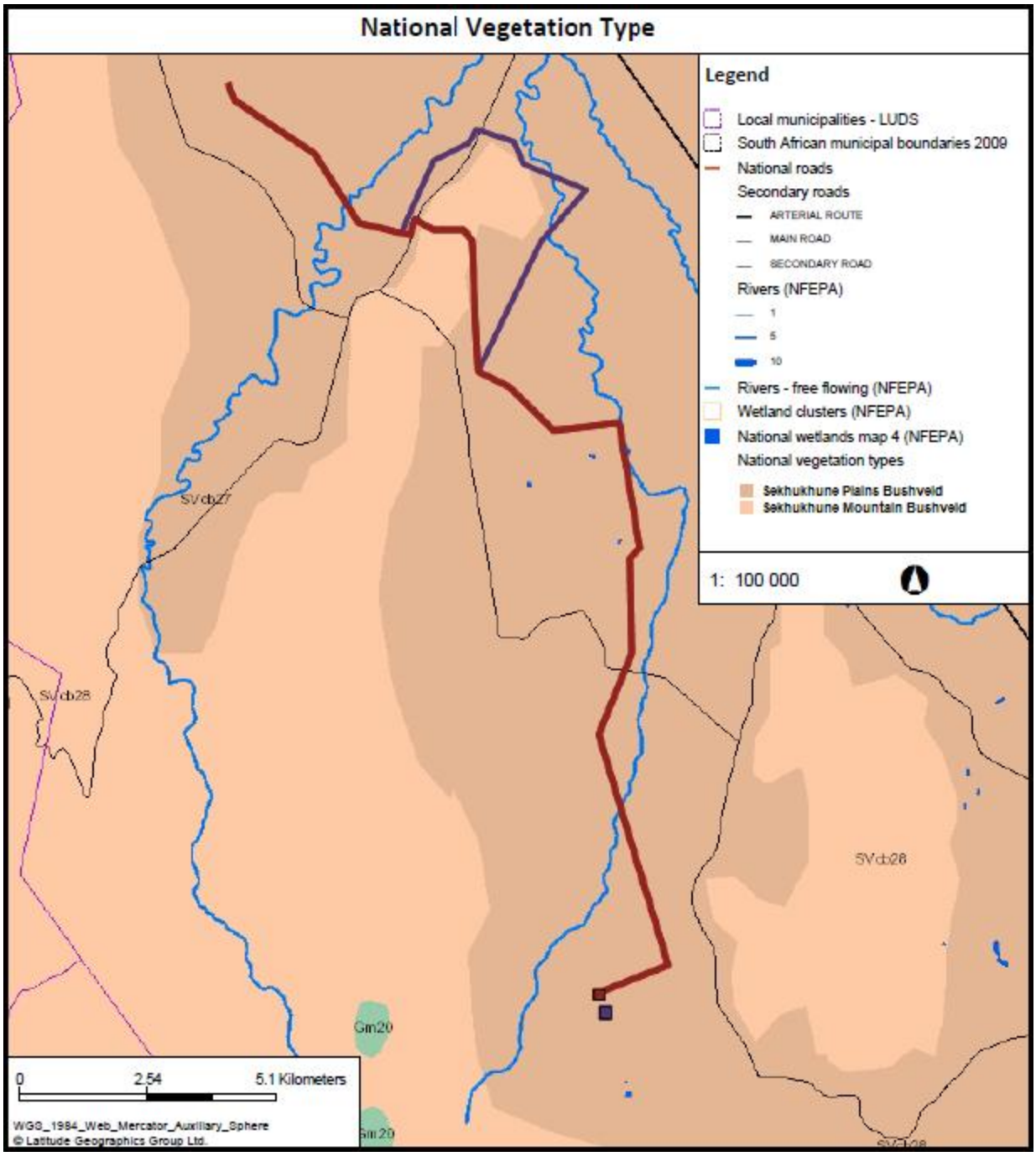

Figure 2 Provides the vegetation types present in the study area. The red line represents Alternative 1 for the power lines and substation, whereas the purple line and square provides the location of Alterative 2 (modified from SANBI BGIS Land Use Decision Support Tool).

4.1.1. Sekhukhune Plains Bushveld

Sekhukhune Plains Bushveld is the dominant vegetation type along the proposed routes (Figure 2). The vegetation is largely short thornveld and can be classified as a semi-arid area (Mucina & Rutherford 2006).

Table 1 Provides a summary of some of the common species present in Plains Bushveld vegetation (Mucina & Rutherford 2006).

Growth form	Common species
Trees	*Acacia erioloba, Philenoptera violacea, Acacia mellifera* subsp. *detinens, Acacia nilotica*, *Acacia tortilis* subsp. *heteracantha* and *Euphorbia tirucalli*
Shrubs	*Searsia engleri, Cadaba termitaria, Dichrostachys cinerea, Felicia clavipilosa* subsp. *transvaalensis, Gnidia polycehala* and *Seddera suffruticosa*
Succulents	*Aloe cryptopoda, Euphorbia enormis* and *Kleinia longiflora*
Climbers	*Sarcostemma viminale, Coccinia rehmannii* and *Decorsea schlechteri*
Graminoids	*Cenchrus ciliaris, Panicum maximum* and *Enneapogon cenchroides*
Herbs	*Becium filamentosum, Phyllanthus maderaspatensis* and *Blepharis integrifolia*
Geophytic herbs	*Drimia altissima* and *Sansevieria pearsonii*

Sekhukhune Plains Bushveld is an endemic vegetation type to Limpopo. It is a Vulnerable ecosystem with 1.2% conserved (the conservation target is at 19%) and 32% is transformed (Desmet *et al*. 2013). Common species present in this vegetation are provided in Table 1.

The biogeographically important taxa expected in the area include *Lydenburgia cassinoides, Nuxia gracilis, Amphiglossa triflora, Asparagus fourei, Hibiscus barnardii, Orthosiphon fruticosus, Petalidium oblongifolium, Searsia batophylla, Asparagus sekukuniensis, Aneilema longirrhizum, Chlorophytum cyperaceum* and *Piaranthus atrosanguineus.*

The transformation and degradation of the habitat is largely owing to subsistence cultivation. Other contributing factors include chrome and platinum mining, harvesting and urbanisation. Though natural erosion dongas are common owing to the edaphic properties of this area, erosion is exacerbated by anthropogenic impacts. Further degradation includes bush encroachment by indigenous vegetation as well as the establishment and invasion of alien species. Common alien species include *Agave* species, *Verbesina encelioides, Caesalpinia decapetala, Lantana camara*, *Xanthium strumarium, Melia azedarach, Nicotiana glauca* and *Opuntia* species (Mucina & Rutherford 2006).

4.1.2. Sekhukhune Mountain Bushveld

Sekhukhune Mountain Bushveld covers only a small portion of the area and is mostly associated with Alternative 1 (Figure 2). The vegetation in this area consists largely of mircrophyllous and broad-leaved savanna, which is associated with mountain slopes and hills (Mucina & Rutherford 2006).

Table 2 Provides a summary of some of the common species in Mountain Bushveld vegetation (Mucina & Rutherford 2006).

Growth form	Common species
Trees	*Acacia nigrescens*, *Acacia Senegal* var. *leiorhachis, Combretum apiculatum, Kirkia wilmsii* and *Aloe marlothii* subsp. *marlothii*
Shrubs	*Dichrostachys cinerea, Euclea crispa* subsp. *crispa, Combretum hereroense Elephantorrhiza praetermissa, Grewia vernicosa* and *Asparagus intricatus*
Succulents	*Aloe castanea* and *Aloe cryptopoda*
Climbers	*Clematis brachiata, Rhoicissus tridentate, Acacia ataxacantha* and *Sarcostemma viminale*
Graminoids	*Aristida canescens, Heteropogon contort* and *Panicum maximum*
Herbs	*Berkheya insignis, Commelina Africana* and *Cyphostemma woodii*
Geophytic herbs	*Hypoxis rigidula* and *Sansevieria hyacinthoides*
Succulent herbs	*Huernia stapelioides*

Sekhukhune Mountain Bushveld is considered Least Threatened. It is an endemic vegetation type to Limpopo of which 0.5% is conserved. Approximately 13.4% has been transformed (Desmet *et al*. 2013) by anthropogenic impacts such as cultivation and urbanisation, erosion and donga formations, mining activities and alien invasions. *Melia azedarach* is the most significant invader in this vegetation type at the moment (Mucina & Rutherford 2006). Other common species that are present in this vegetation type are provided in Table 2.

The biogeographically important taxa expected in the area include *Lydenburgia cassinoides, Searsia sekhukhuniensis, Euclea sekhukhuniensis, Searsia batophylla, Petalidium oblongifolium, Plectranthus venteri, Asparagus sekukuniensis, Rhoicissus sekhukhuniensis, Chlorophytum cyperaceum* and *Raphionacme chimanimaniana.* Endemic taxa include *Acacia ormocarpoides, Plectranthus porcatus* and *Euphorbia sekukuniensis.*

4.2. Land Cover

The types of land cover in the study area include relatively natural Sekhukhune Plains and Mountain Bushveld, cultivated land, rivers and urban built up environments (Figure 3). The area designated for the proposed substation and power lines is subject to immense anthropogenic pressures, with a relatively small portion of the entire route still housing intact natural vegetation (Figure 3). Large areas of the original Sekhukhune Plains and Mountain Bushveld habitats in the study area have been transformed by agriculture, urbanisation, mining and other infrastructure.

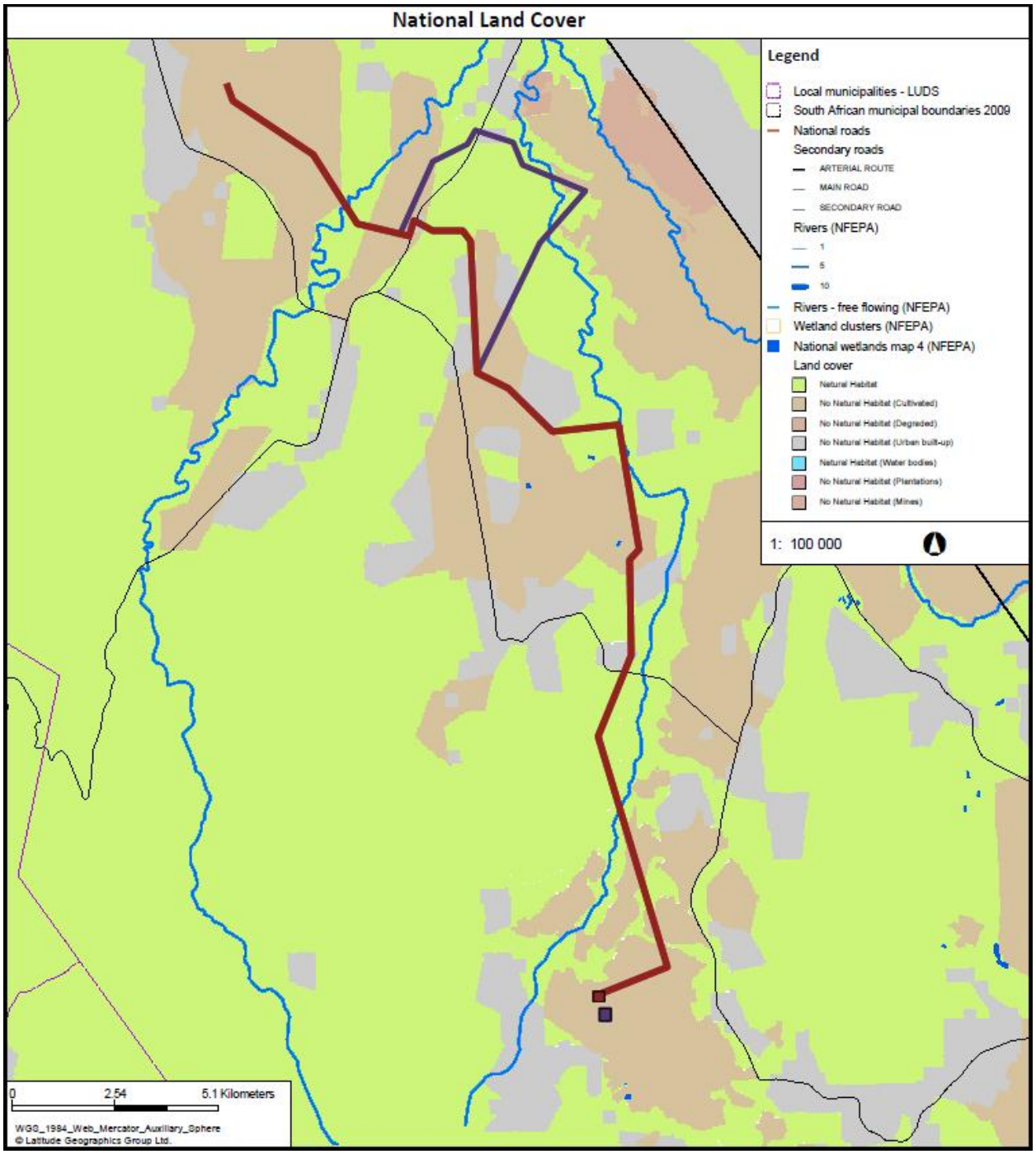

Figure 3 Depicts the land cover associated with the study area. The red line and square are Alternative 1 for the power lines and substation, whereas the purple line and square provide the location of Alterative 2 (modified from SANBI BGIS Land Use Decision Support Tool).

4.3. Conservation

The locations of the proposed power line routes and substation alternatives do not overlap with a Threatened Terrestrial Ecosystem (National Environmental Management: Biodiversity Act, Act no. 10 of 2004), cross the Core or Buffer areas of a protected area and will not affect any Focus areas for the National Protected Area Expansion Strategy (NPAES 2010).

However, as per the Limpopo Conservation Plan v.2: Technical Report (2013) both Alternative 1 and 2 cross Critical Biodiversity Areas i.e. Critical Biodiversity Area 1, Critical Biodiversity Area 2[1], Ecological Support Area 1 and Ecological Support Area 2[2]. Figure 4 provides the location of these areas relative to the power line routes.

The aim of the Limpopo Conservation Plan is to identify areas to sustain ecological and evolutionary processes to allow for the long term persitence of biodiversity. Climate change provision in the form of terrestrial and riverine corridors, hydrological processes and species requirements form the basis of the conservation plan. The particular features of the proposed development that included the site as priority area for the plan are listed below (Desmet *et al*. 2013):

- In terms of alignment with other plans the powerline crosses several sections considered by the Mpumalanga Biodiversity Conservation Plan (MBCP) as important and necessary.
- The site and the surrounding area house threatened plant species.
- The entire site falls within the Sekhukhuneland Centre of Endemism. The site is also adjacent to ridges and escarpments, with Alternative 1 crossing such an area.
- Both vegetation types associated with the proposed development are Endemic to Limpopo.

[1] Critical Biodiversity Areas 1 are "irreplaceable" areas where very limited/no alternative areas are available to meet targets.
Critical Biodiversity Areas 2 are "optimal" areas where other options are available, however the selected sites are best suited to meet targets.
[2] Ecological Support Areas 1 are areas that are in a relatively natural state.
Ecological Support Areas 2 are areas that are not in a natural state, but are important to maintain ecological processes.

Critical Biodiversity Areas 2 are "optimal" areas where other options are available, however the selected sites are best suited to meet targets.
[2] Ecological Support Areas 1 are areas that are in a relatively natural state.
Ecological Support Areas 2 are areas that are not in a natural state, but are important to maintain ecological processes.

- Sekhukhune Plains Bushveld is classified as a Vulnerable vegetation type and is poorly protected (1.2%). Sekhukhune Mountain Busheveld is classified a Least Threatened with barely any protection (0.5%). The level of degradation and transformation of the former is 13.4% and the latter is 32%.
- The site will also cross an Ecological Corridor.

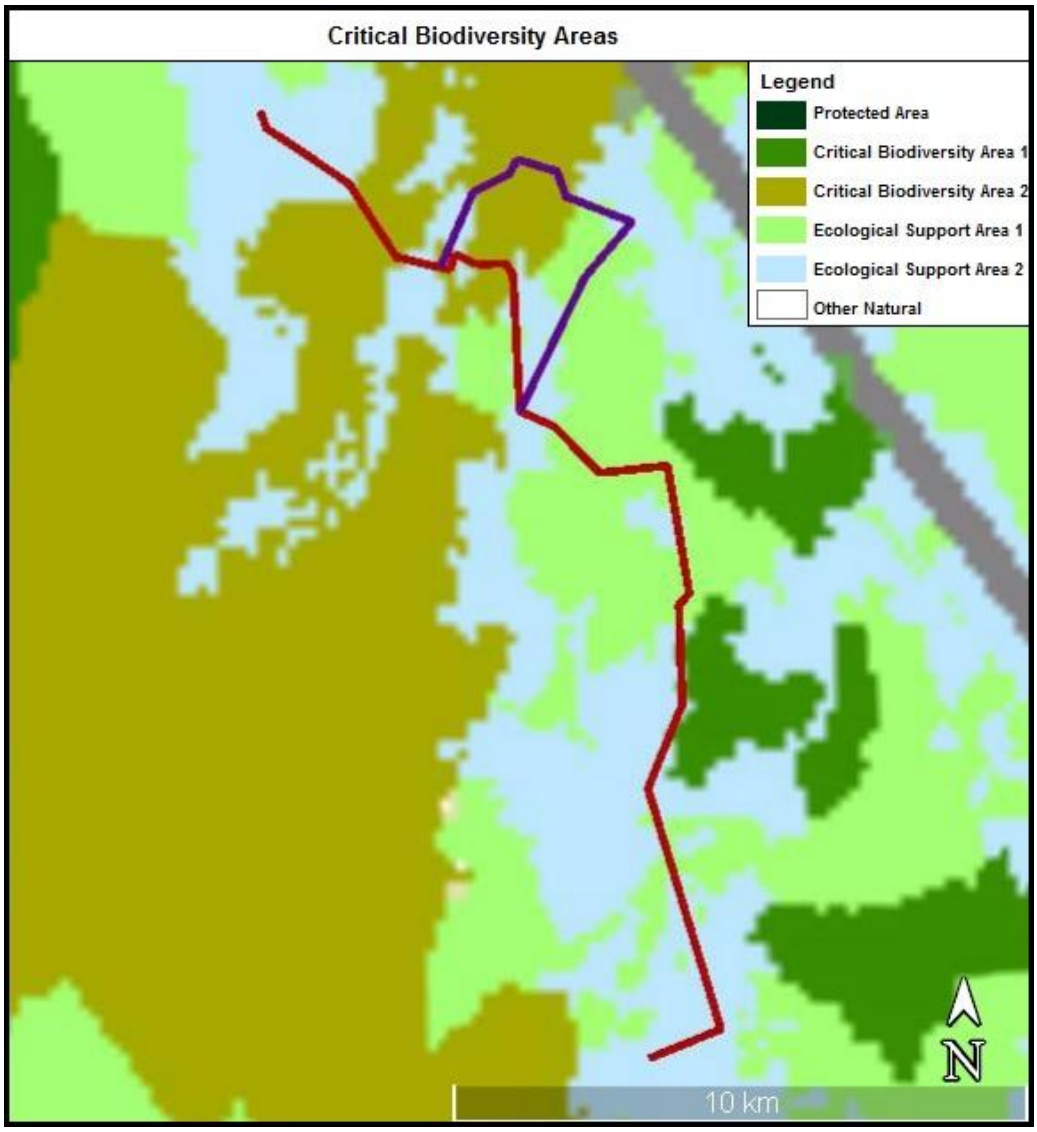

Figure 4 Provides the location of the Critical Biodiversity Areas relevant to the project. The red line is Alternative 1 for the power lines, whereas the purple line provides the location of Alterative 2 (modified from Google Earth and Desmet *et al.* 2013).

4.4. Description of existing vegetation units

The environmental variability and anthropogenic influences of the study area results in diverse vegetation patterns and site specific species composition. The following broad vegetation types were identified, followed by a description of each:

1. Plains Bushveld (Sekhukhune Plains Bushveld)
2. Mountain Bushveld (Sekhukhune Mountain Bushveld)
3. Rocky outcrops (Sekhukhune Plains Bushveld)
4. Riparian vegetation (Sekhukhune Plains Bushveld)
5. Erosion dongas (Sekhukhune Plains Bushveld)
6. Cultivated land (Sekhukhune Plains Bushveld)
7. Villages and built environments (Sekhukhune Plains Bushveld)

4.4.1. Plains Bushveld

The plains bushveld vegetation unit includes dense shrublands, sparse thornveld and open tree savanna. Surface rocks are widespread and may contribute large portions of the ground cover at some locations. *Acacia tortillis* subsp. *heteracantha, Dichrostachys cinerea* and *Ziziphus mucronata* are amongst the common tree and shrub species present in the shrublands. Bush encroachment by *Dichrostachys cinerea* was observed in several locations, forming dense stands. The removal of vegetation for various reasons, mentioned below, is a contributing factor to the open savanna areas observed. Large *Sclerocarya birrea* subsp. *caffra*, *Boscia foetida* subsp. *rehmanniana* and *Schotia brachypetala* trees occur scattered within this vegetation type.

Overgrazing by domestic livestock, bush encroachment, erosion and harvesting are some of the factors contributing to the degradation of this habitat. Few locations are expected to be in its natural state, with the veld ranging from natural veld with scattered aliens to heavy alien infestation. Disturbance of this vegetation type is evident from the presence of alien species such as *Xanthium strumarium* (Category 1 invader), *Zinnia peruviana, Agave sisalana* (Category 2 invader, NEM:BA listed invasive) and *Opuntia ficus-indica* (Category 1 invader, NEM:BA listed invasive).

Despite the high level of disturbance in this vegetation unit, the conservation value and ecosystem function is at a medium level. Contributing factors include the Vulnerable status of the Sekhukhune Plains Bushveld, as well as the presence of protected species. *Sclerocarya birrea* subsp. *caffra* (Marula), protected under the National Forests Act, Act no. 84 of 1998, is relatively common in this habitat type, particularly in the southern region of the proposed route, with *Philenoptera violacea* (Apple-leaf) also present. The presence of an *Orbea* species was also confirmed on site, all of which are protected by the Limpopo Environmental Management Act, Act no. 7 of 2003 and one of which is listed by NEM:BA as a Vulnerable Medicinal plant. This habitat type is interrupted by numerous erosion dongas and perennial and non-perennial watercourses, all of which house threatened and/or protected species (see sections 4.4.4 and 4.4.5 below).

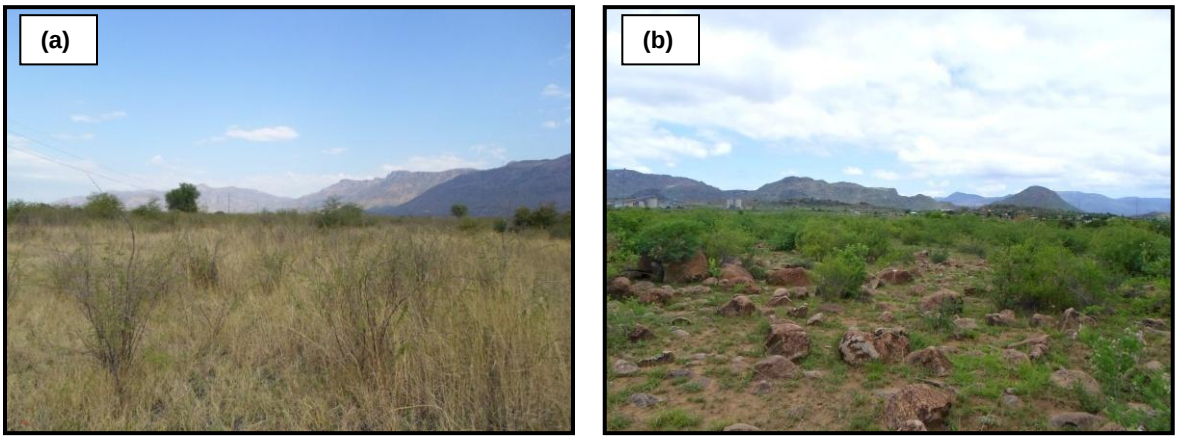

Figure 5 a) Provides a view of the plains bushveld vegetation unit with the initial stages of encroachment by *Dichrostachys cinerea*. **b)** Plains bushveld vegetation with rocky ground cover.

Table 3 Provides common species observed in the plains bushveld vegetation unit. The asterisk indicates alien species and/or declared invaders.

Species	Species	Species
Acacia karroo	*Corchorus confusus*	* *Opuntia ficus-indica*
Acacia mellifera subsp. *detinens X Acacia senegal* var. *leiorhachis*	*Croton gratissimus* var. *subgratissimus*	*Orbea* sp.
Acacia mellifera subsp. *detinens*	*Cynodon dactylon*	*Philenoptera violacea*
Acacia natalitia	*Dichrostachys cinerea*	*Polygala hottentotta*
Acacia nilotica var. *kraussiana*	*Digitaria eriantha*	*Ruellia patula*
Acacia tenuispina	*Diospyros lycioides* subsp. *lycioides*	*Schlerocarya birrea* subsp. *caffra*

Species	Species	Species
Acacia tortilis subsp. *heteracantha*	*Diospyros lycioides* subsp. *sericea*	*Schotia brachypetala*
Aloe cryptopoda	*Ehretia rigida* subsp. *nervifolia*	*Searsia engleri*
Asparagus laricinus	*Euclea crispa* subsp. *crispa*	*Seddera capensis*
Asparagus suaveolens	*Fingerhuthia africana*	*Solanum lichtensteinii*
Boscia foetida subsp. *rehmanniana*	*Grewia flava*	*Tapinanthus natalitius*
Bothriochloa insculpta	*Justicia protracta* subsp. *rhodesiana*	*Triaspis glaucophylla*
Cadaba termitaria	*Lantana rugosa*	*Ximenia americana* var. *microphylla*
Carissa bispinosa	*Lycium horridum*	** Zinnia peruviana*
Clematis brachiata	*Maerua cafra*	*Ziziphus mucronata*
Combretum hereoense	*Monechma divaricatum*	** Xanthium strumarium*

4.4.2. Mountain Bushveld

Mountain bushveld is present in Alternative 1 of the proposed development and consists of a small mountain with rocky ridges and mountain seeps. The terrain is to a large extent covered with protruding and surface rocks. The mountain lies in an approximately north-south direction, ranging from 830 m to 894 m a.s.l.

The canopy layer of this vegetation is somewhat higher than that of the plains bushveld, however it is largely shrubs with scattered patches of closed canopy bushveld. The dominant trees include *Acacia nigrescens, Kirkia wilmsii, Acacia senegal* var. *leiorhachis and Terminalia prunioides,* with the dominant shrubs *Croton menyharthii, Diospyros lycioides* and *Grewia vernicosa.* Prominent herbs include *Clerodendrum ternatum* and *Leucas capensis.* Graminoides include *Melinis nerviglumis* and *Enneapogon scoparius.*

The main sources of disturbance to this habitat are grazing, erosion and pollution, particularly at the foothills. However, it appears to be in a relatively natural state with a few scattered aliens e.g. *Tridax procumbens and Cryptostegia grandiflora* (NEM:BA listed invasive).

Sekhukhune Mountain Bushveld vegetation is classified as Least Concern. However, important and protected species can be expected in this habitat e.g. *Scadoxis puniceus* was observed, and is protected by the Limpopo Environmental Management Act, Act no. 7 of 2003.

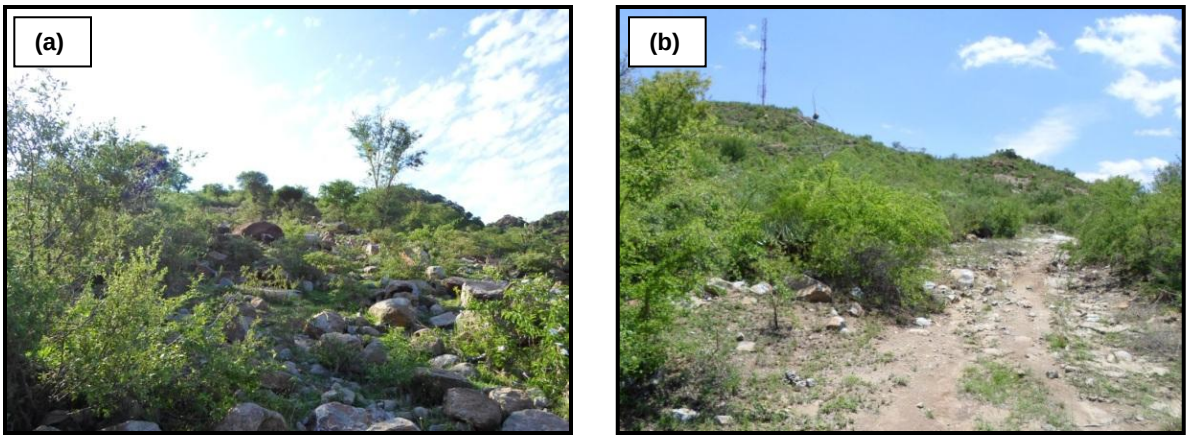

Figure 6 a) Provides a view of mountain bushveld vegetation. **b)** Erosion owing to overland runoff.

Table 4 Provides some of the species observed in this vegetation type. The asterisk indicates alien species and/or declared invaders.

Species	Species	Species
Acacia nigrescens	*Emilia transvaalensis*	*Kohautia caespitosa* subsp. *brachyloba*
Acacia senegal var. *leiorhachis*	*Enneapogon scoparius*	*Leucas capensis*
Adenia glauca	*Eragrostis pseudosclerantha*	*Melinis nerviglumis*
Aloe castanea	*Eragrostis superba*	*Mundulea sericea*
Aloe cryptopoda	*Eragrostis trichophora*	*Pechuel-Loeschea leubnitziae*
Bauhinia tomentosa	*Euphorbia tirucalli*	*Pellaea calomelanos* var. *calomelanos*
Canthium armatum	*Evolvulus alsinoides*	*Psiadia punctulata*
Clerodendrum ternatum	*Festuca scabra*	*Rhigozum obovatum*
Combretum molle	*Geigeria burkei*	*Scadoxus puniceus*
Commelina sp.	*Grewia flava*	*Senna italica* subsp. *arachoides*
Crossandra greenstockii	*Grewia vernicosa*	*Sida ovata*
Croton gratissimus var. *subgratissimus*	*Heliotropium ciliatum*	*Terminalia prunioides*
Croton menyharthii	*Indigofera schimperi* var. *schimperi*	*Tinnea rhodesiana*
* *Cryptostegia grandiflora*	*Karomia speciosa*	* *Tridax procumbens*
Diospyros lycioides subsp. *sericea*	*Kedrostis foetidissima*	*Vangueria infausta* subsp. *infausta*
Dodonaea viscosa var. *angustifolia*	*Kirkia wilmsii*	*Waltheria indica*

4.4.3. Rocky Outcrop

This vegetation type refers to the vegetation associated with isolated rocky outcrops. Rocky outcrops may be found intermittently along the route, however apart from the rocky areas in the mountain bushveld vegetation, few sites were observed.

Degradation of this habitat was observed to be trampling and browsing by domestic livestock and to a small extent pollution from surrounding villages. Alien species observed in this vegetation type include *Opuntia ficus-indica* (Category 1 invader, NEM:BA listed invasive) and *Catharanthus roseus* (proposed Category 3 invader, NEM:BA listed invasive).

Rocky outcrops generally represent an isolated, specialised habitat. Certain species associated with these habitats have been linked to species endemism, thus rocky outcrops is of high conservation value and ecosystem function (Siebert *et al.* 2003).

Owing to the small size of some of these outcrops, the vegetation is similar to the surrounding vegetation. However, large clumps of Aloe species may be expected in this habitat e.g. *Aloe castanea*. In addition, the presence of several important and protected species e.g. *Combretum imberbe* (National Forests Act, Act no. 84 of 1998), *Scadoxus puniceus* and *Hibiscus barnardii* (Limpopo Environmental Management Act, Act no. 7 of 2003) was also confirmed in this habitat type.

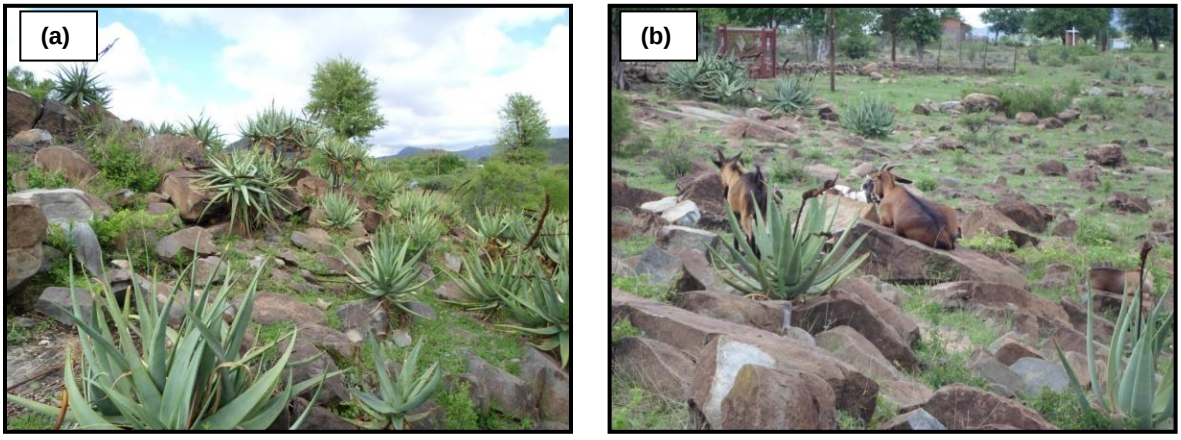

Figure 7 a) Provides an example of a rocky outcrop dominated by *Aloe castanea*. This outcrop is adjacent to Alternative 2 (30 m from the centre of the proposed route). **b)** The vegetation type is heavily impacted by browsing of domestic stock from neighbouring villages.

Table 5 Provides the species that were observed in this vegetation type. The asterisk indicates alien species and/or declared invaders.

Species	Species	Species
Abutilon sonneratianum cf.	*Cyphostemma sulcatum*	** Opuntia ficus-indica*
Acacia mellifera subsp. *detinens*	*Diospyros lycioides* subsp. *guerkei*	*Pechuel-Loeschea leubnitziae*
Acacia nigrescens	*Ehretia obtusifolia*	*Philyrophyllum schinzii*
Acacia tortilis subsp. *heteracantha*	*Eragrostis barbinodis*	*Ruellia cordata*
Aloe castanea	*Euphorbia tirucalli*	*Scadoxus puniceus*
Aptosimum lineare	*Geigeria burkei*	*Senna italica* subsp. *arachoides*
Asparagus suaveolens	*Gerbera jamesonii*	*Solanum delagoense*
Boscia foetida subsp. *rehmanniana*	*Hibiscus barnardi*	*Tephrosia purpurea* subsp. *leptostachya*
** Catharanthus roseus*	*Karomia speciosa*	*Terminalia prunioides*
Combretum imberbe	*Ledebouria* sp.	*Tinnea rhodesiana*
Corchorus confusus	*Melinis nerviglumis*	

4.4.4. Riparian Vegetation

Wetland delineation does not form part this report and requires investigation by a wetland specialist. However, riparian vegetation was found throughout the study area i.e. on the stream banks of perennial and non-perennial rivers (associated with the Motse and Moopetsi rivers). The vegetation consists largely of riverine thickets, however in certain areas large erosion dongas cause sparse vegetation cover.

A waterway, possibly a man made canal or diverted stream to accommodate infrastructure or mining activities, is also present (Figure 8d). The dominant species are *Cynodon dactylon, Xanthium strumarium* and *Cyperus sexangularis*. The stream is in poor condition with the presence of invasive species, pollution and severe overgrazing/trampling adjacent to the stream.

An apparent mountain seep will cross Alternative 1 of the proposed power line routes (Figure 8e). However, owing to its proximity to the village, it is subject to trampling, overgrazing and pollution. Alien vegetation was also observed here e.g. *Boerhavia erecta* and *Tridax procumbens.* Nonetheless, the seep should preferably be avoided for the placement of power line pylons. Plateau wetlands may also be present i.e. standing water was also observed adjacent to the proposed power line route (Figure 8f). However, it does not overlap with the

proposed development and is approximately 58 m from the centre of the proposed power lines between S24 27.856 E30 03.227 and S24 27.859 E30 03.250. Mountain seeps and plateau wetland are only associated and may be expected in the mountain bushveld vegetation.

Though the riparian vegetation serves an important ecological function with high conservation value it is subject to erosion, browsing pressure and infestations by alien vegetation. Some of the other alien species observed here include *Tagetes minuta*, *Solanum nigrum* and *Argemone ochroleuca* subsp. *ochroleuca* (Category 1 invader, NEM:BA listed invasive).

Several important and protected species were observed in this habitat e.g. *Combretum imberbe* (Leadwood) which is protected under the National Forests Act, Act no. 84 of 1998, and *Searsia batophylla* which is a Vulnerable Red Listed species and it is protected under Limpopo Environmental Management Act, Act no. 7 of 2003. *Spirostachys africana* was also recorded in this habitat and is also protected under the Limpopo Environmental Management Act, Act no. 7 of 2003.

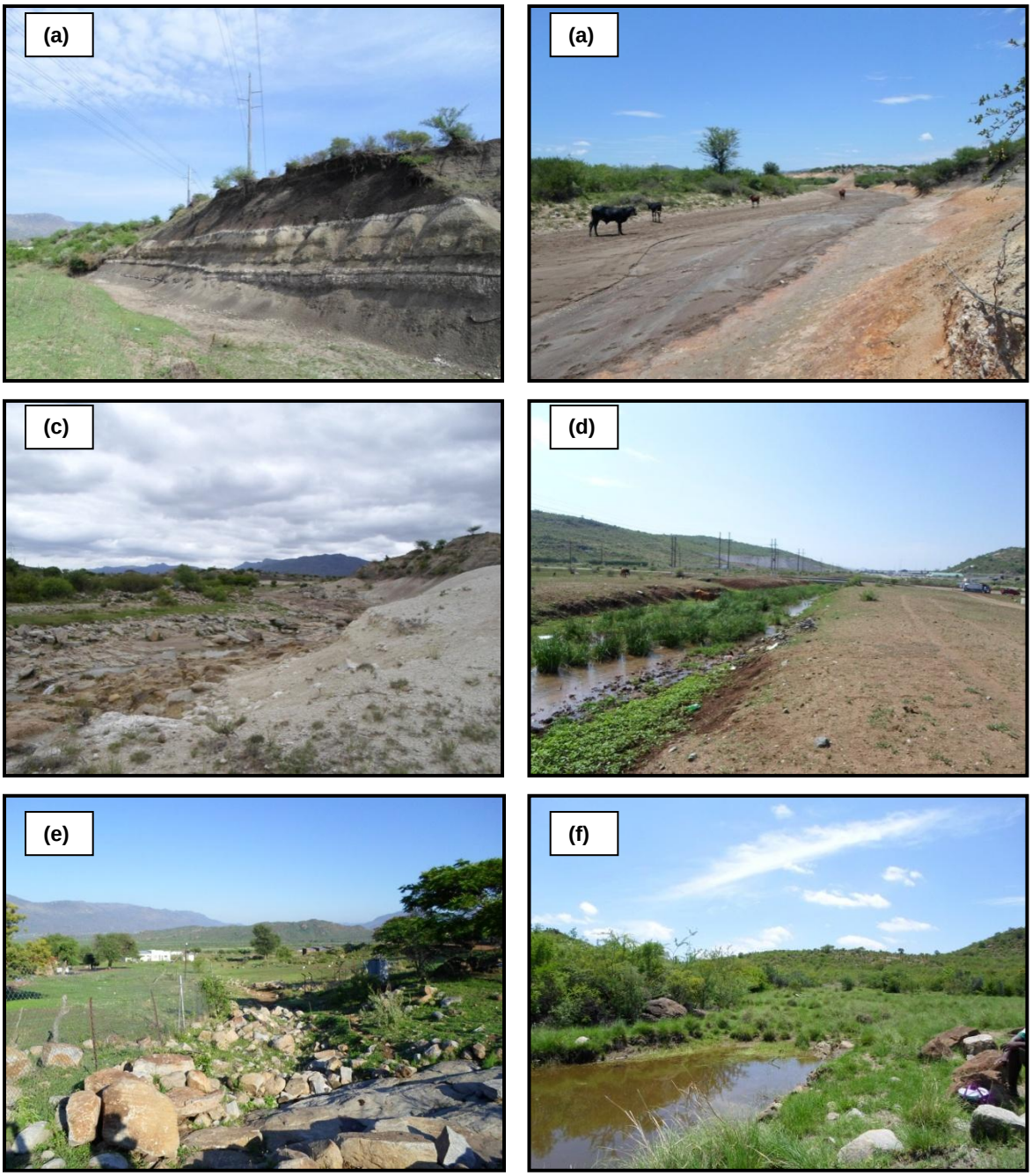

Figure 8 a-c) Provides examples of riparian vegetation of the Motse and Moopetsi rivers. **d)** Waterway with sparse vegetation possibly associated with mining activities. **e)** Possible mountain seep. **f)** Standing water on mountain plateau, approximately 50 m from the proposed power line route.

Table 6 The table provides some of the species observed in this vegetation type. The asterisk indicates alien species and/or declared invaders.

Species	Species	Species
Acacia karroo	*Cyperus sexangularis*	*Lobelia erinus*
Acacia mellifera subsp. *detinens*	*Cyphostemma sulcatum*	*Oenothera indecora*
Acacia nilotica var. *kraussiana*	** Datura stramonium*	*Ornithoglossum vulgare*
Acalypha glabrata var. *pilosa*	*Dichrostachys cinerea*	*Panicum deustum*
** Agave americana*	*Diheteropogon amplectens* var. *amplectens*	** Paspalum dilatatum*
** Argemone ochroleuca* subsp. *ochroleuca*	*Diospyros lycioides* subsp. *lycioides*	*Pechuel-Loeschea leubnitziae*
Asparagus suaveolens	*Diospyros lycioides* subsp. *nitens*	*Piriqueta capensis*
Blepharis subvolubilis	*Diospyros lycioides* subsp. *sericea*	*Polygala hottentotta*
** Boerhavia erecta*	*Eragrostis racemosa*	*Ruellia patula*
Bolusanthus speciosus	*Eragrostis superba*	*Searsia batophylla*
Canthium armatum	*Euphorbia tirucalli*	*Setaria spacelata*
Carissa bispinosa	*Felicia clavipilosa* subsp. *transvaalensis*	** Solanum nigrum*
Cleome gynandra	*Fingerhuthia africana*	*Spirostachys africana*
Coccinia sessilifolia	** Flaveria bidentis*	** Tagetes minuta*
Combretum erythrophyllum	** Galinsoga parviflora*	*Tarchonanthus camphoratus*
Combretum hereoense	*Geigeria burkei*	*Terminalia prunioides*
Combretum imberbe	*Gomphocarpus fruticosus* subsp. *decipiens*	*Themeda triandra*
Combretum mossambicense	*Gomphocarpus tomentosus*	** Tridax procumbens*
Commelina benghalensis	*Grewia flava*	*Urochloa mosambicensis*
Corchorus confusus	*Grewia vernicosa*	*Vangueria madagascariensis*
Croton menyharthii	*Gymnosporia buxifolia*	** Xanthium strumarium*
** Cryptostegia grandiflora*	*Leucas capensis*	** Zinnia peruviana*
Cynodon dactylon	*Leucas* sp.	*Ziziphus mucronata*

4.4.5. Erosion Donga

Erosion dongas form a natural part of the ecosystem in this area (Siebert *et al.* 2001). They are extremely common and are found throughout the study area, particularly at the foothills of mountains and in the proximity of rivers. The donga size, species composition and vegetation cover varies depending on the location, surrounding vegetation and edaphic features of the area.

Several important and protected species were observed and can be expected in this habitat i.e. *Combretum imberbe* (Leadwood) and *Acacia erioloba* (Camel thorn) (National Forests Act, Act no. 84 of 1998). However, this is also dependent on the surrounding vegetation e.g. dongas in the proximity of rivers or with active erosion may house more protected species e.g. *Searsia batophylla* have also been identified in this vegetation type (Siebert *et al.* 2001).

Apart from the substantial erosion degradation, these areas are subject to alien infestations. In some areas large patches of *Agave sisalana* (Category 2 invader, NEM:BA listed invasive) were observed with *Xanthium strumarium* (Category 1 invader) also very common. *Ricinus communis* var. *communis* (Category 2 invader, NEM:BA listed invasive) is also present.

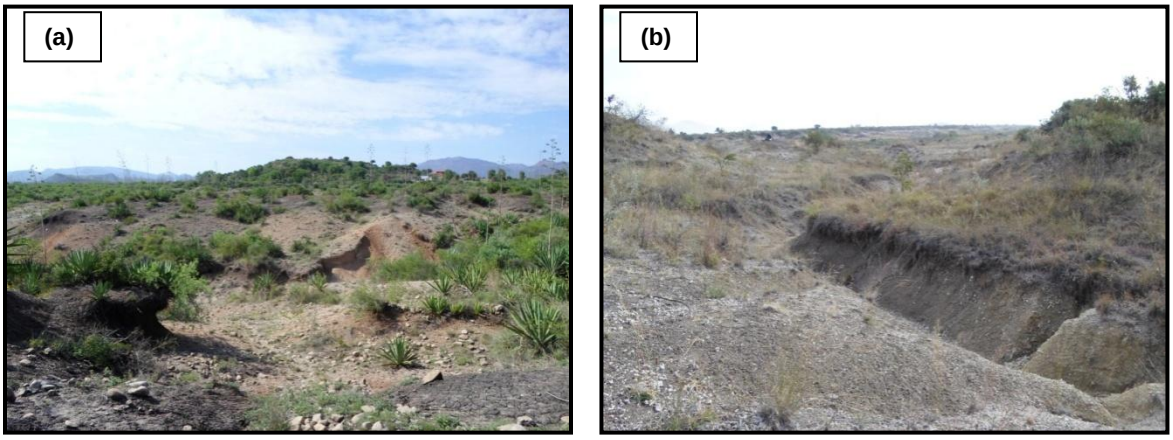

Figure 9 a) Provides an example of an erosion donga at the foothill of a mountain. **b)** An erosion donga next to the Moopetsi River.

Table 7 The table provides some of the species that were observed in this vegetation type. The asterisk indicates alien species and/or declared invaders.

Species	Species	Species
Acacia erioloba	*Ehretia rigida* subsp. *nervifolia*	*Pechuel-Loeschea leubnitziae*
Acacia mellifera subsp. *detinens*	*Elephantorrhiza goetzei* subsp. *goetzei*	*Peltophorum africanum*
Acacia nilotica var. *kraussiana*	*Eragrostis superba*	*Polygala hottentotta*
Acacia tortilis subsp. *heteracantha*	*Eragrostis trichophora*	* *Ricinus communis* var. *communis*
* *Agave sisalana*	*Euclea crispa* subsp. *crispa*	*Scabiosa columbaria*
Asparagus suaveolens	*Euclea undulata*	*Seddera capensis*
Boscia foetida subsp. *rehmanniana*	*Fingerhuthia africana*	*Senna italica* subsp. *arachoides*
Cadaba termitaria	*Geigeria burkei*	*Setaria sphacelata* var. *sphacelata*
Carissa bispinosa	*Grewia flava*	*Stipagrostis hirtigluma* subsp. *patula*
Combretum hereoense	*Grewia vernicosa*	*Tarchonanthus camphoratus*
Combretum imberbe	*Hirpicium bechuanense*	*Terminalia prunioides*
Cyphostemma sulcatum	*Jamesbrittenia atropurpurea* subsp. *atropurpurea*	* *Xanthium strumarium*
Dichrostachys cinerea	*Justicia protracta* subsp. *rhodesiana*	*Ximenia americana* var. *microphylla*
Diospyros lycioides subsp. *lycioides*		

4.4.6. Cultivated Land

This is Sekhukhune Plains Bushveld that has been transformed for cultivation activities. The vegetation type can be divided into current/recently cultivated land and old cultivated land. Cultivated land makes up the largest part of the study area i.e. approximately half of the total route.

Currently cultivated land has undergone considerable degradation, with complete removal of vegetation. It is mostly open fields, with large trees scattered across the area. Alien infestations are common with *Agave sisalana* (Category 2 invader, NEM:BA listed invasive) often used as barrier.

Old Cultivated land has undergone some recovery and shows a strong association with the plains bushveld described in Section 4.4.1., with vegetation ranging from dense shrublands to open tree savanna. Dominant tree and shrubs include *Ziziphus mucronata, Acacia tortillis* and *Peltophorum africanum*. Bush encroachment by *Dichrostachys cinerea* is also common. *Brachiaria eruciformis* and *Aristida transvaalensis* are common grasses in the area.

Several important and protected species were observed and can be expected in this habitat i.e. *Sclerocarya birrea* subsp. *caffra* (Marula) (National Forests Act, Act no. 84 of 1998). However, this is also dependent on the surrounding vegetation e.g. old cultivated land in the proximity of rivers or with active erosion may house more protected species.

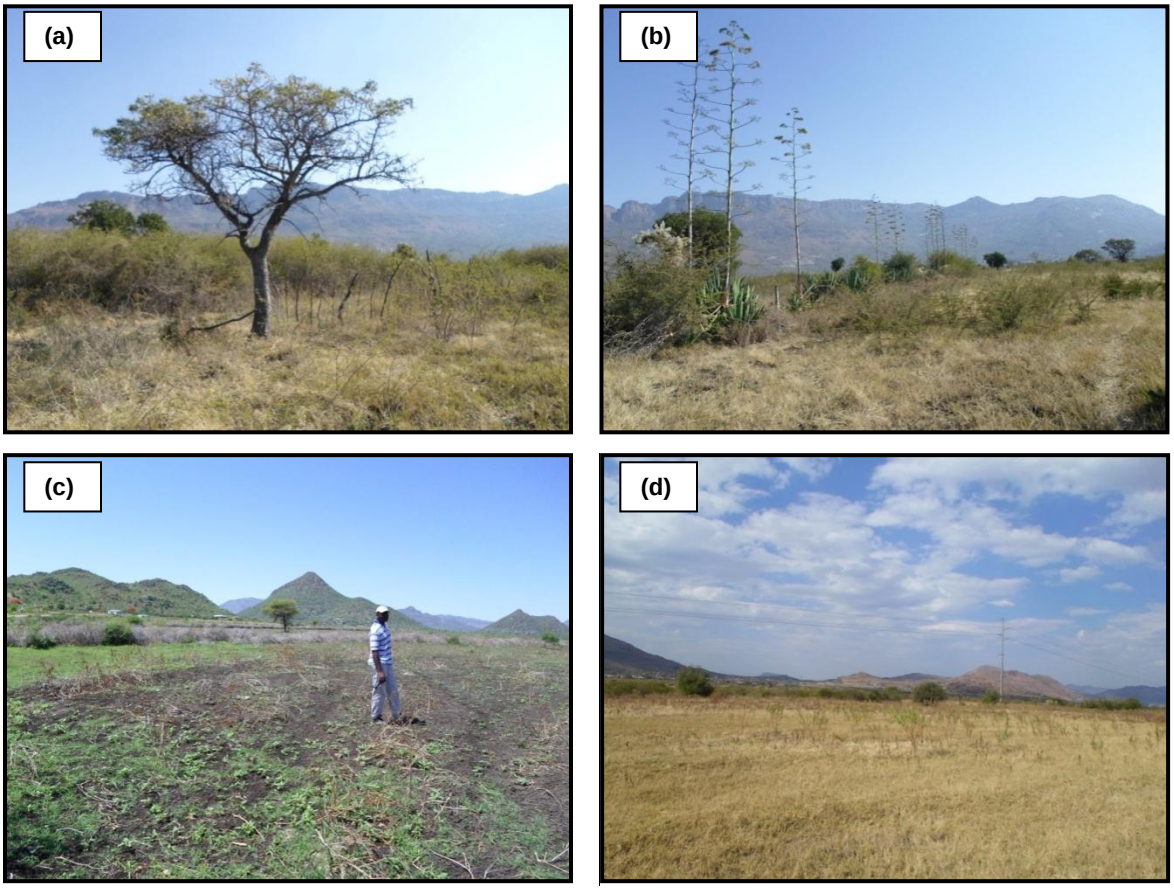

Figure 10 a) Provides an example of old and relatively recently cultivated land behind and in front of the fence respectively. Large *Sclerocarya birrea* (Marula) trees can be expected here. **b)** An *Agave sisalana* fence used between old agricultural lands. **c) - d)** Shows the vegetation condition in recently cultivated land.

Table 8 The table provides some of the species that were observed in this vegetation type. The asterisk indicates alien species and/or declared invaders.

Species	Species	Species
Acacia gerrardii	*Corchorus confusus*	*Philenoptera violacea*
Acacia karroo	*Dichrostachys cinerea*	*Schotia brachypetala*
Acacia nilotica var. *kraussiana*	*Diospyros lycioides* subsp. *lycioides*	*Sclerocarya birrea* subsp. *caffra*
Acacia tortilis subsp. *heteracantha*	*Erianthemum dregei*	*Searsia pyroides*
* *Agave sisalana*	*Euclea crispa* subsp. *crispa*	*Setaria spacelata*
Aristida transvaalensis	*Gomphocarpus fruticosus*	*Solanum lichtensteinii*
* *Bidens pilosa*	*Gymnosporia senegalensis*	* *Tagetes minuta*
Bolusanthus speciosus	*Heteropogon contortus*	*Vitex obovata* subsp. *wilmsii* cf.
Brachiaria eruciformis	*Ischaemum afrum*	* *Xanthium strumarium*
Clematis brachiata	* *Melia azedarach*	* *Zinnia peruviana*
Clerodendrum eriophyllum	*Melinis repens* subsp. *repens*	*Ziziphus mucronata*
Combretum hereoense	*Peltophorum africanum*	

4.4.7. Built Environments

The built environments consist largely of villages and the associated infrastructure, with no natural vegetation left. There are several large mines in the surrounding areas. The proposed route crosses pipelines and quarries possibly associated with these mines. The vegetation in the latter is in poor condition with sparse vegetation cover (Figure 11b).

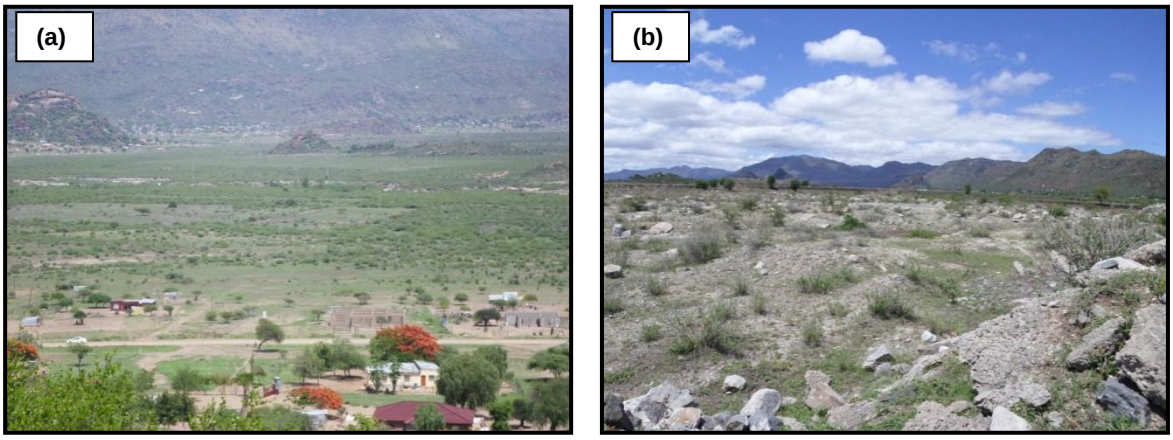

Figure 11 a) Provides a general view of the northern section of the proposed route of the power line, also depicting villages in the surrounding and crossing area. **b)** A quarry/dumping site which the proposed route will cross.

4.5. Species of Special Concern

The complete list of species identified can be found in the Appendix of this document (Table 17). The following section provides the classification of IUCN (International Union for Conservation of Nature) Red-listing for species in the study area[3]:

Critically Endangered (CR) This is when evidence suggests that a species meets one or more of the five IUCN criteria for CR. The risk of extinction for the species is thus extremely high.

Endangered (EN) This is when evidence suggests that a species meets one or more of the five IUCN criteria for EN. The risk of extinction for the species is therefore very high.

Vulnerable (VU) This is when evidence suggests that a species meets one or more of the five IUCN criteria for VU. The risk of extinction for the species is therefore high.

Near Threatened (NT) This is when evidence suggests that a species nearly meets any of the IUCN criteria for VU. The risk of extinction for the species in the near future is therefore likely.

[N]**Critically Rare** This is when a species occurs at only a single site, however it is not subject to any potential threat. The species also does not meet one of the five IUCN criteria to otherwise qualify for a category of threat.

[N]**Rare** This is when a species meets one or more of the four South African criteria for rarity, however it is not subject to any potential threat. The species also does not meet one of the five IUCN criteria to qualify for a category of threat.

The four South African criteria are as follows:

i. Restricted range, where the Extent of Occurrence (EOO) is less than 500 km^2.
ii. Habitat specialist, where a species is restricted to a specialized microhabitat. It therefore has a small Area of Occupancy (AOO), typically less than 20 km^2.

[3] The **N** refers to categories that are not IUCN, national Red List categories and are therefore listed Least Concern (LC). These species are not considered at risk of extinction; however they are of conservation concern.

iii. Low densities of individuals, where a species occurs as single individuals or small subpopulations i.e. usually fewer than 50 mature individuals, scattered over a wide area.

iv. Small global population, where a species consists of less than 10 000 mature individuals.

[N]**Declining** This is when threatening processes cause an ongoing decline of a species. However, it is not Critically Endangered, Endangered, Vulnerable or Near Threatened, as it does not meet or nearly meet any of the five IUCN criteria.

Least Concern This is when a species does not meet any of the IUCN criteria and does not warrant classification in any of the above categories. The species is widespread and abundant, and at a low risk of extinction.

Data Deficient - Insufficient Information (DDD) This is when insufficient information is available for an assessment. However the species is well defined and it could be classified as threatened with future research.

Data Deficient - Taxonomically Problematic (DDT) This is when taxonomic problems encumber the determination of the distribution range and habitat parameters of the species. Thus assessment of the extinction risk is not possible.

Not Evaluated (NE) This refers to species that have not been evaluated, as well as species that would not qualify for a national listing e.g. exotics and hybrids (natural or cultivated).

Table 9 List of threatened and protected species in the study area (2430AC and 2430CA quarter-degree grid squares species lists from SANBI POSA). Alt. refers to Altitude (m above sea level).

Family	Species	Threat status	SA Endemic	Habitat	Likelihood of occurrence
ACANTHACEAE	*Dicliptera fruticosa*	NT	No	Mixed bushveld with rocky or stony soil. Alt. 640-1065 m.	Likely
AMARYLLIDACEAE	*Crinum stuhlmannii*	Declining	No	Grassland, bushveld and on sandy soils in low altitudes areas. Lowveld bushveld in deep sand. Alt. 50-1450 m.	Likely

Family	Species	Threat status	SA Endemic	Habitat	Likelihood of occurrence
ANACARDIACEAE	***Searsia batophylla***	**VU**	**No**	**Watercourses in the vicinity of chrome deposits. Alt. 650-975 m.**	**Confirmed**
ANACARDIACEAE	*Searsia sekhukhuniensis*	Rare	No	Pyroxenite substrates of the Bushveld Igneous Complex eastern rim. Alt. 700-800 m.	Likely
AQUIFOLIACEAE	*Ilex mitis* var. *mitis*	Declining	No	Riverbands, streambeds, evergreen forests. Alt. 10-2130 m.	Likely
ARACEAE	*Zantedeschia jucunda*	VU	No	Mountainsides. Alt. up to 1830 m.	Likely
ASPARAGACEAE	*Asparagus intricatus*	DDT	No	Dry, rocky hills. Alt. not known.	Likely
ASPARAGACEAE	*Asparagus sekukuniensis*	EN	No	Hills. Alt. 730-960 m.	Likely
ASPHODELACEAE	*Aloe hardyi*	Rare	No	Typically in almost inaccessible areas on cliffs. Alt. 850-1430 m.	Not likely
CELASTRACEAE	*Elaeodendron transvaalense*	NT	No	Bushveld, woodland, along streams and on termite mounds. Alt. 200-1700 m.	Likely
CELASTRACEAE	*Lydenburgia cassinoides*	NT	No	Ravines, rocky hillsides, mountainsides. Alt. 335-1900 m.	Likely
COMBRETACEAE	*Combretum petrophilum*	Rare	No	Mountain slopes in mixed bushveld, typically among rocks. Alt. 977-1000 m.	Likely
EUPHORBIACEAE	*Acalypha caperonioides* var. *caperonioides*	DDT	No	Grassland. Alt. 455-2550 m.	Likely
EUPHORBIACEAE	*Euphorbia barnardii*	EN	No	Mixed bushveld, between sandstone boulders. Alt. 915-1400 m.	Likely
EUPHORBIACEAE	*Euphorbia sekukuniensis*	Rare	No	Alt. 915-1200 m.	Likely
FABACEAE	*Acacia sekhukhuniensis*	CR	No	An isolated, quartzite mountain plateau near the north-eastern border of Sekhukhuneland. Open woodland and wooded grassland. Alt. not known.	Likely
HYPOXIDACEAE	*Hypoxis hemerocallidea*	Declining	No	Grassland and mixed woodland. Alt. 50-1800 m.	Likely
IRIDACEAE	*Gladiolus sekukuniensis*	VU	No	Alt. up to 1000 m.	Likely
MESEMBRYANTHEMACEAE	*Delosperma rileyi*	DDD	No	Rocky grassland. Alt. 1200-1800 m.	Not likely
MYROTHAMNACEAE	*Myrothamnus flabellifolius*	DDT	No	Amongst rocky granite or sandstone outcrops and crevices with shallow soil. Alt. 365-1850 m.	Likely
MYRSINACEAE	*Rapanea melanophloeos*	Declining	No	Evergreen and riverine fringe forest. Sometimes in drier coastal and mountain forests. Alt. 5-2000 m.	Likely
ORCHIDACEAE	*Eulophia speciosa*	Declining	No	Bushveld and thorny bush of the lowveld, and mountain grassland. Alt. 5-1220 m.	Likely
PASSIFLORACEAE	*Adenia fruticosa* subsp. *fruticosa*	NT	No	Thorny bushveld, sandy soil and rocky places. Alt. 730-1250 m.	Likely

Family	Species	Threat status	SA Endemic	Habitat	Likelihood of occurrence
SCROPHULARIACEAE	*Nemesia zimbabwensis*	EN	No	Rocky outcrops. Often in forest on moist, rocky ledges. Alt. 1800 m.	Likely

*Take note that this only includes the species that have been evaluated and provided with a conservation status as per the IUCN red list of threatened species (POSA http://posa.sanbi.org on June 22, 2015).

There are 24 Red List species (according to the relevant POSA Grid Squares) that can be expected to occur in the study area, 21 with likely occurrence and 1 species (*Searsia batophylla* – Vulnerable A2c) confirmed on site. Owing to the length of the servitude and the range of habitats present on site, the presence of most of the species previously recorded in the area (and confirmed in the present study) is considered likely. In addition, *Asparagus* sp. was identified and certain species from this genus are also red listed.

Apart from the Red List species mentioned above and identified from the POSA relevant grid squares (Table 9) additional species of importance are also present on site. An *Orbea* sp. was identified, and all species from this genus are protected by the Limpopo Environmental Management Act, Act no.7 of 2003 and one is listed by NEM:BA as a Vulnerable Medicinal plant.

Furthermore, the presence of *Hibiscus barnardii, Scadoxis puniceus, Searsia batophylla* (also a Red List species), *Spirostachys africana, Euphorbia barnardii, Aloe cryptopoda* and *Orbea* sp., protected by the Limpopo Environmental Management Act, Act 7 of 2003, was also confirmed in the study area. Based on distribution (POSA relevant grid squares) the following species protected by the aforementioned act can also be expected: *Combretum petrophilum*, *Elephantorrhiza praetermissa, Aloe pretoriensis, Aloe verecunda, Aloe zebrina, Aloe hardyi, Brachystelma coddii, Ceropegia ampliata, Huernia kirkii, Huernia zebrina, Riocreuxia picta, Agapanthus inapertus, Zantedeschia jucunda,* and and *Papillaria Africana* (tree moss).

Philenoptera violaceae, Acacia erioloba, Sclerocarya birrea subsp. *caffra* and *Combretum imberbe* were observed on site and are protected by the National Forests Act, Act no. 84 of 1998. *Balanites maughamii* subsp. *maughamii, Catha edulis, Elaeodendron transvaalensis, Boscia albitrunca* and *Lydenburgia cassinoides* are also protected by the National Forests Act, Act no. 84 of 1998 and may also be expected on site (not confirmed).

4.6. Alien and invasive species

A total of 45 alien species can be expected in the study area, 22 of which have been confirmed on site during this study. There are 17 expected listed invasive species and one expected prohibited species in the study area (National Environmental Management Act, Act no.10 of 2004). In terms of CARA five Category 1 weeds, two Category 2 invaders and one Category 3 invader were indentified on site. All relevant alien and invasive species are provided in Table 10 below.

Table 10 Provides the species not indigenous to South Africa that may be expected in the study area from the POSA relevant grid square distribution, as well as the species confirmed on site (indicated with a bold font). The status of the species listed under CARA and NEM:BA are also provided.

Family	Species	CARA	NEM:BA
AGAVACEAE	***Agave sisalana***	**Category 2**	**Listed invasive**
AGAVACEAE	***Agave americana***	**Proposed Category 2**	**Listed invasive**
AMARANTHACEAE	*Amaranthus spinosus*	-	-
APOCYNACEAE	***Catharanthus roseus***	**-**	**Listed invasive**
APOCYNACEAE	*Cryptostegia grandiflora*	**-**	**Listed invasive**
ASTERACEAE	***Bidens pilosa***	**-**	**-**
ASTERACEAE	***Flaveria bidentis***	**-**	**Listed invasive**
ASTERACEAE	***Zinnia peruviana***	-	**-**
ASTERACEAE	*Cirsium vulgare*	**-**	Listed invasive
ASTERACEAE	*Conyza bonariensis*	**-**	-
ASTERACEAE	*Conyza sumatrensis* var. *sumatrensis*	**-**	**-**
ASTERACEAE	***Galinsoga parviflora***	**-**	**-**
ASTERACEAE	***Schkuhria pinnata***	-	**-**
ASTERACEAE	*Sonchus oleraceus*	**-**	**-**
ASTERACEAE	***Tagetes minuta***	**-**	**-**
ASTERACEAE	***Tridax procumbens***	-	**-**
ASTERACEAE	*Xanthium spinosum*	**-**	Listed invasive
ASTERACEAE	***Xanthium strumarium***	**Category 1**	**-**
CACTACEAE	***Opuntia ficus-indica***	**Category 1**	**Listed invasive**
CACTACEAE	***Opuntia humifusa***	**Category 1**	**Listed invasive**
CHENOPODIACEAE	*Chenopodium album*	-	-
CHENOPODIACEAE	*Chenopodium schraderianum*	**-**	**-**

Family	Species	CARA	NEM:BA
CONVOLVULACEAE	*Ipomoea carnea* subsp. *fistulosa*	-	Listed invasive
EUPHORBIACEAE	*Euphorbia indica*	**-**	**-**
EUPHORBIACEAE	***Ricinus communis* var. *communis***	**Category 2**	**Listed invasive**
FABACEAE	*Senna septemtrionalis*	-	Listed invasive
LAMIACEAE	*Salvia reflexa*	**-**	-
LAMIACEAE	*Salvia stenophylla*	-	**-**
MALVACEAE	*Hibiscus trionum*	**-**	**-**
MELIACEAE	***Melia azedarach***	**Category 3**	**Listed invasive**
NYCTAGINACEAE	***Boerhavia erecta***	-	-
ONAGRACEAE	***Oenothera indecora***	**-**	**-**
OXALIDACEAE	*Oxalis latifolia*	**-**	**-**
PAPAVERACEAE	***Argemone ochroleuca* subsp. *ochroleuca***	**Category 1**	**Listed invasive**
POACEAE	*Cymbopogon pospischilii*	-	-
POACEAE	**Paspalum dilatatum**	**-**	**-**
POLYGONACEAE	*Persicaria lapathifolia*	**-**	**-**
RANUNCULACEAE	*Ranunculus multifidus*	**-**	**-**
SALICACEAE	*Populus x canescens*	Category 2	Listed invasive
SOLANACEAE	***Datura stramonium***	**Category 1**	**Listed invasive**
SOLANACEAE	*Physalis peruviana*	-	-
SOLANACEAE	***Solanum nigrum***	**-**	**-**
VERBENACEAE	*Verbena brasiliensis*	**-**	Listed invasive
VERBENACEAE	*Verbena officinalis*	**-**	-
ZYGOPHYLLACEAE	*Tribulus terrestris*	**-**	Listed prohibited alien

5. SENSITIVITY ANALYSIS

A sensitivity analysis of all the vegetation types in the study area was performed. Each vegetation type was examined and rated, thereby providing a summary of the condition of the study area, as well as allowing for comparison of the route alignment options. The criteria used to assess each vegetation unit are provided in Table 11.

High sensitivity values indicate that the vegetation unit is in a natural state i.e. environment is relatively unaltered by human activity or subject to sustainable management. Whereas low sensitivity values indicate areas of little ecological value in terms of the vegetation e.g. areas negatively impacted by human activity. A high sensitivity value therefore indicates areas in which human disturbance and transformation would be detrimental, whereas areas of low

sensitivity values would be negatively impacted to a lesser degree. A summary of the sensitivity values for the different vegetation units is provided in Table 11.

Table 11 Provides the floristic sensitivity summary for each vegetation type in the study area.

Habitat / Feature	Plains Bushveld	Mountain Bushveld	Rocky outcrops	Riparian vegetation	Erosion dongas	Cultivated land	Built environ-ments
Species of special concern	40%	40%	70%	60%	35%	35%	0%
Absence of alien and invasive species	65%	70%	60%	60%	50%	50%	0%
Species richness	45%	60%	55%	75%	50%	45%	0%
Topographic attributes	10%	80%	60%	25%	10%	10%	0%
Ecological functions	50%	65%	60%	80%	30%	35%	0%
Absence of degradation and transformation	50%	65%	50%	60%	35%	20%	0%
Irreplaceability	60%	40%	60%	65%	25%	20%	0%
Vulnerability to disturbance	35%	60%	50%	75%	30%	30%	0%
Average	**44%**	**60%**	**58%**	**63%**	**33%**	**31%**	**0%**

The results suggest riparian vegetation (63%) has the highest level of sensitivity and will also be most sensitive to disturbance (Table 11). This is followed by mountain bushveld (60%), rocky outcrops (58%) and plains bushveld (44%). Erosion dongas (33%) and cultivated land (31%) have the lowest level of sensitivity and the development will have no expected impact on built environments.

Comparison of the sensitivity of the vegetation types along Alternative routes 1 and 2 suggested that Alternative 1 would be preferable to route 2. In terms of the substation sites, both are located on old cultivated land and therefore hold similar sensitivities.

Table 12 Provides the floristic sensitivity summary for each vegetation type in the study area. Note that rocky outcrops are not included in the analysis, as the only confirmed rocky outcrops were directly adjacent to the proposed route. It was however analysed as outcrops may be present along the route e.g. at the footslopes of small hills and mountains.

Routes		**Alternative 1**		**Alternative 2**	
Vegetation units	**Sensitivity (%)**	**Distance (km)**	**Total**	**Distance (km)**	**Total**
Plains Bushveld	44	4.8	212.1	7.2	316.0
Mountain Bushveld	60	0.6	35.1	0.0	0.0
Riparian vegetation	63	1.0	62.7	1.2	74.1
Erosion dongas	33	1.8	59.3	2.8	92.0
Cultivated land	31	11.5	355.7	12.9	398.7
Built environments	0	2.5	0.0	3.2	0.0
Total	-	**22.2**	**724.9**	**27.2**	**880.7**

Habitat condition was determined by assigning a broad habitat condition to the different vegetation types and adding those of similar condition. The result is provided in percentage (%) to allow for the variation in distance of the routes.

The results indicated that for both sites approximately half of the study area for both Alternative 1 and 2 have been transformed by cultivation activities and built environments. It also shows that Alternative 2 has a higher percentage of natural vegetation and degraded areas, with a lower percentage of transformed areas (Table 13). This is largely owing to the higher percentage of recently cultivated land and the lower percentage of near natural plains bushveld along route Alternative 1. However, the difference is relatively small.

Both proposed substation sites are on old cultivated land and have been moderately degraded by the presence of alien and invasive species i.e. there is no clear difference in the habitat condition between the two sites.

Table 13 Provides the comparison of habitat condition for power line Alternative 1 and 2, as well as the substation site Alternatives.

Habitat Condition	Percentage of habitat condition class (adding up to 100%)		Description and additional Comments and Observations (including additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc).
	Power line routes		
	Alternative 1	Alternative 2	
Natural	0	0	Both routes are between villages, mines and the associated infrastructure. An insignifacant portion of the routes are expected to be completely untouched by humans. Particularly as domestic livestock are free to browse and graze throughout the area. Erosion dongas are also common in the study area and is the result of natural and anthropogenic causes.
Near Natural (includes areas with low to moderate level of alien invasive plants)	28.8	30.7	Parts of the plains, mountain bushveld and riparian vegetation are still in a relatively natural state. However, alien vegetation is scattered throughout the study area with isolated patches of alien dominated vegetation.
Degraded (includes areas heavily invaded by alien plants)	20.0	21.5	Erosion dongas and old cultivated land represent degraded habitats with heavy alien infestations in certain sections. A quarry was also observed along the route with sparse vegetation and limited recovery thus far.
Transformed (includes cultivation, dams, urban, plantation, roads, etc)	51.3	47.7	This includes currently/recently cultivated land, as well as built environments e.g. roads, housing, mines etc.
Habitat Condition	**Substation sites**		**Description and additional Comments and Observations**
	Alternative 1	**Alternative 2**	
Near natural to Degraded (includes areas with moderate to heavy alien invasions)	100	100	Both sites are located on old cultivated land, with patches of alien infestations.

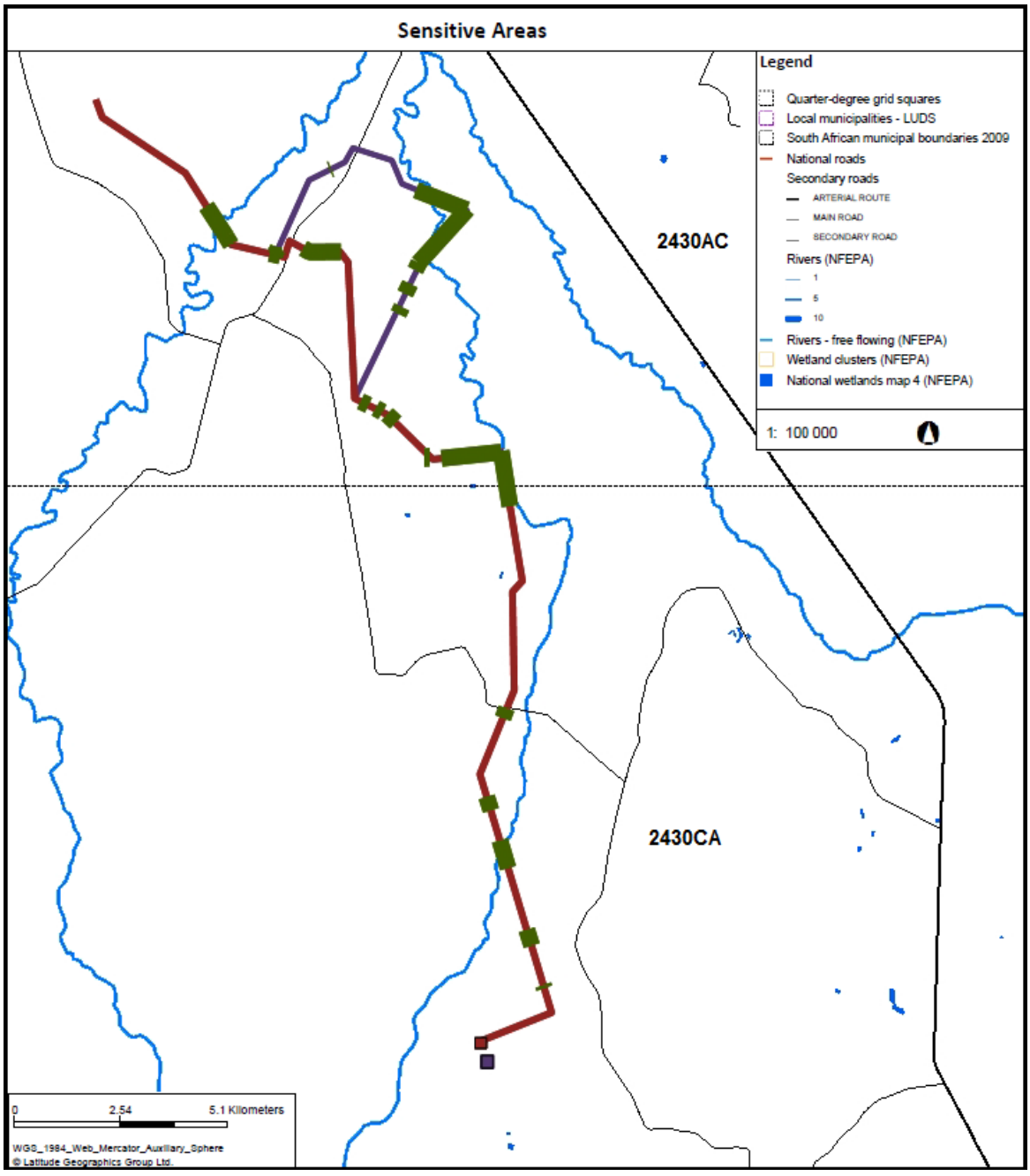

Figure 12 This map provides an indication of sensitive areas along the proposed routes. The red line and square represent Alternative 1 for the power lines and substation, and the purple line and square represent Alternative 2. The green sections are sensitive areas.

The sensitive areas (Figure 12) include riparian vegetation, mountainous areas e.g. steep slopes, plateaus and ridges, as well as near natural plains bushveld and potentially sensitive erosion dongas. Also take note that the southern part of the proposed development is in the

2430CA quarter-degree grid square, which is one of the two grid squares central to the distribution of the Sekhukhuneland endemic taxa (Siebert *et al.* 2001).

6. IMPACT ASSESSMENT

An impact assessment was conducted to determine the significance of any environmental impacts associated with the construction, operation and decommissioning of the proposed development. The criteria used to determine the significance of the impacts include the nature, extent, duration, intensity, probability, reversibility and mitigation potential.

6.1. Impact identification

The activities responsible for the impacts of the proposed project on the vegetation include both the construction and maintenance (operational) phases of the development. Identification of these impacts during the planning phase of the development will assist in the reduction thereof. The reversibility of the impact is indicated in brackets.

The following activities have been identified as sources of vegetation disturbances:

a) Site clearing to accommodate the **development footprint** i.e. pylon and substation areas, as well as the access roads. This will be associated with habitat destruction and it will be the main source of natural vegetation removal. (Irreversible)
b) Clearing and trimming of natural vegetation will be associated with **power line maintenance.** (Reversible)
c) In addition there will be disturbance and damaging of surrounding vegetation e.g. trampling owing to the pylon and substation **construction activities**, in and around **camp/office sites**, as well as during general servitude **maintenance**. (Reversible)
d) The **movement of people** on the construction site, as well as for maintenance activities may result in the introduction and spread of alien species. (Reversible)
e) Owing to the **increased human activity** during the construction phase for both development activities there may also be an increase in pollution e.g. littering, dumping of construction and maintenance materials, spillages and dust generation, as well as an increase in the risk of veld fires. (Reversible)

f) There will be soil disturbance in and surrounding the **development footprint**, owing to the removal and disturbance of vegetation, compacting relating to construction activities as well as pollution and chemical spillages. (Reversible)

Note that the indirect impacts of vegetation removal and disturbance mentioned above include the increase in habitat loss and fragmentation, the removal of threatened and protected species, ecological function and soil erosion. These are taken into account in the impact analyses and included in the mitigation measures.

6.2. Impact prediction and evaluation

The criteria used to determine the nature and significance of the impacts include the extent, duration, intensity and probability and will be assessed as follows:

Extent

(1) Site specific
(2) Regional refers to the site and its immediate surroundings
(3) National
(4) International
(5) Global

Duration (impact lifespan)

(1) Short term (0-5 years), thus the impact will be insignificant/restored either by mitigation or natural causes
(2) Medium term (6-15 years)
(3) Periodical
(4) Long term (more than 15 years) refers to when the impact will exist throughout the operational phase with or without mitigation measures
(5) Permanent (irreversible)

Intensity (Severity)

(1) Low i.e. when environmental functioning is unaffected

(2) Medium, where the impact is temporary and localized, however environmental processes are modified
(3) High i.e. when environmental functions come to a temporary or permanent end

Probability (Likelihood of occurrence)

(1) Improbable i.e. a proven small possibility of the impact taking place
(2) Probable, when there is a possibility of the impact occurring
(3) Highly probable refers to when the impact will almost certainly occur
(4) Definite is when no measures of prevention or mitigation will avert the impact from taking place

Significance

(1) Low, where biodiversity would be inconsequentially affected and the decision to continue would not be influenced
(2) Moderate i.e. where mitigation measures should be implemented or else the impact should influence the decision to proceed with the development
(3) High, when the decision to continue will be influenced regardless of mitigation measures. When the risk of an irreversible negative or positive impact on biodiversity is high.

Table 14 Provides the power line impact analysis for the development during the construction and operational phases of Alternative 1. The mitigation measures referred to in this table are described in Section 6.3.

Impact nature	Extent	Duration	Intensity	Probability	Significance	Significance (Mitigated)
Habitat destruction						
Pylons footprint	1	4	2	4	**2.8**	**2.8**
Access road footprint	2	4	2	4	**3**	**3**
Safe clearing distance	1	4	3	3	**2.8**	**2.5**
Clearing and disturbance of natural vegetation						
Development footprints	1	4	2	3	**2.5**	**2**
Vegetation surrounding sites	1.5	3	2	2	**2.1**	**1.6**

Introduction and spread of alien species	2	5	2	2	**2.8**	**2**
Littering and dumping of material	1	4	1	2	**2**	**1.3**
Dust generation	2	4	2	3	**2.8**	**2.3**
Oil and chemical spills	2	2.5	2.5	2	**2.3**	**1.5**
Veld fires	2	1	2	1	**1.5**	**1.3**
Soil disturbance						
In and around the development footprint	2	3	2	3	**2.5**	**2.3**
Average					**2.5**	**2**

Table 15 Provides the power line impact analysis for the development during the construction and operational phases of Alternative 2. The mitigation measures referred to in this table are described in Section 6.3.

Impact nature	**Extent**	**Duration**	**Intensity**	**Probability**	**Significance**	**Significance (Mitigated)**
Habitat destruction						
Pylons footprint	1.5	4	2	4	**2.9**	**2.9**
Access road footprint	2	4	2	4	**3**	**3**
Safe clearing distance (maintenance)	1.5	4	3	3	**2.9**	**2.6**
Clearing and disturbance of natural vegetation						
Development footprint	1.5	4	2.5	3	**2.8**	**2.3**
Vegetation surrounding sites	1.5	3	2	2	**2.1**	**1.6**
Introduction and spread of alien species	2.5	5	2	2.5	**3**	**2.3**
Littering and dumping material	1.5	4	1	2	**2.1**	**1.4**
Dust generation	2	4	2	3	**2.8**	**2.3**
Oil and chemical spills	2	3	3	2	**2.5**	**1.8**
Veld fires	2	1	2	1	**1.5**	**1.3**
Soil disturbance						
In and around the development footprint	2	3	2	2.5	**2.4**	**2.1**
Average					**2.5**	**2.1**

Table 16 Provides the impact analysis during the construction and operational phases for the substation. The mitigation measures referred to in this table are described in Section 6.3.

Impact nature	Extent	Duration	Intensity	Probability	Significance	Significance (Mitigated)
Habitat destruction						
Substation	1	4	1.5	4	**2.6**	**2.6**
Access road footprint	1	4	1.5	4	**2.6**	**2.6**
Clearing and disturbance of natural vegetation						
Development footprints	1	4	1.5	4	**2.6**	**2.1**
Vegetation surrounding sites	1	3	1.5	2	**1.9**	**1.4**
Introduction and spread of alien species	2	5	2	2	**2.8**	**2**
Littering and dumping of material	1	4	1	2	**2**	**1**
Dust generation	1	3	2	3	**2.3**	**1.8**
Oil and chemical spills	2	3	3	2	**2.5**	**1.8**
Veld fires	2	1	2	1	**1.5**	**1.3**
Soil disturbance						
In and around the development footprint	1	3	2	3	**2.3**	**1.8**
Average					**2.3**	**1.8**

The impact analysis revealed that the impact of Alternative route 1 and 2 are of moderate significance thus suggesting that mitigation measures should be implemented. The significance of the impact for the routes is similar, however after mitigation measures the impact of Alternative route 1 is less than that of route 2 (Table 14 and 15).

As the habitat condition and sensitivity of both substation options are similar, only one impact analysis was conducted. The impact of the substation would have a moderate effect on the vegetation and mitigation measures should be implemented (Table 16).

6.3. Mitigation measures and management options

Remedial action can be achieved in several ways i.e. avoidance/prevention, mitigation (which includes minimization, site restoration and rehabilitation, and reduction of impacts by maintenance actions) and compensation (DEAT 2002). The first approach to limit the impacts

of a development should be avoidance and prevention. If an impact is unavoidable mitigation and compensation measures should be used to reduce the impact of activities.

The impacts include the following: habitat destruction, clearing of natural vegetation, removal of rare and protected species, vegetation disturbance, the spread and increase of alien vegetation, increased soil erosion, pollution and increased risk of veld fires. If not properly managed and mitigated it may have detrimental effects on the environment.

Irreversible impacts associated with the development will include the loss of habitat and removal of vegetation to accommodate the development footprint. The impacts of other activities are to a large degree reversible and can be mitigated to reduce the impacts. The following measures and guidelines are provided to ameliorate the impacts of the proposed development.

6.3.1. Habitat destruction

The development footprint i.e. pylons, substation, access road and the two 132 kV power line servitudes, and the associated habitat destruction allow for limited mitigation measures. Though the location of the footprint may be flexible and mitigation is possible, the footprint is a fixed area required for the safe construction and operation of the proposed project. However, removal and trimming of only the minimum required vegetation for safe operation will reduce the impact of the safe clearing distance of the power line and complete habitat destruction can be avoided.

6.3.2. Clearing and disturbance of natural vegetation

<u>Clearing and disturbance of natural vegetation</u>

The clearing of natural vegetation will be necessary for the development footprint i.e. substation, tower positions, access road and constructions camp/office site.

- Vegetation clearing should be conducted so as to minimize the number of trees and vegetation necessary to trim or clear for the above mentioned footprint.
- Designated areas must be identified during construction where workers are allowed, to minimize the impact of construction on the surrounding vegetation. Surrounding “no-go”

areas e.g. natural plain and mountain bushveld, rocky outcrops and riparian zones must be identified and avoided.

- The use of existing roads is suggested, where possible.
- Indigenous vegetation outside the statutory clearance distance of the conductors and not compromising the safe operation of the system should not be disturbed.
- The removal of riparian vegetation should be avoided where possible as per provincial legislation.
- Herbicides should be used and disposed of in accordance with the relevant legislation.
- Firewood should not be collected in the veld.
- The construction site and associated temporary buildings should be removed and the area should be rehabilitated upon completion of the construction phase.

Removal of protected species

Several protected species are expected to occur and have been confirmed along the power line routes, as well as the substation sites. As the tower and substation positions have not been determined, an additional botanical inspection is proposed to identify any rare or threatened plant species. Consultation with the landowner before the removal of valuable species should also be conducted. Measures to protect these species should then be established.

- *In situ* conservation is recommended for species of special concern i.e. these plants should not be removed e.g. the use of doglegs. This is particularly important for red list species such as *Searsia batophylla* (Vulnerable – 2Ac). This species has a restricted range and no further loss of habitat is recommended (http://redlist.sanbi.org/eiaguidelines.php.) *Searsia batophylla* can be expected in low-lying areas and along watercourses, 650-975 m above sea level.
- During the use of doglegs, areas housing this or other threatened or protected species should be fenced off prior to construction.
- In situations where the threatened and protected plants must be removed, Eskom may only do so after the required permission/permits have been obtained in accordance with national and provincial legislation.
- In the abovementioned situation the development of a search, rescue and recovery program is suggested for the protection of these species.

- Small aloes, other succulents and bulbous geophytes, not interfering with the construction and operation of the development e.g. the clearing distance of the power line, should not be removed or should be replanted where possible.

Spread and increase of alien vegetation

The introduction and spread of alien vegetation may be associated with the development during the construction and maintenance phases, as a result of the removal of natural vegetation as well as the movement of workers in and around the construction and camp sites. To ameliorate these impacts the following measures are recommended.

- Designated areas must be identified during construction where workers are allowed, to prevent the spread and establishment of alien species.
- "No-go" areas e.g. natural plain and mountain bushveld and riparian zones must be identified. These areas must be avoided, however where not possible regulation of activities in these areas should be used as a preventative measure to minimize the spread of alien species by removing the seeds from clothes and shoes e.g. *Bidens pilosa*.
- Where invasive plants and weeds have established as a result of construction activities, these should be identified and removed to prevent their spread.
- Weeds and invasive species already present on site should be eradicated in accordance with the Conservation of Agricultural Resources Act, Act 43 of 1983 and the National Environmental Management: Biodiversity Act, Act no 10 of 2004. This is not only a legislative requirement, but will also reduce the further spread of these species.
- The spillage of water should be avoided to limit the potential for weed and invader establishment and proliferation.
- There should be no dumping of materials in surrounding areas e.g. natural vegetation and bordering properties.
- Use only indigenous species for rehabilitation purposes and erosion control.

Pollution

Pollution in the form of littering, dumping of construction and maintenance material, dust generation and chemical spillages should be avoided, and in the event of pollution, the effects should be remedied.

- Any oil or chemical spillages should be assessed, contained and removed, and the area should be rehabilitated.
- No littering should be allowed during the construction and maintenance phases of the development.
- Designated areas must be assigned for the disposal of waste e.g. bins and stockpiles.
- Disposal sites and rubble stockpiles must be removed following the construction phase.
- Materials replaced during the maintenance phase should also be removed from the site.
- Dust generation associated with the access roads and construction activities can be limited by reducing the speed limit.

Veld fires

The occurrence of veld fires should be limited by means of the following:

- No open fires should be allowed on site.
- Fire extinguishers should be available on site and on vehicles.
- Dense vegetation and cut debris under the power lines increases the fire hazard and should thus be cleared and treated with herbicides.

6.3.3. Soil disturbance

Erosion is an existing problem in the area, particularly the plains bushveld vegetation where erosion dongas form, and should be properly managed to avoid further degradation of the vegetation.

- Soil erosion and habitat integrity at tower positions, access roads, river crossings, existing erosion dongas and slopes should be considered during the planning and construction phases of the development. It is crucial to minimize topsoil damage, prevent further erosion and maintain habitat condition of these areas.

- Vegetation near watercourses should be trimmed, rather than cleared, where possible, so as to minimize the erosion of stream banks.
- Disturbed areas of natural vegetation must be rehabilitated **immediately** to prevent soil erosion, where possible. It should be noted that erosion in this area is the result of both natural and anthropogenic causes, thus successful rehabilitation may be problematic in certain areas of Sekhukhune Mountain and Plains Bushveld.
- Where possible native top soils should be stored and reused to preserve and restore the seed bank, microorganisms and organic matter/nutrients.
- Construction-related soil compaction in vegetation restoration areas can be mitigated by loosening the structure of the soil and revegetation.
- A combination of endemic grass species should be used in the rehabilitation of soil erosion and compaction, at the start of the new growing season.

6.4. Monitoring

Though the prediction of biodiversity response to the removal and disturbance of vegetation is possible to a degree, deviation owing to environmental and temporal variables, particularly over long periods of time, limits predictability. Appropriate monitoring is thus important to identify and address unforeseen negative impacts, as well as ensure the efficacy of mitigation measures to achieve management targets.

Regular auditing and provision of emergency response measures should therefore be included in the monitoring programme, where the floral integrity could be compromised.

An Environmental Control Officer should be appointed to audit the implementation of the mitigation measures and ensure compliance with the monitoring programme. The following monitoring measures are key to the mitigation of vegetation impacts:

- Unnecessary removal or disturbance of trees and other vegetation.
- Persistence of Red List species
- Removal of rubble, construction material and any form of spillages.
- Rehabilitation of erosion damage.

- Control of declared weeds and invaders as per the Conservation of Agricultural Resources Act, Act no. 43 of 1983 and the National Environmental Management Biodiversity Act, Act no 10 of 2004.

7. PROJECT OPTIONS

As the location of most of the power line route alternatives are shared the sensitivity and impact analysis showed little variation between the two routes. However, the results for both analyses suggest that Alternative 1 represents a preferable option to Alternative 2 in terms of the power line route.

Firstly, Alternative 1 is approximately 5.0 km shorter (approximately 25.5 ha less) than Alternative 2, therefore the loss of habitat will be less owing to the smaller development footprint. Second, is the variation in the vegetation types. Alternative 1 includes approximately 600 m of mountain Bushveld (sensitivity of 60%), a relatively sensitive vegetation type absent from Alternative 2, whereas Alternative 2 includes crossing the Moopetsi River and associated riparian vegetation (sensitivity of 62%) twice. Alternative 2 also puts a greater area of the Vulnerable Plains Bushveld vegetation at risk. Thirdly, though protected species are also present in mountain bushveld vegetation e.g. *Scadoxis pinuceus* (protected by provincial legislation), the riparian vegetation and the adjacent erosion dongas house numerous protected species e.g. *Searsia batophylla* (Red listed as Vulnerable) and *Combretum imberbe* (Protected tree). Note that these are also expected in the shared power line route, however Alternative 2 would result in more exposure of these species to the development. Finally, the habitat condition of Alternative 1 represents more transformed, with less degraded and near natural vegetation, compared to Alternative 2.

Alternative 1 and 2 for the location of the substation is on the same vegetation type i.e. old cultivated land and therefore represents similar habitat conditions, sensitivity and impacts. It is important to note that several large *Sclerocarya birrea* subsp. *caffra* (Marula) trees are present on both sites. *Philenoptera violacea* (Apple leaf) was also recorded in this area, however only one small plant was observed. These are scattered across the entire area and should be avoided as far as possible.

The “no-go” option would mean the study area would be unaffected and unaltered by the proposed development. However, unless rehabilitation and conservation action is taken, anthropogenic pressure e.g. mining activities, cultivation, urbanisation and overgrazing may place pressure on the habitat integrity and threatened and protected species in the area regardless of the proposed development.

8. CONCLUSION

Though the largest part of the study area is located in Sekhukhune Plains Bushveld, anthropogenic impacts have severely degraded certain areas. In addition, an existing power line follows the route for a substantial distance in the area adjacent to the proposed power line route. This, together with the level of degradation associated with this vegetation type may therefore ameliorate the effect of erecting two additional power lines.

In terms of site sensitivity mountain bushveld and riparian vegetation was found to be the most sensitive of the vegetation units identified. Mountain bushveld is only found along Alternative 1, however Alternative 2 includes two river crossings housing sensitive riparian vegetation. This together with the fact that the largest part of the route alternatives is shared resulted in the low sensitivity variation between Alternative 1 and 2. However, Alternative 1 represented the less sensitive route option.

The impact analysis suggested that both Alternative 1 and 2 of the power line routes will have moderate to high impacts prior to mitigation. The use of mitigation measures is expected reduce these negative environmental impacts to moderate. There was very little difference in the impact assessment results between Alternative 1 and 2, which is largely owing to the fact that a large portion of the routes is shared. However, after mitigation measures are implemented Alternative 1 represents the option with the lowest impact.

The substation alternatives are expected to show insignificant variation owing to the proximity of these areas to one another and the resulting overlap in species composition and habitat condition. Both these sites are located on old agricultural land. Though this is not a sensitive habitat and have been subject to prior disturbance and transformation, several *Sclerocarya birrea* subsp. *caffra* (Marula) trees ranging from small (<1 m in height) to large (>4 m in height) occur on both sites.

In conclusion, Alternative 1 was found to represent a lower environmental risk based on the shorter distance, lower sensitivity and lower mitigated impact. However, the limited variation suggests that no one alternative require complete exclusion as an option.

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APPENDIX

Table 17 Species list for all the identifiable taxa observed in the study area. The asterisk indicates alien and invasive species.

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
ACANTHACEAE	*Ruellia cordata*	Herb	0.5
ACANTHACEAE	*Blepharis subvolubilis*	Shrub	0.5
ACANTHACEAE	*Crossandra greenstockii*	Herb	0.6
ACANTHACEAE	*Justicia protracta* subsp. *rhodesiana*	Herb or shrublet	2.0
ACANTHACEAE	*Monechma divaricatum*	Shrub	1.0
ACANTHACEAE	*Ruellia patula*	Shrub	0.5
AGAVACEAE	* *Agave americana*	Shrub	2.0
AGAVACEAE	* *Agave sisalana*	Shrub	2.0
AMARANTHACEAE	*Alternanthera pungens*	Herb	0.3
AMARYLLIDACEAE	*Scadoxus puniceus*	Herb	0.75
ANACARDIACEAE	*Sclerocarya birrea* subsp. *caffra*	Tree	17.0
ANACARDIACEAE	*Searsia batophylla*	Shrub	2.0
ANACARDIACEAE	*Searsia engleri*	Shrub or small tree	4.0
ANACARDIACEAE	*Searsia leptodictya*	Shrub or tree	9.0
ANACARDIACEAE	*Searsia pyroides*	Shrub or small tree	6.0
APOCYNACEAE	* *Catharanthus roseus*	Herb	1.0
APOCYNACEAE	*Carissa bispinosa*	Shrub or small tree	5.0
APOCYNACEAE	*Cryptostegia grandiflora*	Climber	
APOCYNACEAE	*Gomphocarpus fruticosus*	Shrub	4.0
APOCYNACEAE	*Gomphocarpus tomentosus*	Shrub	2.0
ASCLEPIADACEAE	*Orbea* sp.	-	-
ASPARAGACEAE	*Asparagus laricinus*	Shrub	2.5
ASPARAGACEAE	*Asparagus* sp.	-	-

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
ASPARAGACEAE	*Asparagus suaveolens*	Shrub	1.0
ASPHODELACEAE	*Aloe castanea*	Arborescent succulent	4.0
ASPHODELACEAE	*Aloe cryptopoda*	Shrub, succulent	2.7
ASTERACEAE	* *Zinnia peruviana*	Herb	0.5
ASTERACEAE	* *Bidens pilosa*	Herb	1.5
ASTERACEAE	**Schkuhria pinnata*	Herb	0.6
ASTERACEAE	* *Tagetes minuta*	Herb	3.0
ASTERACEAE	* *Tridax procumbens*	Herb	0.3
ASTERACEAE	* *Xanthium strumarium*	Herb	1.5
ASTERACEAE	**Galinsoga parviflora*	Herb	0.5
ASTERACEAE	*Doellia cafra*	Herb	1.0
ASTERACEAE	*Felicia clavipilosa* subsp. *Transvaalensis*	Shrub	0.6
ASTERACEAE	*Geigeria burkei* subsp. *burkei* var. *burkei*	Herb	0.7
ASTERACEAE	*Geigeria burkei* subsp. *diffusa* cf.	Herb	1.0
ASTERACEAE	*Gerbera jamesonii*	Herb	0.7
ASTERACEAE	*Hirpicium bechuanense*	Subshrub	0.4
ASTERACEAE	*Litogyne gariepina*	Herb	1.0
ASTERACEAE	*Pechuel-Loeschea leubnitziae*	Shrub	1.3
ASTERACEAE	*Philyrophyllum schinzii*	Herb	0.4
ASTERACEAE	*Psiadia punctulata*	Shrub	2.0
ASTERACEAE	*Tarchonanthus camphoratus*	Shrub or small tree	9.0
ASTERACEAE	* *Flaveria bidentis*	Herb	1.2
BIGNONIACEAE	*Rhigozum obovatum*	Shrub or small tree	4.5
BORAGINACEAE	*Ehretia obtusifolia*	Shrub or small tree	4.5
BORAGINACEAE	*Ehretia rigida* subsp. *nervifolia*	Shrub or small tree	12
BORAGINACEAE	*Heliotropium ciliatum*	Perennial herb	0.8
CACTACEAE	* *Opuntia ficus-indica*	Shrub, succulent	5.0

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
CACTACEAE	* *Opuntia humifusa*	Succulent	-
CAESALPINIOIDEAE	*Peltophorum africanum*	Tree	10.0
CAPPARACEAE	*Boscia foetida* subsp. *rehmanniana*	Tree	4.0
CAPPARACEAE	*Cadaba termitaria*	Shrub	3.0
CAPPARACEAE	*Cleome gynandra*	Herb	0.6
CAPPARACEAE	*Maerua cafra*	Shrub or tree	9.0
CAPPARACEAE	*Maerua angolensis* subsp. *angolensis*	Shrub or tree	10.0
CELASTRACEAE	*Gymnosporia buxifolia*	Shrub or small tree	3.0
CELASTRACEAE	*Gymnosporia senegalensis*	Shrub or tree	4.0
COLCHICACEAE	*Ornithoglossum vulgare*	Geophyte	1.5
COMBRETACEAE	*Combretum erythrophyllum*	Shrub or tree	30.0
COMBRETACEAE	*Combretum hereoense*	Tree	10.0
COMBRETACEAE	*Combretum imberbe*	Tree or shrub	15.0
COMBRETACEAE	*Combretum molle*	Tree	12.0
COMBRETACEAE	*Combretum mossambicense*	Climber, shrub or tree	13.0
COMBRETACEAE	*Terminalia prunioides*	Shrub or small tree	7.0
COMMELINACEAE	*Commelina benghalensis*	Herb	0.9
COMMELINACEAE	*Commelina* sp.	-	-
CONVOLVULACEAE	*Evolvulus alsinoides*	Herb	0.6
CONVOLVULACEAE	*Seddera capensis*	Subshrub	0.2
CONVOLVULACEAE	*Xenostegia tridentata* subsp. *angustifolia*	Herb	-
CRASSULACEAE	*Kalanchoe luciae* subsp. *luciae* cf.	Shrub	2.0
CUCURBITACEAE	*Coccinia sessilifolia*	Climber, herb, succulent	5.0
CUCURBITACEAE	*Kedrostis foetidissima*	Herb or climber	3.0
CYPERACEAE	*Cyperus sexangularis*	Hydrophyte, helophyte, herb	1.5
CYPERACEAE	*Fuirena pubescens*	Helophyte, herb	1.0
DIPSACACEAE	*Scabiosa columbaria*	Herb	1.5

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
EBENACEAE	*Diospyros lycioides* subsp. *guerkei*	Shrub	7.0
EBENACEAE	*Diospyros lycioides* subsp. *lycioides*	Shrub or small tree	7.0
EBENACEAE	*Diospyros lycioides* subsp. *nitens*	Shrub	1.5
EBENACEAE	*Diospyros lycioides* subsp. *sericea*	Shrub or small tree	7.0
EBENACEAE	*Euclea crispa* subsp. *crispa*	Shrub or tree	20.0
EBENACEAE	*Euclea undulata*	Shrub or small tree	7.0
EUPHORBIACEAE	* *Ricinus communis* var. *communis*	Shrub or small tree	4.0
EUPHORBIACEAE	*Acalypha glabrata* var. *pilosa*	Herb or shrub	2.0
EUPHORBIACEAE	*Acalypha villicaulis*	Perennial herb	1.0
EUPHORBIACEAE	*Croton gratissimus* var. *subgratissimus*	Shrub or small tree	10.0
EUPHORBIACEAE	*Croton menyharthii*	Shrub or small tree	4.0
EUPHORBIACEAE	*Euphorbia barnardii*	Shrub, succulent	0.6
EUPHORBIACEAE	*Euphorbia tirucalli*	Tree	10.0
EUPHORBIACEAE	*Jatropha erythropoda*	Dwarf shrub, succulent	0.2
EUPHORBIACEAE	*Spirostachys africana*	Tree	15.0
EUPHORBIACEAE	*Tragia* sp.	-	-
FABACEAE	*Tephrosia purpurea* subsp. *leptostachya*	Shrub	0.6
FABACEAE	*Acacia caffra*	Tree	8.0
FABACEAE	*Acacia erioloba*	Shrub or tree	16.0
FABACEAE	*Acacia gerrardii*	Tree	8.0
FABACEAE	*Acacia karroo*	Tree	15.0
FABACEAE	*Acacia luederitzii* var. *retinens*	Shrub or tree	15.0
FABACEAE	*Acacia mellifera* subsp. *detinens*	Shrub or small tree	7.0
FABACEAE	*Acacia mellifera* subsp. *detinens X Acacia senegal* var.*leiorhachis (possibly Acacia laeta)*[4]	Shrub or tree	-

[4] The true classification of this species has not been established yet. However, it is expected to either be a cross between *Acacia mellifera* subsp. *detinens* and *Acacia Senegal* var. *leiorhachis* or it may be *Acacia laeta*. It has more pairs of pinnae and leaflets than *Acacia mellifera* and it has three hooks pointing downwards (from http://www.acacia-world.net/index.php/africa-me/south-africa/acacia-mellifera-ssp-detinens/acacia-laeta).

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
FABACEAE	*Acacia natalitia*	Tree	8.0
FABACEAE	*Acacia nigrescens*	Tree	20.0
FABACEAE	*Acacia nilotica* var. *kraussiana*	Tree	10.0
FABACEAE	*Acacia robusta* subsp. *robusta*	Tree	20.0
FABACEAE	*Acacia senegal* var. *rostrata*	Shrub or tree	8.0
FABACEAE	*Acacia senegal* var. *leiorhachis*	Tree	8.0
FABACEAE	*Acacia tenuispina*	Shrub	2.4
FABACEAE	*Acacia tortilis* subsp. *heteracantha*	Tree	20.0
FABACEAE	*Bauhinia tomentosa*	Shrub or small tree	8.0
FABACEAE	*Bolusanthus speciosus*	Tree	7.0
FABACEAE	*Crotalaria* sp.	-	-
FABACEAE	*Dichrostachys cinerea*	Shrub or small tree	6.0
FABACEAE	*Elephantorrhiza goetzei* subsp. *goetzei*	Shrub or small tree	7.0
FABACEAE	*Indigofera schimperi* var. *schimperi*	Shrub	1.0
FABACEAE	*Mundulea sericea*	Shrub or small tree	3.0
FABACEAE	*Philenoptera violacea*	Tree	10
FABACEAE	*Rhynchosia nitens*	Shrub	2.0
FABACEAE	*Schotia brachypetala*	Tree	16.0
FABACEAE	*Senna italica* subsp*. arachoides*	Herb	0.4
FABACEAE	*Tehprosia* sp.	-	-
HYACINTHACEAE	*Ledebouria* sp.	-	-
KIRKIACEAE	*Kirkia wilmsii*	Tree	15.0
LAMIACEAE	*Clerodendrum eriophyllum*	Tree	10.0
LAMIACEAE	*Clerodendrum ternatum*	Undershrub	2.0
LAMIACEAE	*Karomia speciosa*	Shrub or small tree	6.0
LAMIACEAE	*Leonotis intermedia*	Shrub	1.5
LAMIACEAE	*Leonotis nepetifolia*	Herb	3.0

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
LAMIACEAE	*Leucas capensis*	Shrub	1.5
LAMIACEAE	*Leucas* sp.	-	-
LAMIACEAE	*Tinnea rhodesiana*	Shrub	2.5
LAMIACEAE	*Vitex obovata* subsp. *wilmsii* cf.	Tree	9.0
LAMIACEAE	*Volkameria (Clerodendrum) eriophyllum*	-	-
LAMIACEAE	*Endostemon tenuiflorus*	Herb	0.3
LOBELIACEAE	*Lobelia erinus*	Annual herb	0.6
LORANTHACEAE	*Erianthemum dregei*	Shrub	2.0
LORANTHACEAE	*Erianthemum ngamicum*	Shrub	1.0
LORANTHACEAE	*Agelanthus natalitius*	Shrub	1.5
MALPIGHIACEAE	*Triaspis glaucophylla*	Shrub	4.5
MALVACEAE	*Abutilon sonneratianum* cf.	Perennial shrub	2.0
MALVACEAE	*Corchorus confusus*	Perennial herb.	0.3
MALVACEAE	*Gossypium herbaceum* subsp. *africanum*	Shrub	1.5
MALVACEAE	*Grewia flava*	Shrub or small tree	4.0
MALVACEAE	*Grewia vernicosa*	Shrub	1.5
MALVACEAE	*Hibiscus barnardii*	Herb	2.5
MALVACEAE	*Sida ovata*	Shrub	0.5
MALVACEAE	*Waltheria indica*	Shrublet	1.3
MELIACEAE	* *Melia azedarach*	Tree	15
NYCTAGINACEAE	* *Boerhavia erecta*	Herb	0.4
NYCTAGINACEAE	*Commicarpus pentandrus*	Herb, scrambler	2.0
OLACACEAE	*Ximenia americana*	Shrub or small tree	5.0
ONAGRACEAE	* Oenothera indecora	Herb	0.9
PAPAVERACEAE	* *Argemone ochroleuca* subsp. *ochroleuca*	Herb	1.0
PASSIFLORACEAE	*Adenia glauca*	Shrublike climber	3.5
PEDALIACEAE	*Sesamum triphyllum* var. *triphyllum*	Herb	2.0

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
PHYLLANTHACEAE	*Phyllanthus glaucophyllus*	Perennial herb	0.3
POACEAE	*Festuca scabra*	Graminoid	1.0
POACEAE	*Melinis repens* subsp. *repens*	Graminoid	1.5
POACEAE	* *Paspalum dilatatum*	Graminoid	1.8
POACEAE	*Aristida canescens* subsp. *canescens*	Graminoid	1.5
POACEAE	*Aristida transvaalensis*	Graminoid	0.7
POACEAE	*Bothriochloa insculpta*	Graminoid	2.0
POACEAE	*Brachiaria eruciformis*	Graminoid	1.0
POACEAE	*Cynodon dactylon*	Graminoid	0.3
POACEAE	*Dichanthium annulatum* var. *papillosum*	Graminoid	1.0
POACEAE	*Digitaria eriantha*	Graminoid	1.4
POACEAE	*Diheteropogon amplectens* var. *amplectens*	Graminoid	2.0
POACEAE	*Elionurus muticus*	Graminoid	1.2
POACEAE	*Enneapogon cenchroides*	Graminoid	1.0
POACEAE	*Enneapogon scoparius*	Graminoid	0.7
POACEAE	*Eragrostis barbinodis*	Graminoid	1.0
POACEAE	*Eragrostis micrantha*	Graminoid	1.0
POACEAE	*Eragrostis pseudosclerantha*	Graminoid	0.4
POACEAE	*Eragrostis racemosa*	Graminoid	0.8
POACEAE	*Eragrostis superba*	Graminoid	1.0
POACEAE	*Eragrostis trichophora*	Graminoid	0.6
POACEAE	*Fingerhuthia africana*	Graminoid	0.9
POACEAE	*Heteropogon contortus*	Graminoid	1.0
POACEAE	*Ischaemum afrum*	Graminoid	1.2
POACEAE	*Melinis nerviglumis*	Graminoid	1.2
POACEAE	*Panicum coloratum* var. *coloratum*	Graminoid	2.5
POACEAE	*Panicum deustum*	Graminoid	2.0

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
POACEAE	*Setaria sphacelata* var. *torta*	Graminoid	1.0
POACEAE	*Setaria sphacelata* var. *sphacelata*	Graminoid	1.0
POACEAE	*Sporobolus nitens*	Graminoid	0.5
POACEAE	*Stipagrostis hirtigluma* subsp. *patula*	Graminoid	0.6
POACEAE	*Themeda triandra*	Graminoid	2.0
POACEAE	*Urochloa mosambicensis*	Graminoid	1.5
POLYGALACEAE	*Polygala asbestina*	Shrub or herb	0.3
POLYGALACEAE	*Polygala hottentotta*	Herb or shrublet	0.6
RANUNCULACEAE	*Clematis brachiata*	Climber	-
RHAMNACEAE	*Ziziphus mucronata*	Tree	9.0
RUBIACEAE	*Afrocanthium gilfillanii*	Shrub or small tree	4.5
RUBIACEAE	*Canthium armatum*	Shrub or small tree	8.0
RUBIACEAE	*Kohautia caespitosa* subsp. *brachyloba*	Annual/perennial herb	0.8
RUBIACEAE	*Pavetta zeyheri*	Shrub or tree	3.0
RUBIACEAE	*Vangueria infausta* subsp. *infausta*	Tree	8.0
RUBIACEAE	*Vangueria madagascariensis*	Shrub or tree	15.0
SALICACEAE	*Scolopia zeyheri*	Shrub or tree	13.0
SANTALACEAE	*Thesium* sp.	-	-
SAPINDACEAE	*Dodonaea viscosa* var. *angustifolia*	Shrub or small tree	5.0
SCROPHULARIACEAE	*Aptosimum lineare*	Dwarf shrub	0.2
SCROPHULARIACEAE	*Jamesbrittenia atropurpurea* subsp. *atropurpurea*	Shrub	1
SENECIONEAE	*Emilia transvaalensis*	Herb	0.5
SINOPTERIDACEAE	*Pellaea calomelanos* var. *calomelanos*	Rhizome	
SOLANACEAE	* *Solanum nigrum*	Herb	.9
SOLANACEAE	* *Datura stramonium*	Herb	1.5
SOLANACEAE	*Lycium horridum*	Shrub	1.8
SOLANACEAE	*Solanum delagoense*	Shrub	0.8

FAMILY	SPECIES	GROWTH FORM	MAXIMUM HEIGHT (m)
SOLANACEAE	*Solanum lichtensteinii*	Shrub	1.5
TURNERACEAE	*Piriqueta capensis*	-	-
VERBENACEAE	*Chascanum pinnatifidum* var. *pinnatifidum*	Herb	0.5
VERBENACEAE	*Lantana rugosa*	Shrub	1.0
VITACEAE	*Cyphostemma sulcatum*	Climber	-
VITACEAE	*Rhoicissus tridentata* subsp. *cuneifolia*	Climber	-