October 2019

AN ECOLOGICAL ASSESSMENTOF THE FLORA AND WATERCOURSES

Eskom Transnet Freight Rail Project

A report commissioned by

LANDSCAPE DYNAMICS

ENVIROGUARD ECOLOGICAL SERVICES CC

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CONTENTS

TERMS OF REFERENCE

Project Description:

The project entails the construction of

- 4 x 132kV Traction Substations (Lephalale, Diepspruit, Matlabas and Marekele)
- 4x communication towers
- ±7km 132kV line from Medupi to proposed Lephalale Traction Sub
- ±26km 132kV line from Lephalale Traction Sub to existing Theunispan Sub
- ±15km 132kV line from Theunispan Sub to Theunispan T-off
- 3 x 132kV line bays at Theunispan Sub
- Loop in-out the 132kV traction stations as follows:
    - Lephalale Traction – 2 x 40 m 132kV lines from the new Medupi Theunispan line
    - Diepspruit Traction – 2 x 1 km 132kV lines from the existing Medupi Thabazimbi line
    - Matlabas Traction – 2 x 1 km 132kV lines from the existing Medupi Thabazimbi line
    - Marekele Traction – 2 x 2.5 km 132kV Lines from the existing Medupi Thabazimbi line

Project Locality:

The project runs south and west of Medupi Power Station near Lephalale to just north of Thabazimbi in the Limpopo Province.

Aim of this assessment:

The aim of the impact assessment is to present a floristic and aquatic assessment of the habitat along the proposed power lines, loops and substations and to highlight sensitive attributes and areas within the environment that might be adversely affected by the proposed development. The impacts are to be evaluated and pertinent mitigating actions recommended.

ASSIGNMENT

Enviroguard Ecological Services cc. was commissioned by **Landscape Dynamics Environmental Consultants** to conduct an ecological and aquatic assessment of the proposed routes identified for the construction of the new Eskom powerlines.

The aims of the study are to:

- conduct a vegetation survey for the proposed routes
- conduct an aquatic assessment for the proposed routes should any water courses be present
- identify ecologically sensitive area/s if they are found to be present

The objectives of this study were to:

- Identify the different vegetation units present along the proposed routes
- Describe and map the different vegetation units
- Identify and assess any water courses that might be present along the proposed routes
- Determine potential impacts of the proposed development on the proposed site on the associated fauna.
- To provide a sensitive map of the study area where applicable.

CONDITIONS RELATING TO THIS REPORT

Factors limiting the quality of this study

Two surveys were conducted on 15 April 2019 and 5 October 2019. These surveys are also supported by surveys from the area done within surrounding areas during February 2019. Thus, only those flowering plants that flowered at the time of the visit could be identified with high levels of confidence. Some of the more rare and cryptic species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the veld) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could therefore increase the chances to record a larger portion of the total species complex associated with the area. The survey of the study site is however considered as successful with a correct identification of the different vegetation units. Some areas could not be accessed due to the gates being locked thereby preventing entrance to the area.

Declaration of interest

Enviroguard Ecological Services cc has no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development. Enviroguard Ecological Services cc is not a subsidiary, legally or financially of the proponent.

The study was undertaken by Prof LR Brown (PhD Plant Ecology - UP). He is registered as a Professional Natural Scientists with the following details:

Prof LR Brown: Reg. No. 400075/98 (Botanical Science and Ecological Science).

He has the following qualifications:

SPECIALIST	QUALIFICATION
Prof. L.R. Brown	PhD Terrestrial plant ecology MSc. Water ecology BSc Hons (Botany) BSc (Ed) (Botany, Zoology, Education) Wetland and Riparian Delineation *(DWAF Accredited Course)* Soil Classification and Wetland Delineation Short Course – TERRASOIL Science

Indemnity

Although Enviroguard Ecological Services cc exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this assessment in terms of the National Environmental Management Act of 1998, and exempt Enviroguard Ecological Services cc and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of the assessment. .Enviroguard Ecological Services cc accepts no liability, and the client, by receiving this document, indemnifies Enviroguard Ecological Services cc and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Enviroguard Ecological Services cc and by the use of the information contained in this document.

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- The results of the project;
- The technology described in any report;
- Recommendations delivered to the Client.

Approach

Conclusions reached, and recommendations made are based not only on occurrence of individual species, but more appropriately on habitats and ecosystem processes. Planning must therefore allow for the maintenance of species, habitats and ecosystem processes, even if Red Data or endemic plant or animal species are absent.

Prof LR Brown *Pri.SciNat*; MGSSA
Enviroguard Ecological Services cc

1. INTRODUCTION

The natural resources of South Africa, with its highly complex and diversified society, are continually under threat from development especially in and close to areas richly endowed with natural resources. The natural environment and assets such as soil, water, indigenous vegetation, biodiversity, endemic and rare species and indigenous wildlife should be part of planning any new developments. New development plans should be based on scientific, ecological principles to prevent destruction or the deterioration of the environment and consequently the loss of valuable natural assets - also the loss of plant and animal species (biodiversity) and natural open spaces within the urban environment. This does not only have economic consequences, but from a conservation viewpoint, may have enormous advantages to the natural ecosystems. Development should, therefore, be planned to make the best possible use of natural resources and to avoid degradation, and therefore attention must be paid to environmental factors to make informed decisions. During the last years development became complicated and sophisticated, scientifically based, enterprises where environmental and nature systems are (or should be) accounted for in the planning stages. Modern development planning is intended to improve the way in which South African environmental resources are utilised. This provides a cost-effective procedure for ensuring that environmental concerns are carefully considered in the project development process. This procedure aims at guiding and facilitating the development process of a project. **An ecological evaluation of any area to be developed is presently considered a necessity.**

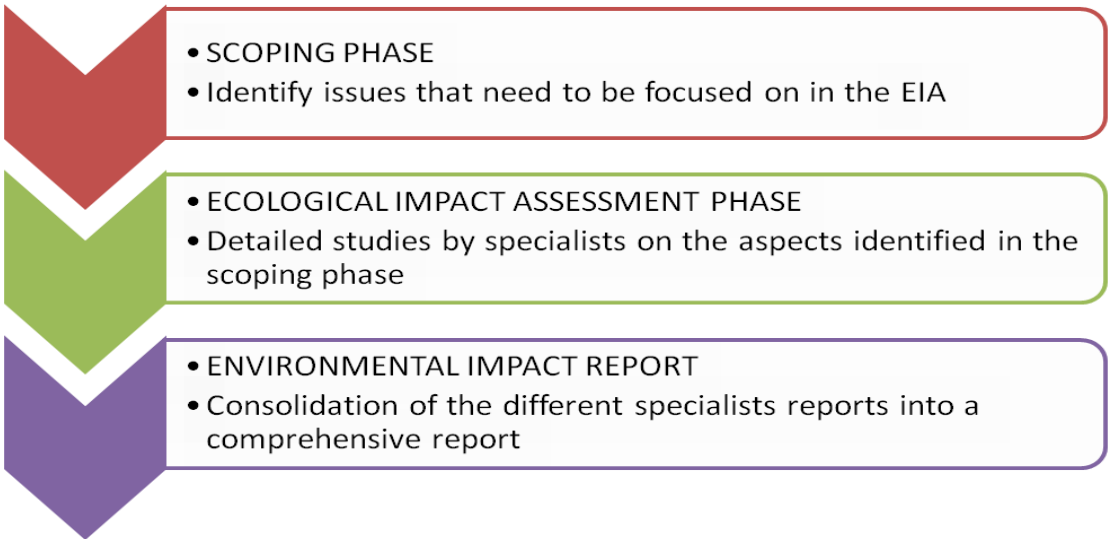
Eskom is responsible for providing a high-quality supply of electricity to meet the ever-increasing needs of its end users in South Africa. As a result, its infrastructure of power lines and substations are continuingly being established and expanded upon to support annual load growth. Eskom entrenches the values of excellence, customer satisfaction, and integrity across all its operations. In order to achieve this, it is important that effective management of the ecosystem is applied.

Eskom endeavors to provide sustainable and affordable energy through the integration and consideration of economic development, environmental quality and social equity. Environmental performance is fundamental to Eskom and they strive to lessen their impact on the natural environment as far as possible. "*Eskom continues*

to operate as a responsible corporate citizen in South Africa – the goal being to be recognised as a world-class utility in terms of environmental management practices and environmental duty of care." (Eskom website 2014).

Active participation of affected and interested parties in the different Eskom projects early in the environmental impact assessment process ensures that the environmental is taken into account before any further plans are made.

In terms of the Environment Conservation Act (Act no. 73 of 1989) an Environmental Impact Assessment (EIA) must be undertaken before any development on land can begin. Such a process will ensure that all aspects and possible consequences to the environment, stakeholders and affected parties are considered during the project. Following the completion of the site/route selection processes by Eskom, the EIA process is activated. The initial phase of the EIA is the scoping exercise. That is followed by a formal and detailed EIA from where the findings of all specialists are condensed in an Environmental Management Plan (see diagram below).



The overarching purpose of an EIA on the environment is to determine the different consequences of a proposed development on the local and regional environment and to assess and evaluate them (positive and negative). The EIA will also recommend strategies to minimise or even avoid negative impacts. It is also important that consideration is given to the probable significance or "acceptability" of the effects or consequences. According to the National Environmental Management Act (Act 107 of 1998) an environmental impact refers to any impacts on land, water, the atmosphere or living organisms, or on the inter-relationships between them, and

impacts on their physical, chemical, aesthetic and cultural properties and conditions that influence human health and well-being (National Environmental Management Act, 1998 (ACT N0.107 OF 1998).

This vegetation and water course assessment was undertaken to assist with final decisions regarding the preferred route for the proposed Eskom power lines to be constructed in the study area.

Plant communities are regarded as fundamental units of an ecosystem and therefore form the base for environmental planning and the compilation of environmental management plans. Vegetation is the most physical representation of the environment and any changes in the environment is first detected in changes in vegetation. Vegetation also provides habitat for various animal species. Some animal species may use various habitats for various purposes such as feeding, sleeping and reproduction. Thus, plant species assemblages reflect habitat and ecosystem health and rarity, and are therefore imperative for an Environmental Impact Assessment.

This report provides information on:

- Main vegetation types that occur along the proposed routes
- Vegetation units present along the proposed routes
- Watercourses present along the proposed routes
- Likelihood that red data plant species could occur along the different proposed routes
- Sensitive ecosystems that could be affected by the proposed routes

2. STUDY AREA

The study area is located south and west of the Medupi Power Station at Lephalale with the proposed substations south of Lephalale towards Thabazimbi (Figure 1).

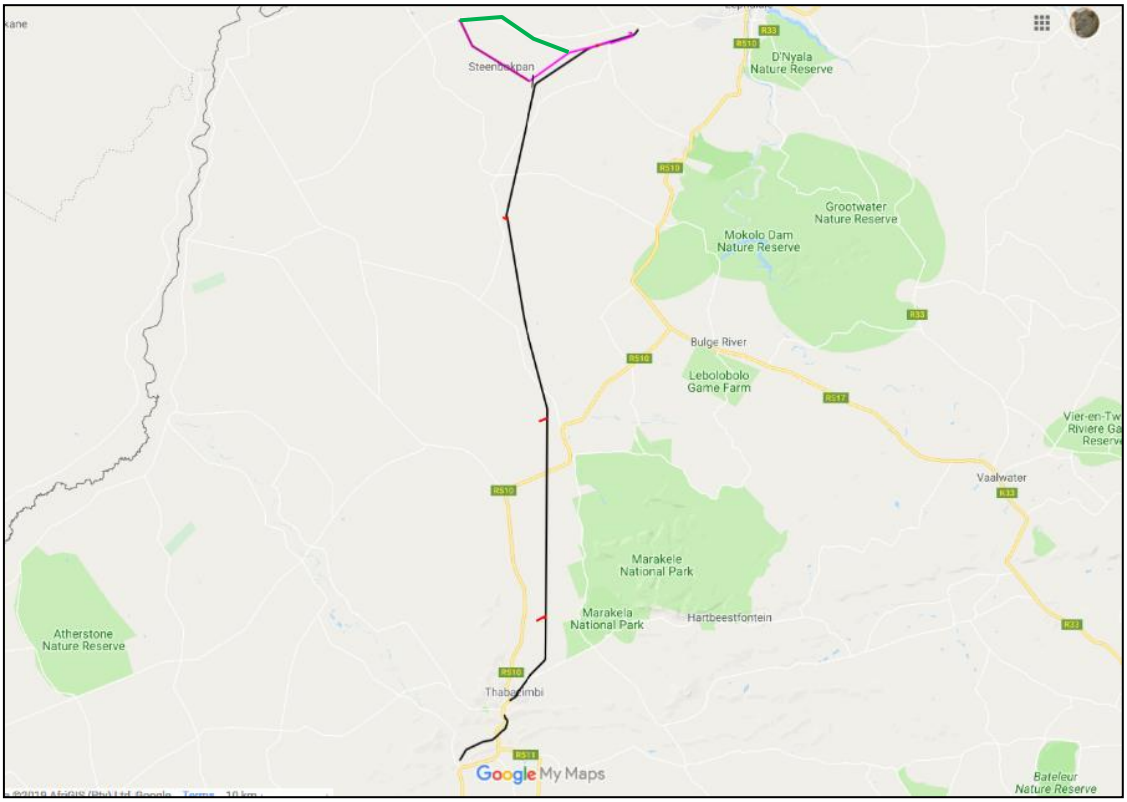


Figure 1. Location of study sites (red and green areas/lines).

Climate

The area is known for its hot summers (November-February) and mild winters (June-August). The average midday temperatures range from 22^{0}C in the winter (June) to 32^{0}C in the summer (January). During July the coldest temperatures are experienced when the mercury drops to 3.5^{0}C during the night. On average the area received 400mm of rain per annum with most of the rainfall occurring during the mid-summer (Figure 3).

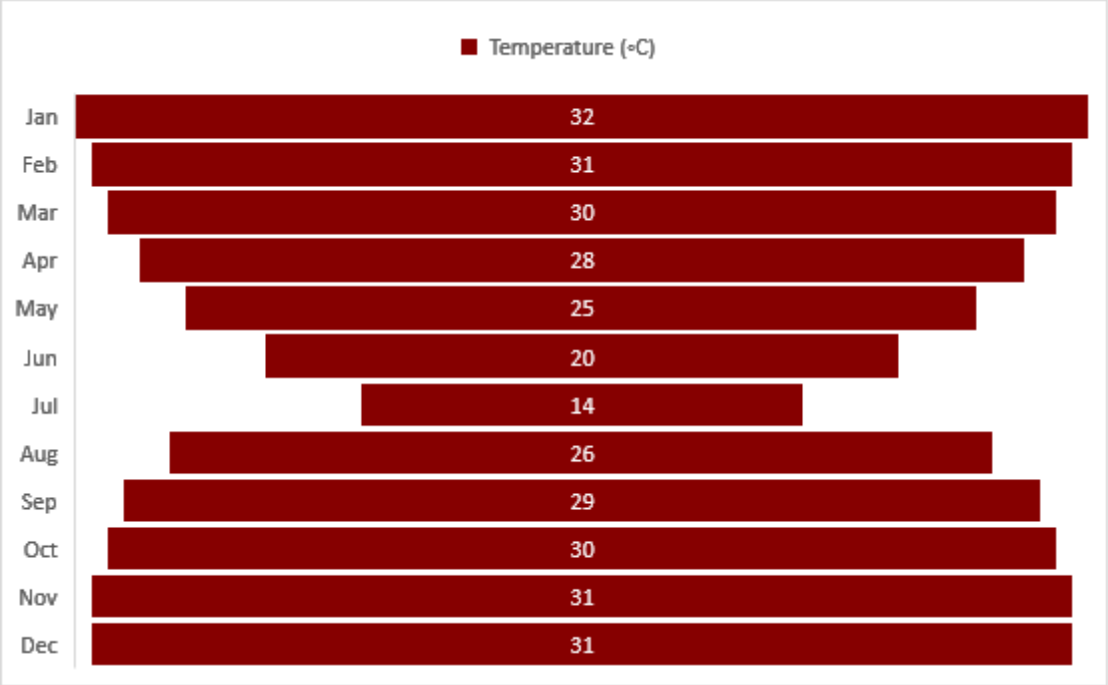


Figure 2. Average temperatures for the study area.

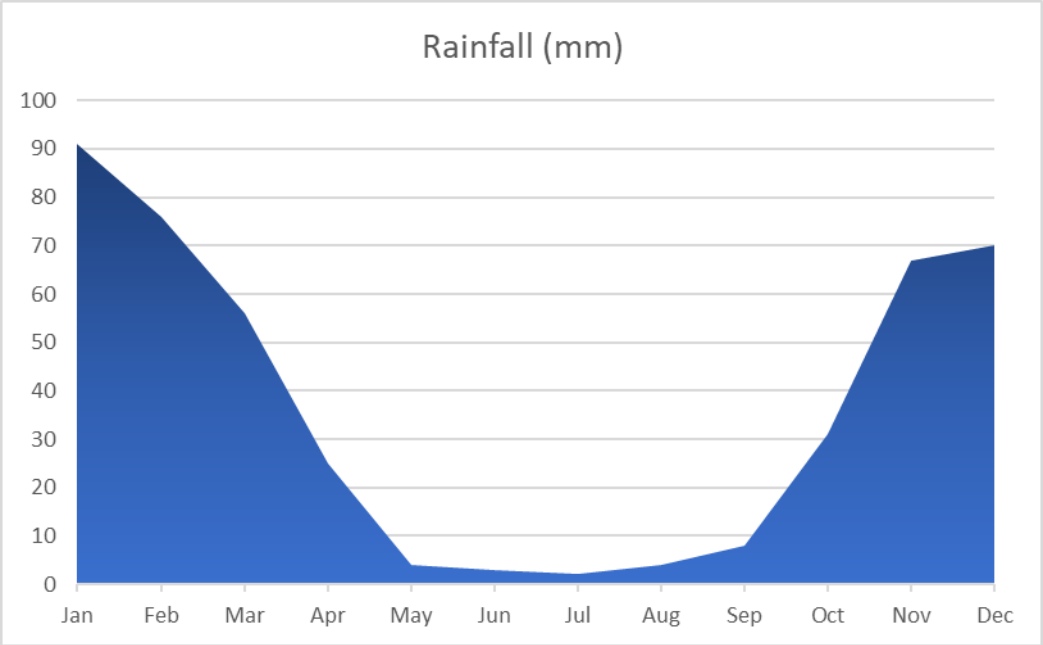


Figure 3. Precipitation for the study area for the study area.

Topography

The landscape varies from flat gently undulating plains. No major rivers flow through the proposed route area.

3. METHODS

Two main alternative routes were visited and surveyed for each of the proposed power lines while various locations were visited for the substations.

3.1 VEGETATION

Prior to the field survey, available literature, and database information pertaining to the vegetation and threatened species of the study area was obtained and reviewed. The literature review included scientific and popular publications on related aspects for the area. Internet searches for ecological issues in the area and red data plant and animal species were done. The Google search engine was used for information pertaining to Red Data flora and fauna and their habitat preferences. The Limpopo Conservation Plan v.2 was consulted to determine Critical Biodiversity and Ecological support areas (Desmet *et al.,* 2013).

During the field trip the proposed routes were covered by vehicle and on foot to survey the vegetation in the field.

The Braun-Blanquet survey technique to describe plant communities as ecological units was used for this study (Brown *et al.* 2013; Kent & Coker 1992; Mueller-Dombois & Ellenberg 1974). It allows for the mapping of vegetation and the comparison of the data with similar studies in the area. The vegetation survey was conducted by Prof. LR Brown.

By using aerial photographs, the study area was stratified into physiognomic - physiographic units. Sample plots were placed on a randomly stratified manner to represent each vegetation unit identified. Plot sizes were fixed at approximately 400 m^2 according to Brown (1997).

Data recorded included:

Data pertaining to the vegetation physiognomy and floristic composition (species richness and canopy cover of each species) was gathered. A list of all plant species

present, including trees, shrubs, grasses, forbs, geophytes and succulents were made.

Red data species

An investigation was also carried out on rare and protected plants that might possibly occur in the region. For this investigation the National Red List of Threatened Plants of South Africa, Lesotho & Swaziland, compiled by the Threatened Species Programme, South African National Biodiversity Institute (SANBI) as well as the Limpopo Environmental Management Act 2003 (Act No. 7 of 2003) were used. Internet sources were also consulted on the distribution of these species in the area. Other information used included:

- Publication of lists of species that are threatened or protected, activities that are prohibited and exemption from restriction from the National Environmental Management: Biodiversity Act, 2004 (ACT NO. 10 OF 2004).
- The IUCN conservation status categories on which the Threatened Species Programme, Red List of South African Plants (2013) is based, was also obtained.

The presence of rare and protected species or suitable habitat was recorded during the field visit.

Data processing

A classification of vegetation data was done based on the plant species groupings and occurrence to identify, describe and map vegetation units. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

The **conservation priority** of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Gauteng area, and the Grassland and Savanna Biomes of South Africa.

The following five **conservation priority** categories were used for each vegetation unit:

High:	Area with high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien

plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes.

Medium-high: An area with a natural species composition; not a threatened or unique ecosystem; moderate-high species diversity; between 5-10% pioneer/alien plant species present and has connectivity with other natural ecosystems. Although natural it is not a sensitive habitat and commonly occur in the region. Low density development/impacts could be allowed with areas to be left in its natural composition so as to lessen the impact on the natural ecosystem.

Medium: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity; between 10-20% pioneer/alien plant species present; that would need moderate input to rehabilitate to an improved condition; and where low density development would have a limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation are maintained**.**

Low-medium: A common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or with large sections in a secondary successional phase; between 20-40% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential. Development could be supported with little impact on the natural environment.

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >40% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

A **sensitivity analysis** was done for the vegetation units identified. This was achieved by evaluating the different vegetation units against a set of habitat criteria. For impact assessment the **potential impacts** on the vegetation was assessed by using the NEMA 2006 guidelines and criteria. To further quantify the severity of each impact, values were assigned to criteria ratings (Table 1).

Table 1: Criteria, criteria ratings and values (in brackets) used in this study to assess possible impacts on vegetation during the proposed development

Criteria	Rating (value)
Extent of impact	Site (1), Region (2), National (3), International (4)
Duration of impact	Short term (1), Medium term (2), Long term (3), Permanent (4)
Intensity of impact	Low (1), Medium (2), High (3)
Probability of impact	Improbable (1), Probable (2), Highly probable (3), Definite (4)

3.2 WATER COURSES

The term “wetland” is a generic term for all the different kinds of habitats where the land is wet for some period of time each year, but not necessarily permanently wet. Wetlands are defined in the National Water Act (36 of 1998) as “land which is transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”. Wetlands are found where the landform (topography) or geology slows down or obstructs the movement of water through the catchment, or where the groundwater surfaces causing the soil layers in the area to be temporarily, seasonally or permanently wet. This provides an environment where particular plants (hydrophytes) that are adapted to wet conditions tend to grow in abundance. The plants in turn affect the soil and hydrology by further slowing down the movement of water (e.g. reed beds) or by producing organic matter that may accumulate in the soil.

Wetlands are important because of the functions and values that they provide which benefit mankind. These benefits can be either direct or indirect benefits (Table 1). Until very recently the benefits of wetlands to society were often not recognized, and many wetlands have been destroyed, or poorly managed. Wetland benefits refer to: "*those functions, products, attributes and services provided by the ecosystem that have values to humans in terms of worth, merit, quality or importance. These benefits may derive from outputs that can be consumed directly; indirect uses which arise from the functions or attributes occurring within the ecosystem; or possible future direct outputs or indirect uses*" (Howe et al., 1991 in Kotze et al., 2005).

The functioning of a wetland is also affected by other factors, many of which result from the activities of people. These include "off-site" factors which take place in the surrounding catchment (e.g. a change in land cover from natural grassland to a gum tree plantation which would decrease the amount of water reaching the wetland) and "on-site" factors which take place at the wetland (e.g. fire, draining, damming, etc.).

Humans have traditionally seen wetlands as wasteland areas and many of these sensitive ecosystems have as a result been transformed and developed. Due to the sensitive nature of these systems as well as the different ecosystem functions they

perform, it is important that wetlands are identified and assessed in any area where development is planned.

The classification system developed for the National Wetlands Inventory in South Africa is based on the principle of "hydro-geomorphic (HGM) units". HGM units take into consideration various factors that determine the nature and direction of water movement into, through and out of the wetland system. All together HGM units encompass three key elements (Kotze et al, 2005; USDA; 2011):

- *Landscape position*: This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment).
- *Dominant water source*: There are usually several sources such as surface water, precipitation, sub-surface water, springs, stream flow, etc.
- *Hydrodynamics:* This refers to the source and direction of water movement (this can be horizontal, vertical, unidirectional or bidirectional) (Figure 4).

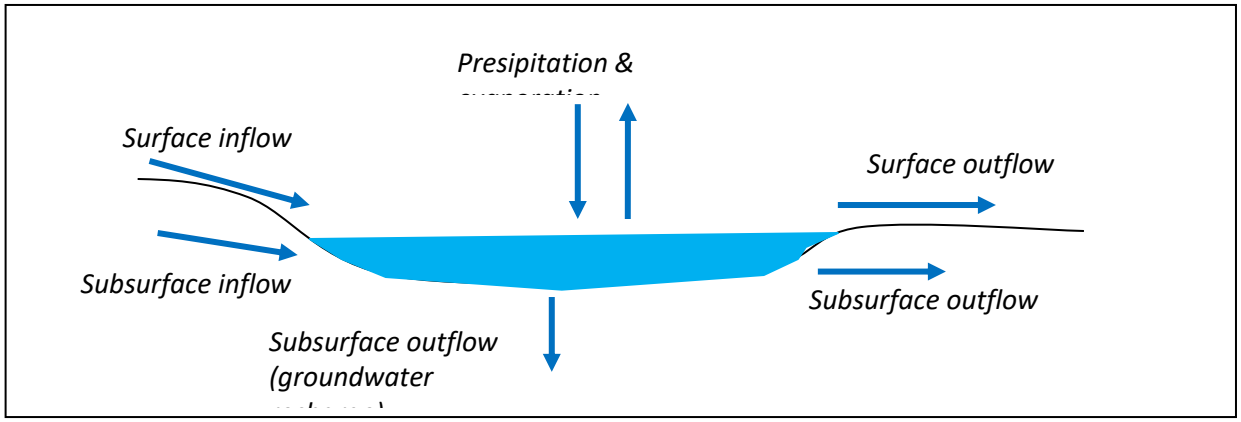


Figure 4. Water budget/movement in a wetland system (Adapted from USDA, 2011)

Dini, Cowan & Goodman (1998) classifies South African wetlands into the following classes:

- *Lacustrine*: Limnetic and Littoral (natural freshwater lakes).
- *Palustrine*: Flat, Slope, Valley Bottom, Floodplain (freshwater marshes, peatlands, springs, swamp forest, floodplains).
- *Endorheic* (permanent and seasonal pans).

For delineation purposes only, the wetland boundary is defined as the edge where the ***hydric indicators are encountered within the top 50cm or 500 mm of the surface***, but from a wetland management perspective consideration should extend beyond the boundaries to include the wetland catchment as a whole.

Terrain Unit Indicator:

Identifies those parts of the landscape where wetlands are likely to occur: Pans are usually concentrated in areas with an average slope of less than one degree and are characterised by a lack of integrated drainage. Inundation is usually seasonal or ephemeral. This indicator cannot be used for mapping but is useful for screening purposes.

Soil Form Indicator:

Particular forms of soil are associated with wetlands and display hydromorphic characteristics, and their presence at a site indicates that permanent or periodic (temporary or seasonal) saturation of the soil near the surface occurs. No comprehensive soil survey has been undertaken for the site.

Vegetation Indicator

The presence of indicator plant species or hydrophytes can be used to denote the presence of wetlands. This indicator is very useful as verification of the boundaries in undisturbed sites.

Soil wetness Indicator

Wetland soils can be permanently, seasonally or temporarily saturated. This normally results in anoxic (low oxygen) conditions in the saturated zone. Soil colour is markedly influenced by the oxidation statues of manganese and iron. Yellow, red and reddish-brown soil form under well-oxidised conditions and greyish colours when aeration is poorer. Under anoxic conditions, iron becomes soluble and can be leached out of the soil. Where the soil is permanently wet; the iron can all be dissolved out of the soil; resulting in a greyish or blueish colour. This is termed gleying. Consequently, it is possible to identify wetland areas on the basis of soil colour, while mottle hue and chroma initially increase and then decrease the more saturated the soils become.

By observing the evidence of these features, in the form of indicators, wetlands can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF 2005).

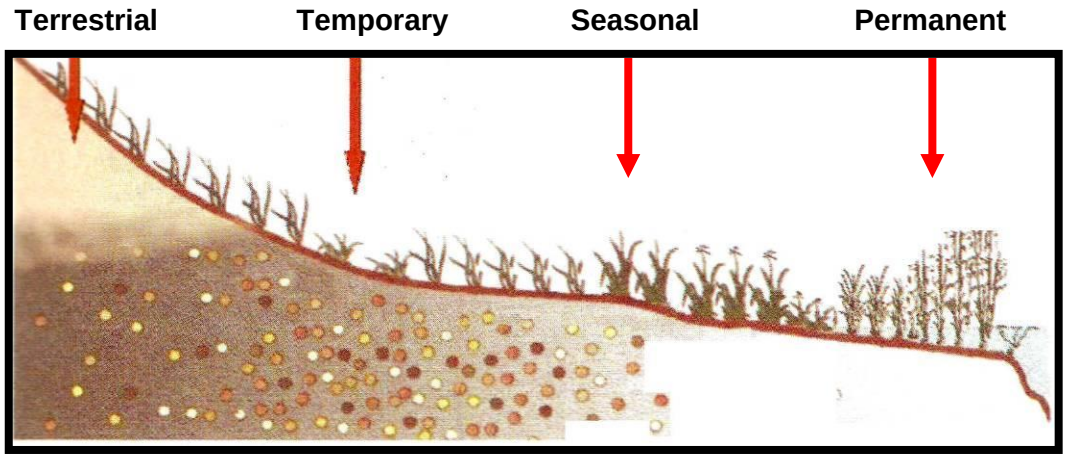


Figure 5. Cross section through a valley bottom wetland indicating how soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the permanent wet hydrological zone to the temporarily wet hydrological zone and eventually into the non-wetland or terrestrial zone (Department of Water Affairs and Forestry, 2003 as adapted by Kotze, 1996)

FIELD SURVEYS & DATA ANALYSIS

Prior to the site visit, a desktop study was conducted of the wetland unit/s present on the site using 1:50 000 topographical maps, aerial images obtained from Google Earth and the SANBI BGIS Map Viewer (accessed March 2019).

A Dutch soil auger was used to extract the cores to a depth of 50cm. All soil samples were evaluated in hand for soil composition, colour, number, size and chroma of mottles as well as wetness, after which they were discarded. The location of each soil core was marked using a hand-held Garmin Colorado 300 GPS. Field verification was limited to the presence of hydric soils on the site as well as presence of hygrophytic and hydrophilic vegetation.

Soil auger samples were taken in transects that were laid parallel to each other in the study area. Soil samples were taken along transects radiating away from the visibly 'wettest' parts of the area at regular intervals. Soil auger samples were restricted to the immediate site of the proposed pipeline.

Wetland assessment

Wetland health / Wetland Index of Habitat Integrity (**IHI**)

WET-Health and Wetland IHI assists in assessing the health of wetlands using indicators based on geomorphology, hydrology, water quality and vegetation. For the purposes of rehabilitation planning and assessment, WET-Health helps users understand the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps diagnose the cause of wetland degradation so that rehabilitation workers can design appropriate interventions that treat both the symptoms and causes of degradation.

The Wetland IHI is a tool that was developed to be able to assess and monitor floodplain and valley-bottom wetlands and provides a score on the Present Ecological State of the wetland habitat. A Wetland Health assessment was conducted as per the procedures in DWAF (2007).

The tool evaluates the intactness of the wetland and is determined by a score known as the Present Ecological Score (PES). The Present Ecological State (PES) refers to

the current state or condition of a watercourse in terms of all its characteristics and reflects the change to the watercourse from its reference condition. The health assessments for the hydrology, geomorphology and vegetation components were then represented by the Present Ecological State (PES) categories. The PES categories are divided into six (A-F) units based on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 2.

Table 2. Present Ecological State categories used to define health of wetlands (adapted from Kleynhans, 1999).

Description	PES Score (%)	PES Category
Unmodified, natural.	**90-100**	**A**
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**80-90**	**B**
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	**60-80**	**C**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	**40-60**	**D**
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	**20-40**	**E**
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**0-20**	**F**

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 3 below.

Table 3. Trajectory descriptions and symbols used to evaluate future direction of change to wetland health (Macfarlane et al, 2007).

Change Category	Description	Symbol
Improve	Condition is likely to improve over the over the next 5 years	(↑)
Remain stable	Condition is likely to remain stable over the next 5 years	(→)
Slowly deteriorate	Condition is likely to deteriorate slightly over the next 5 years	(↓)
Rapidly deteriorate	Substantial deterioration of condition is expected over the next 5 years	(↓↓)

Ecological Importance and Sensitivity

The **Ecological Importance and Sensitivity** (EIS) of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales, and both abiotic and biotic components of the system are taken into consideration. Sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The ecological importance and sensitivity categories are indicated in Table 4.

Table 4. Ecological Importance & Sensitivity Categories of Wetlands (DWAF, 1999)

EIS CATEGORIES	DESCRIPTION	RATING
LOW/MARGINAL	Not ecologically important and sensitive at any scale. The biodiversity of wetland is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <1
MODERATE	Ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <2
HIGH	Ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <3
VERY HIGH	Ecologically important and sensitive on a national (or even international) level. Biodiversity usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in rivers	>3 and <4

4. RESULTS

4.1 VEGETATION UNITS

- 4 x 132kV Traction Substations (Lephalale, Diepspruit, Matlabas and Marekele)
- 4x communication towers
- ±7km 132kV line from Medupi to proposed Lephalale Traction Sub
- ±26km 132kV line from Lephalale Traction Sub to existing Theunispan Sub
- ±15km 132kV line from Theunispan Sub to Theunispan T-off
- 3 x 132kV line bays at Theunispan Sub

The vegetation along the proposed power line route comprises six distinct vegetation units that could be identified and are indicated in Figure 6. The vegetation does however, form a mosaic distribution pattern in areas with sections comprising a variety of plant species representative of different vegetation units. The delineation was therefore based on the field work as well as the colour and structure differences observed on the aerial photographs.

1. *Combretum apiculatum* woodland
2. *Senegalia nigrescens* woodland
3. *Senegalia erubescens* woodland
4. *Terminalia sericea* woodland
5. Drainage pathways and seasonally wet depressions
6. Old fields

Other areas identified include the developed areas (Figure 6). The Developed areas consist of the Medupi Power Station as well as retention dams and areas cleared of all vegetation. No natural vegetation is present on these areas since all have been destroyed by the developments and buildings.

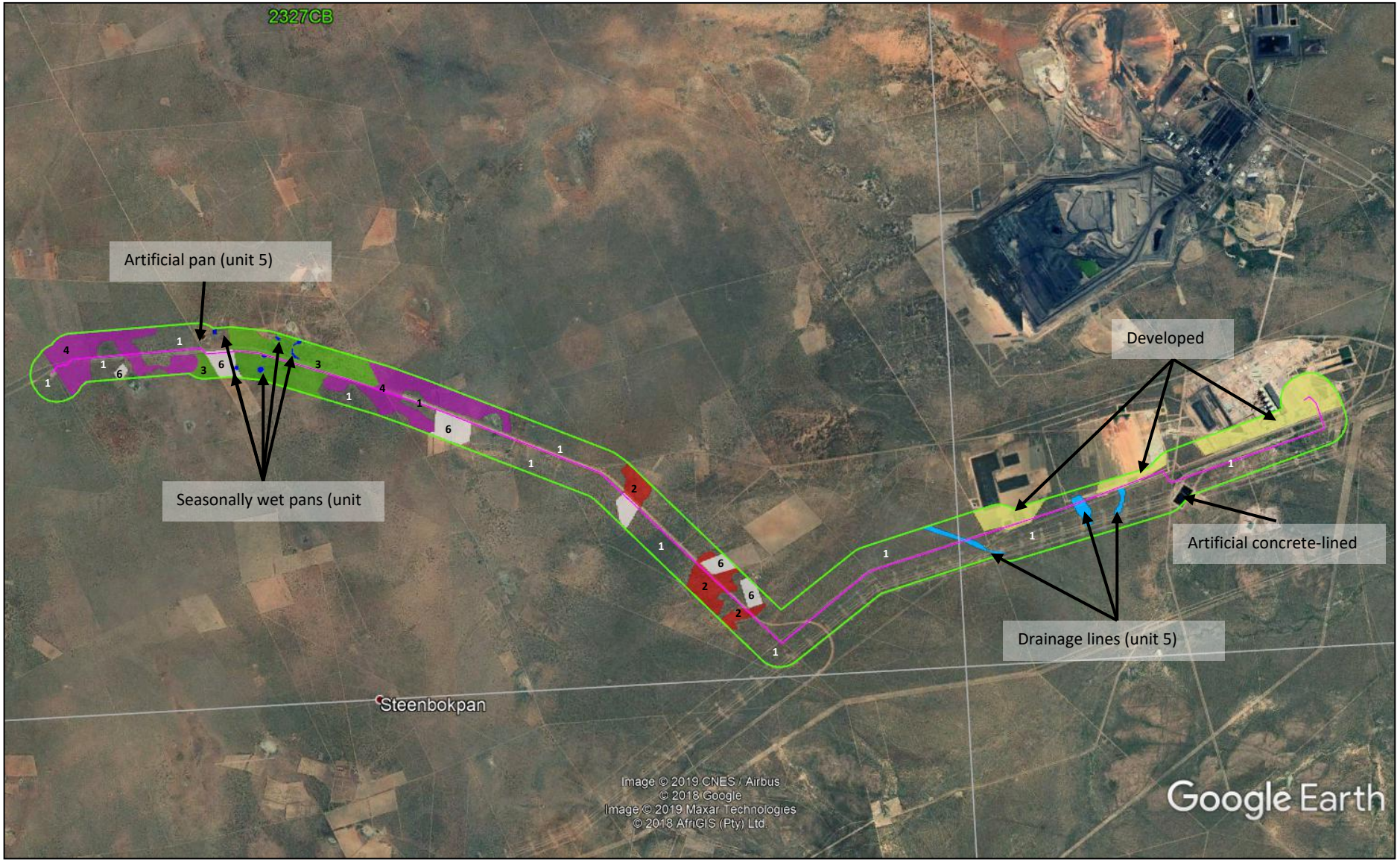


Figure 6. Vegetation units of the proposed study routes [No colour = Unit 1; Red = Unit 2; Green = Unit 3; Purple = Unit 4; Blue = Unit 5 (Light blue = Drainage lines; Dark blue = Seasonally wet depressions); White = unit 6] (Source: Google earth 2019)

1. *Combretum apiculatum* woodland

Soil	Red loamy sandy soil	**Tree cover**	30%
Topography	Level	**Shrub cover**	45%
Land use	Livestock and free moving game	**Herb cover**	8%
Unit status	Natural to degraded	**Grass cover**	1-25%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	1-5%
		Erosion	0%

Dominant spp.	*Combretum apiculatum; Combretum zeyheri; Sclerocarya birrea; Senegalia nigrescens, Ehretia rigida*.

Conservation value	**Medium-high**	**Ecosystem functioning**	**Medium-high**

This dense woodland occurs on wide plains that are strongly associated with red loamy soil with low rock cover.

The woody layer is dense and characterised by the dominance of the trees *Combretum apiculatum, Combretum zeyheri* and *Senegalia nigrescens.* The tree *Senegalia erubescens* are locally prominent and varies in density throughout this unit. The tree layer consists of trees between 3-5m and shrubs between 1-3m tall. The herbaceous layer is not well developed with sections being overutilised, although other areas have a moderate cover. The grasses *Eragrostis rigidior, Schmidtia pappophoroides* and *Enneapogon scoparius* are dominant in the herbaceous layer

with the grass *Eragrostis pallens* co-dominant where the soil is sandier and deeper. Prominent species include the grasses, *Heteropogon contortus, Panicum maximum, Aristida stipitata* and the forbs *Sida cordifolia, Solanum panduriforme, Abutilon austro-africanum* and *Ajuga ophrydis.*

The protected trees *Sclerocarya birrea* and *Boscia albitrunca* are present as single medium to tall individuals throughout this unit.

The topography varies from flat to slightly undulating floodplains (4). The well-drained, red brown sandy soil (clay-content 4-8%) of this vegetation unit varies in depth from shallow to deep (0.3 > 1.2 m) and is through to belong to the Clovelly soil form (Mucina & Rutherford, 2006).

Alien species

Verbena bonariensis

Red data species

The protected trees *Sclerocarya birrea* and *Boscia albitrunca* were found within this woodland.

The following is a list of plant species identified in this during the survey (=alien invasive species; ✚=medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

	Species name	
	Abutilon austro-africanum	F
	Ajuga ophrydis	F
	Aristida adscensionis	G
	Aristida congesta subsp barbicollis	G
	Aristida congesta subsp congesta	G
	Aristida stipitata	G
	Asparagus suaveolens	W
	Boscia albitrunca	W
	Cenchrus ciliaris	G
	Combretum apiculatum	W
	Combretum zeyheri	W
	Corchorus asplenifolius	F
	Dichrostachys cinerea	W
	Ehretia rigida	W
✚	*Elephantorrhiza elephantina*	W

	Eragrostis pallens	G
	Eragrostis rigidior	G
	Eragrostis superba	G
	Evolvulus alsinoides	F
	Gardenia volkensii	W
	Grewia bicolor	W
	Grewia flava	W
	Grewia flavescens	W
	Heteropogon contortus	G
	Hibiscus trionum	F
	Indigofera daleoides	F
	Limeum spp	F
	Melinis repens	G
	Oldenlandia oleracea	F
	Panicum maximum	G
	Pavonia burchelli	F
	Peltophorum africanum	W
	Pogonarthria squarrosa	G
	Portulaca oleracea	F
	Pterocarpus rotundifolius	W
	Schmidtia pappophoroides	W
	Sclerocarya birrea	W
	Scolopia zeyheri	W
	Senegalia erubescens	W
	Senegalia nigrescens	W
	Sida cordifolia	F
	Solanum panduriforme	F
	Tephrosia capensis	F
	Terminalia sericea	W
	Tragus berteronianus	G
	Tribulus terrestris	F
	Urochloa mosambicensis	G
	Vachellia karroo	W
	Vachellia tortilis	W
	Verbena bonariensis	F
	Waltheria indica	F
	Zornia linearis	F

2. *Senegalia nigrescens* woodland

Soil	Red loamy sandy soil	**Tree cover**	15%
Topography	Level – undulating slight southern slope (1-2^0)	**Shrub cover**	25%
Land use	Game & cattle	**Herb cover**	8%
Unit status	Natural to degraded	**Grass cover**	55-60%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	1%
		Erosion	5%

Dominant spp	*Senegalia nigrescens, Senegalia erubescens, Combretum apiculatum, Eragrostis rigidior, Heteropogon contortus*

Conservation value	**Medium-high**	**Ecosystem functioning**	**Medium-high**

This woodland occurs as smaller sections within the larger *Combretum apiculatum* woodland (vegetation unit 1). The soil is red sandy loam with no rocks observed while slight erosion was observed in areas.

The vegetation is characterised by the dominance of the trees *Senegalia nigrescens* and *Combretum apiculatum.* The grass layer is dominated by the grasses *Eragrostis rigidior, Schmidtia pappophoroides* and *Heteropogon contortus.* Other species present include the woody *Dichrostachys cinerea, Grewia bicolor, Grewia flava, Euclea undulata,* the grasses *Eragrostis biflora, Eragrostis gummiflua, Panicum*

maximum and the forbs *Agathisanthemum bojeri, Commelina africana, Solanum panduriforme* and *Abutilon austro-africanum*.

The woodland is closely associated with moderate (0.1 – 0.9m depth) loamy-clayey soil and thought to be of the Hutton soil form (Mucina & Rutherford, 2006).

Alien plant species

None

Red data species

Except for the protected tree *Boscia albitrunca,* no rare or endangered plant species were recorded.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

	Species name	
	Abutilon austro-africanum	F
	Agathisanthemum bojeri	F
	Ajuga ophrydis	F
	Aristida congesta subsp congesta	G
	Aristida stipitata	G
	Boscia albitrunca	W
	Combretum apiculatum	W
	Commelina africana	F
	Dichrostachys cinerea	W
	Digitaria eriantha	G
	Eragrostis biflora	G
	Eragrostis gummiflua	G
	Eragrostis pallens	G
	Eragrostis rigidior	G
	Euclea undulata	W
	Gardenia volkensii	W
	Grewia bicolor	W
	Grewia flava	W
	Grewia flavescens	W
	Heteropogon contortus	G
	Panicum maximum	G
	Peltophorum africanum	W
	Pogonarthria squarrosa	G
	Schmidtia pappophoroides	G
	Senegalia erubescens	W

Senegalia nigrescens	W
Solanum panduriforme	F
Solanum panduriforme	F
Urochloa mosambicensis	G
Urochloa mosambicensis	G

3. *Senegalia erubescens* shrubland

Soil	Red loamy sandy soil	**Tree cover**	5%
Topography	Level – undulating slight southern slope (2^0)	**Shrub cover**	35%
Land use	Game & cattle	**Herb cover**	10%
Unit status	Natural to degraded	**Grass cover**	30%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	1%
		Erosion	2%

Dominant spp	*Senegalia erubescens, Eragrostis rigidior; Grewia bicolor*

Conservation value	**Medium**	**Ecosystem functioning**	**Medium**

This shrubland occurs towards the western part of the proposed power line route on red loamy to clayey soil with slight erosion in some places visible.

The vegetation is characterised by the dominance of the medium-sized tree *Senegalia erubescens* that comprises single large individuals taller than 5m, but with many individuals between 2-4m tall and more shrub-like. The herbaceous layer is not that well developed, and sections have been overgrazed in the past resulting in some bare soil patches present. Prominent herbaceous species include the grasses *Eragrostis rigidior, Schmidtia pappophoroides, Aristida stipitata* and the forbs *Waltheria indica, Tephrosia lupinifolia, Evolvulus alsinoides* and *Zornia milneana.*

Other woody species that also have a moderate canopy cover include *Dichrostachys cinerea, Senegalia nigrescens, Vachellia robusta, Grewia flava* and *Senegalia tortilis.*

Alien plant species

Opuntia ficus-indica.

Red data species

No rare or endangered plant species were recorded.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Species name	
Aristida stipitata	G
Asparagus suaveolens	W
Dichrostachys cinerea	W
Eragrostis rigidior	G
Evolvulus alsinoides	F
Grewia bicolor	W
Grewia flava	W
Grewia flava	W
Indigofera spp	F
Opuntia ficus-indica	
Panicum maximum	G
Portulaca quadrifida	F
Pterocarpus rotundifolius	W
Sansevieria aethiopica	F
Schmidtia pappophoroides	G
Senegalia erubescens	W
Senegalia nigrescens	W
Tephrosia lupinifolia	F
Terminalia sericea	W
Vachellia nilotica	W
Vachellia robusta	W
Vachellia tortilis	W
Waltheria indica	F

4. *Terminalia sericea* woodland

Soil	Red sandy soil	**Tree cover**	15%
Topography	Level – undulating slight southern slope (1-2^0)	**Shrub cover**	15%
Land use	Game & cattle	**Herb cover**	3%
Unit status	Natural to degraded	**Grass cover**	65%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	0%
		Erosion	0%

Dominant spp	*Terminalia sericea; Eragrostis pallens*

Conservation value	**Low**	**Ecosystem functioning**	**Low-medium**

This woodland occurs as large to narrow belts within the larger *Combretum apiculatum* woodland (vegetation unit 1). These belts/strips consist of deep red sandy soil with no rocks or erosion observed.

The vegetation is characterised by the dominance of the woody species *Terminalia sericea* that consists of trees taller than 5m and shrubs between 2-3m that are evenly spread throughout the area forming dens stands in some areas. The herbaceous layer has a moderate to good vegetation cover (65%) and is characterised by the dominance of typical sandy soil grasses *Eragrostis pallens* and *Aristida stipitata.* Other species present include the woody species *Grewia bicolor, Terminalia*

brachystemma, Dichrostachys cinerea, the grasses *Schmidtia pappophoroides, Perotis patens* and the forbs *Waltheria indica, Oldenlandia herbacea, Ceratotheca triloba* and *Indigofera daleoides.*

The woodland is closely associated with deep (0.3 – 2m) sandy soil and though to be of the Hutton soil form (Mucina & Rutherford, 2006).

Alien plant species

None

Red data species

One protected tree *Sclerocarya birrea* was found within this woodland.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

	Species name	
	Aristida stipitata	G
	Ceratotheca triloba	F
	Commelina africana	F
	Dichrostachys cinerea	W
	Eragrostis pallens	G
	Grewia bicolor	W
	Indigofera daleoides	F
	Kohautia amatymbica	F
	Limeum aethiopicum	F
	Oldenlandia herbacea	F
	Pavonia burchelli	F
	Pentarrhinum insipidum	F
	Perotis patens	G
	Portulaca oleracea	F
	Schmidtia pappophoroides	G
	Sclerocarya birrea	W
	Tephrosia lupinifolia	F
	Terminalia brachystemma	W
	Terminalia sericea	W
	Waltheria indica	F

5. Drainage pathways and seasonally wet depressions

Soil	Red to grey sandy sodic soil	**Tree cover**	10%
Topography	Slightly to medium deep depressions	**Shrub cover**	15%
Land use	Game & cattle	**Herb cover**	3%
Unit status	Natural but degraded	**Grass cover**	45%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	3%
		Erosion	3%

Dominant spp	*Vachellia tortilis*

Conservation value	**High**	**Ecosystem functioning**	**Medium**

This woodland occurs as smaller sections within the larger *Combretum apiculatum* woodland (vegetation unit 1) as indiscernible drainage lines and as slight to medium deep depressions. The soil is red to grey loam with some clay with few rocks present while slight erosion was observed in areas.

The vegetation is characterised by the dominance of the trees *Senegalia nigrescens, S erubescens* and *Combretum apiculatum* (drainage lines) and *Vachellia karroo, Vachellia tortilis* and *Senegalia nigrescens* (depressions). The grass layer is dominated by the grasses *Schmidtia pappophoroides, Cenchrus ciliaris* and *Heteropogon contortus.* Other species present include the woody *Dichrostachys cinerea, Grewia flava, Euclea undulata,* the grasses *Cynodon dactylon, Eragrostis*

gummiflua, Panicum maximum and the forbs *Solanum panduriforme* and *Abutilon austro-africanum*.

The woodland is closely associated with moderate (0.1 – 0.9m depth) loamy-clayey soil and thought to be of the Hutton soil form (Mucina & Rutherford, 2006).

An artificial pan surrounded by overnight huts was also found within the corridor section. This pan is pumped with water as an attraction for the overnight visitors and therefore permanently wet. The proposed powerline route does not affect the pan or the overnight huts.

Alien plant species

None

Red data species

One protected tree *Boscia albitrunca* was found within the depressions.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

	Species name	
	Abutilon austro-africanum	F
	Aristida congesta subsp congesta	G
	Boscia albitrunca	W
	Cenchrus ciliaris	G
	Combretum apiculatum	W
	Commelina africana	F
	Cynodon dactylon	G
	Dichrostachys cinerea	W
	Eragrostis gummiflua	G
	Eragrostis rigidior	G
	Euclea undulata	W
	Grewia flava	W
	Gymnosporia buxifolia	W
	Heteropogon contortus	G
	Panicum maximum	G
	Pogonarthria squarrosa	G

Schmidtia pappophoroides	G
Senegalia erubescens	W
Senegalia nigrescens	W
Solanum panduriforme	F
Urochloa mosambicensis	G
Vachellia karroo	W
Vachellia tortilis	W

6. Old fields

Soil	Red sandy loam soil	**Tree cover**	0-5%
Topography	Level – undulating slight southern slope (1-2^0)	**Shrub cover**	0-25%
Land use	Game & cattle	**Herb cover**	5%
Unit status	Degraded	**Grass cover**	65%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	0%
		Erosion	5%

Dominant spp	*Dichrostachys cinerea, Vachellia tortilis; Eragrostis rigidior; Cynodon dactylon*

Conservation value	**Low**	**Ecosystem functioning**	**Low**

The old fields consist of areas where the woody vegetation has been previously removed for either grazing or planting of pastures. These areas have been left fallow and are slowly being encroached by woody species in the form of shrubs establishing. The areas are mostly level with red loamy soil and no rocks present.

The vegetation composition and structure vary. In some areas the soil is bare and dominated by the pioneer grass *Cynodon dactylon* and in other areas where the old fields have been left fallow for many years the grasses *Eragrostis rigidior* and *Eragrostis curvula* are prominent in the herbaceous layer with either the shrub

Dichrostachys cinerea or *Vachellia tortilis* dominant in the woody layer. The woody species are between 0.5-1.6m tall.

The old fields are associated with deep (0.3 – 2m) loamy soil and though to be of the Hutton soil form (Mucina & Rutherford, 2006).

Alien plant species

None

Red data species

None.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Species name	
Aristida congesta subsp. barbicollis	G
Aristida stipitata	G
Ceratotheca triloba	F
Dichrostachys cinerea	W
Eragrostis curvula	G
Eragrostis rigidior	G
Limeum aethiopicum	F
Pentarrhinum insipidum	F
Plectranthus madagascariensis	F
Portulaca oleracea	F
Sesamum triphyllum	F
Sida cordifolia	F
Terminalia sericea	W
Vachellia tortilis	W

- Loop in-out the 132kV traction stations as follows:
  - Diepspruit Traction – 2 x 1 km 132kV lines from the existing Medupi Thabazimbi line
  - Matlabas Traction – 2 x 1 km 132kV lines from the existing Medupi Thabazimbi line
  - Marakele Traction – 2 x 2.5 km 132kV Lines from the existing Medupi Thabazimbi line

7. Diepspruit Traction

Soil	Red sandy soil	**Tree cover**	15%
Topography	Level – undulating slight southern slope (1-2^0)	**Shrub cover**	15%
Land use	Game & cattle	**Herb cover**	3%
Unit status	Natural to degraded	**Grass cover**	65%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	0%
		Erosion	0%

Dominant spp	*Terminalia sericea; Eragrostis pallens*

Conservation value	**Medium**	**Ecosystem functioning**	**Medium**

The vegetation of the three alternatives for the Traction substation comprises of the same vegetation unit (Figure 6). The vegetation is dominated by the tree *Combretum apiculatum* with *Peltophorum africanum, Dichrostachys cinerea* and *Terminalia sericea* prominent. The herbaceous layer is well-developed with the grasses covering

75% of the area comprising tall to medium-tall grasses such as *Eragrostis pallens, Heteropogon contortus, Eragrostis rigidior* and *Digitaria eriantha.* Forb species include *Sida dregei, Dicerocaryum eriocarpum* and *Tephrosia capensis.*

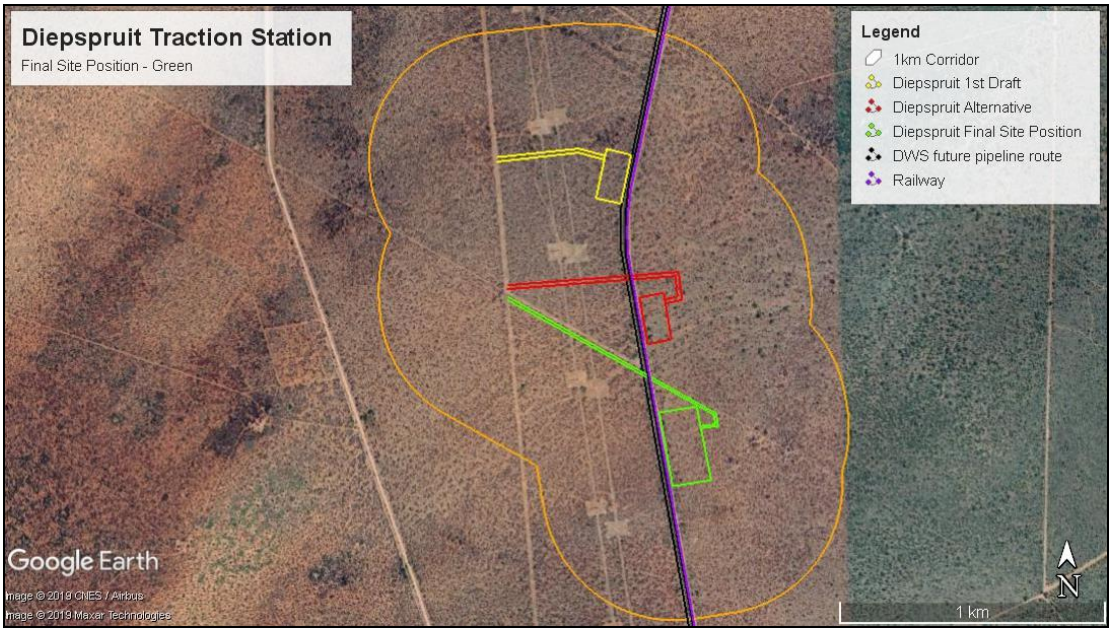


Figure 6. Proposed locations of the Diepspruit Traction substation (Source: Google earth 2019)

Alien plant species

None.

Red data species

No rare or endangered plant species were recorded.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Species name	
Abutilon austro-africanum	F
Aristida congesta subsp congesta	G
Aristida stipitata	G
Ceratotheca triloba	G
Chamaecrista mimosoides	F
Combretum apiculatum	W
Combretum zeyheri	W
Cucumis spp	F

	Dicerocaryum eriocarpum	F
	Dichrostachys cinerea	W
	Digitaria eriantha	G
	Eragrostis lehmanniana	G
	Eragrostis pallens	G
	Eragrostis rigidior	G
	Heteropogon contortus	G
	Indigofera daleoides	F
	Ipomoea spp	F
	Ozoroa paniculosa	W
	Panicum maximum	G
	Peltophorum africanum	W
	Pentarrhinum insipidum	F
	Phyllanthus parvulus	F
	Pogonarthria squarrosa	G
	Schmidtia pappophoroides	G
	Scolopia zeyheri	W
	Senegalia erubescens	W
	Sida cordifolia	F
	Sida dregei	F
	Solanum panduriforme	F
	Tephrosia lupinifolia	F
	Terminalia sericea	W
	Urochloa mosambicensis	G
	Waltheria indica	F
✚	*Ziziphus mucronata*	W

8. Matlabas Traction

Soil	Deep red sandy soil	**Tree cover**	15%
Topography	Level	**Shrub cover**	15%
Land use	Game & cattle	**Herb cover**	5%
Unit status	Degraded	**Grass cover**	5%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	0%
		Erosion	0%

Dominant spp	*Combretum apiculatum; Dichrostachys cinerea; Grewia bicolor*

Conservation value	**Low**	**Ecosystem functioning**	**Low-medium**

This vegetation unit occurs on deep red sandy soil with no rocks present. Both the proposed alternatives for the substation are located in this unit.

The vegetation is characterised by the dominance of the vegetation by the tree *Combretum apiculatum* while *Dichrostachys cinerea* and *Grewia bicolor* are prominent throughout. The herbaceous layer is degraded and consists of various forb and grass species covering less than 10% of the area and include the grasses *Aristida stipitata, Aristida congesta* subsp *congesta, Eragrostis lehmanniana* and the forbs *Sida cordifolia, Solanum panduriforme* and *Waltheria indica.*

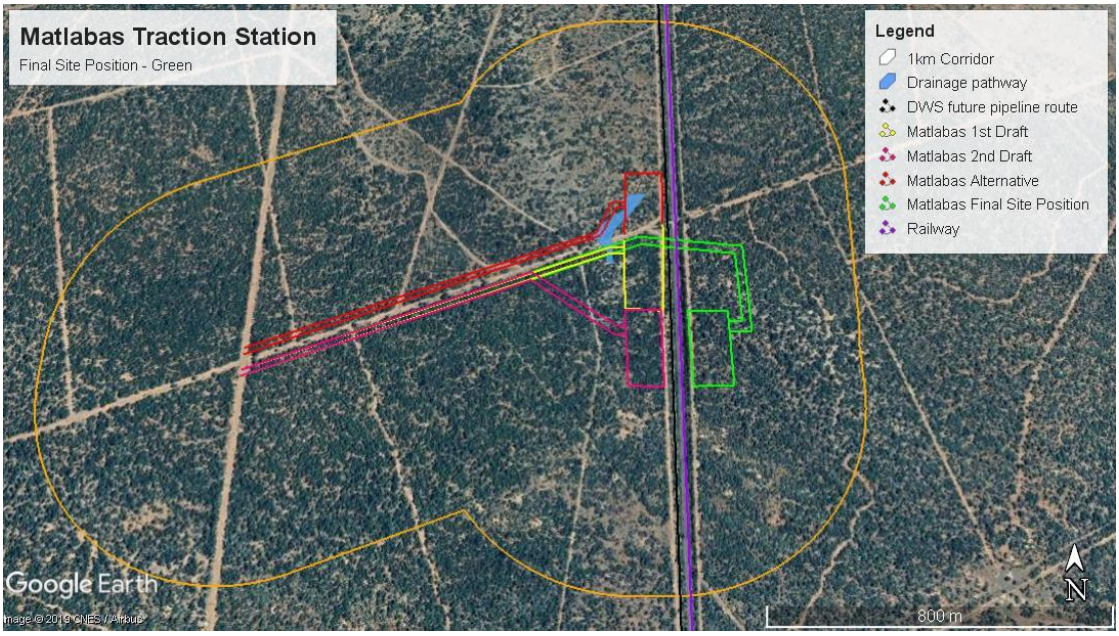


Figure 7. Proposed locations of the Matlabas Traction substation (blue area = broad indiscernible drainage pathway) (Source: Google earth 2019)

Alien plant species

None

Red data species

One protected tree *Sclerocarya birrea* was found within this woodland.

The following is a list of plant species identified in this during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

Species name	
Agathisanthemum bojeri	F
Aristida congesta subsp congesta	G
Aristida stipitata	G
Asparagus suaveolens	W
Combretum apiculatum	W
Combretum zeyheri	W
Commelina africana	F
Dichrostachys cinerea	W
Ehretia lehmanniana	G
Ehretia rigida	W
Eragrostis pallens	G
Euclea undulata	W
Grewia bicolor	W

	Grewia flavescens	W
	Panicum maximum	G
	Parinari capensis	W
	Sclerocarya birrea	W
	Sida cordifolia	F
	Solanum panduriforme	F
	Terminalia sericea	W
	Waltheria indica	F

9. Marakele Traction

Soil	Red loam soil	**Tree cover**	8%
Topography	Level – undulating slight southern slope (1-2^0)	**Shrub cover**	50%
Land use	Game & cattle	**Herb cover**	5%
Unit status	Natural to degraded	**Grass cover**	50%
Faunal spp.	Birds, insects, small mammals, domestic animals	**Rock cover**	0%
		Erosion	1%

Dominant spp	Various spp

Conservation value	**Low**	**Ecosystem functioning**	**Low-medium**

This vegetation unit is located on red loamy soil with few rocks present. The localities of both of the proposed substations are located within this vegetation unit.

The vegetation comprises a mixture of woody and grass species that included the woody species *Combretum hereroense, Peltophorum africanum, Vachellia tortilis, Combretum apiculatum, Pterocarpus rotundifolius, Grewia flava,* the grasses *Eragrostis rigidior, Digitaria eriantha, Aristida congesta* subsp. *barbicollis* and the forbs *Kyphocarpa angustifolia* and *Sida dregei.*

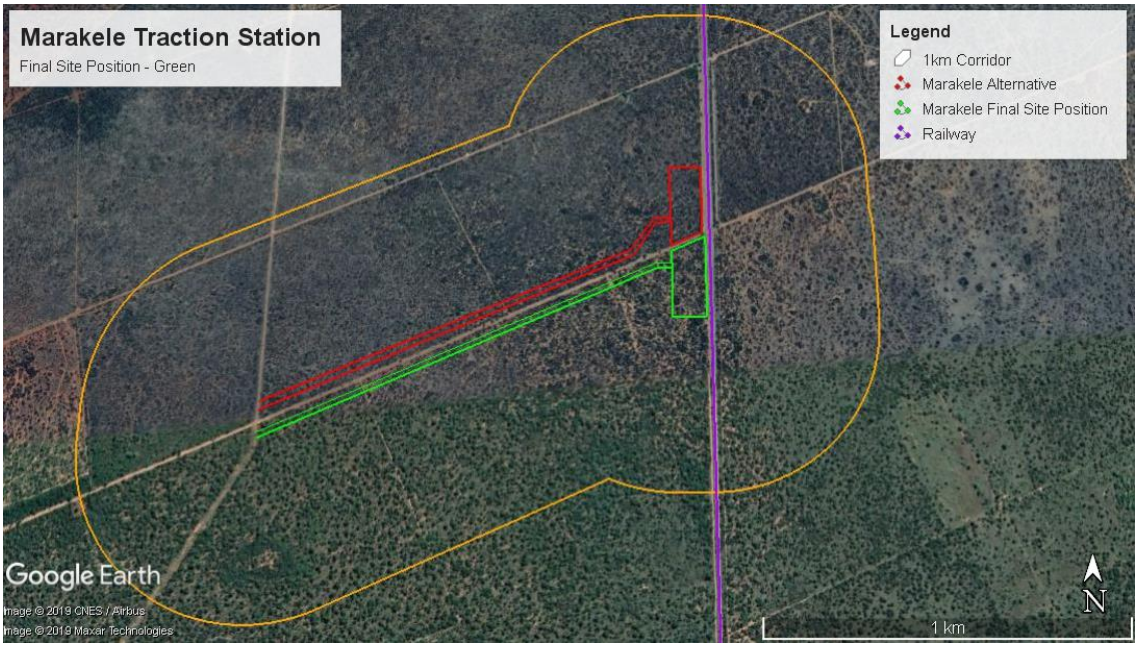


Figure 8. Proposed locations of the Marakele Traction substation (Source: Google earth 2019)

Alien plant species

None

Red data species

No rare or endangered plant species were recorded.

The following is a list of plant species identified in this during the survey (=alien invasive species; ✚=medicinal value; =Protected species; =Garden hybrid) (W=woody; G=grass; F=forb):

	Species name	
	Aristida congesta subsp barbicollis	G
	Aristida congesta subsp congesta	G
	Combretum apiculatum	W
	Combretum hereroense	W
	Dichrostachys cinerea	W
	Digitaria eriantha	G
	Diospyros lycioides	W
✚	*Elephantorrhiza elephantina*	W
	Euclea undulata	W
	Grewia flavescens	W
	Kyphocarpa angustifolia	F
	Lannea discolor	W
	Panicum maximum	G

	Peltophorum africanum	W
	Pterocarpus rotundifolius	W
	Schmidtia pappophoroides	G
	Sida dregei	F
	Solanum panduriforme	F
	Urochloa mosambicensis	G
✚	*Vachellia karroo*	W
	Vachellia tortilis	W
✚	*Ziziphus mucronata*	W

4.2 WATER COURSES

Apart from one small artificial concrete-lined dam, no permanent or seasonally wet water courses were found to be present, but rather broad slightly lower open drainage pathways (that are topographically indiscernible from the surrounding area and only marginally different from a vegetation perspective) and seasonally moist/wet depressions.

Drainage pathways

The drainage pathways fall within vegetation unit 5 as described under the vegetation section. The soil is red loamy with a slightly higher clay content than the surrounding areas which is responsible for the higher density of the *Senegalia nigrescens, Senegalia erubescens* and *Vachellia* woody species compared to the tree *Combretum apiculatum* that is present in the drainage pathways, but not dominant as in the surrounding *Combretum apiculatum* vegetation unit.

Although the area cannot be classified as a wetland or even seasonally wet area, it was assessed in terms of its Ecological Importance and Sensitivity (EIS).

Ecological Importance and Sensitivity (EIS)

The EIS and functions for the drainage pathway were calculated using a modified DWA guidelines and model, as developed by M. Rountree, but not yet published. Information was used form the SIBIS and VEGMAP products. A mean score between 0 and 4 is obtained, with 0 as the lowest and 4 as the highest score (0-1 = Low to very low; >1-2 = Low-Moderate; >2-3 = Medium-high: >3-4 = High to very high).

The **drainage pathway system** area has a **Low Ecological Importance and Sensitivity** (EIS) score of **0.92** (Table 5). This is a value between 0 and 4, with 0 being very low and 4 very high. It is regarded as having a low ecological sensitivity with a low biodiversity. This area is not regarded as being ecologically of high importance or sensitive on a provincial or local scale and mainly has a surface water channelling function during high rainfall events. The habitat of this system is not highly sensitive to flow and habitat modifications.

Table 5 EIS calculation of the drainage pathway areas

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	*Confidence (1-5)*	Motivation
Biodiversity support	**0.50**	***5.00***	
Presence of Red Data species	**0.50**	*5.00*	No known red data or protected species observed on site and no suitable habitat exists.
Populations of unique species	**0.50**	*5.00*	No unique plant or animal populations were observed. Apart from thron trees slightly more dominant not much
Migration/breeding/feeding sites	**0.50**	*5.00*	The vegetation is similar in structure to that of the adjacent vegetation and thus provide similar breeding/feeding sites.
Landscape scale	**1.25**	***5.00***	
Protection status of the riverine habitat	**0.50**	*5.00*	The habitat of the drainage pathway is not part of a protected system and classified as a broad indiscernible drainage line that is used for grazing purposes for game and cattle.
Protection status of the vegetation type	**2.50**	*5.00*	The vegetation of the drainage pathway does not form part of any protected or threatened ecosystem on a national basis, though the larger area is classified as ESA/CBA on Provincial basis.
Regional context of the ecological integrity	**1.00**	*5.00*	The drainage pathway directs small amounts of surface water over a broad area, to a tributary further south. The tar road does however pose a barrier that results in large amounts of the water never reaching the tributary. .
Diversity of habitat types	**1.00**	*5.00*	The drainage pathway is mostly homogeneous with a mixture of pioneer, secondary successional and climax species present. There is a low diversity of habitats.
Sensitivity of the stream/wetland	**1.00**	***4.00***	
Sensitivity to changes in floods	0.50	*4.00*	The area is not particularly sensitive to flooding, with little to no changes in the vegetation or habitat expected.
Sensitivity to changes in low flows/dry season	0.50	*4.00*	Very little sensitivity with a negligible effect on the vegetation and habitat.
Sensitivity to changes in water quality	2.00	*4.00*	Area receives surface water from high rainfall events. Changes in the water quality should have a low impact on the vegetation and habitat.
ECOLOGICAL IMPORTANCE & SENSITIVITY	**0.92**	***4.67***	

Seasonally wet depressions

These areas fall within vegetation unit 5 as described under the vegetation section. The soil is red to grey loam with a slightly higher clay content than the surrounding areas which is responsible for the higher density of the *Senegalia* and *Vachellia* woody species compared to the tree *Combretum apiculatum* that is present in the area, but not dominant as in the surrounding *Combretum apiculatum* vegetation unit.

Although these depressions cannot be classified as wetlands, they are seasonally wet to moist. They were therefore assessed for their PES using the WET-Health assessment tool. The results are indicated in Table 6 below:

Table 6 **PES calculation of the seasonally wet depressions**

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	3	100	3.5	0	1.2	0	2.1	0
Area weighted impact			3.5	0	1.2	0	2.1	0
PES Category			C	→	B	→	C	→

The results from the PES analysis indicate the **hydrology** and **vegetation** of these areas (**PES = C**) to be moderately modified with a moderate loss of biodiversity. Overall the system does however remain predominantly natural and intact. of the area

The **geomorphology** of the area (**PES = B**) indicates the topography to be largely natural with minimal loss of ecosystem services as a result thereof. The only impacts on the topography is the smaller areas where erosion have occurred. The loss of herbaceous vegetation as a result of trampling and/or grazing has most probably contributed to soil erosion during rainfall events since there is no vegetation binding the soil or protecting it from the force of the rainwater.

5. DISCUSSION

5.1 *VEGETATION*

5.1.1 Threatened ecosystems & Protected areas

According to the SANBI data and locality maps no protected or threatened vegetation types are present within the proposed corridors and substations.

5.1.2 Vegetation types

On a small scale the proposed routes fall within the savanna biome and within a larger regional scale the proposed route and substations are located within the (Mucina & Rutherford, 2006) located within the Central Bushveld Bioregion (Svk) (Figure 9).

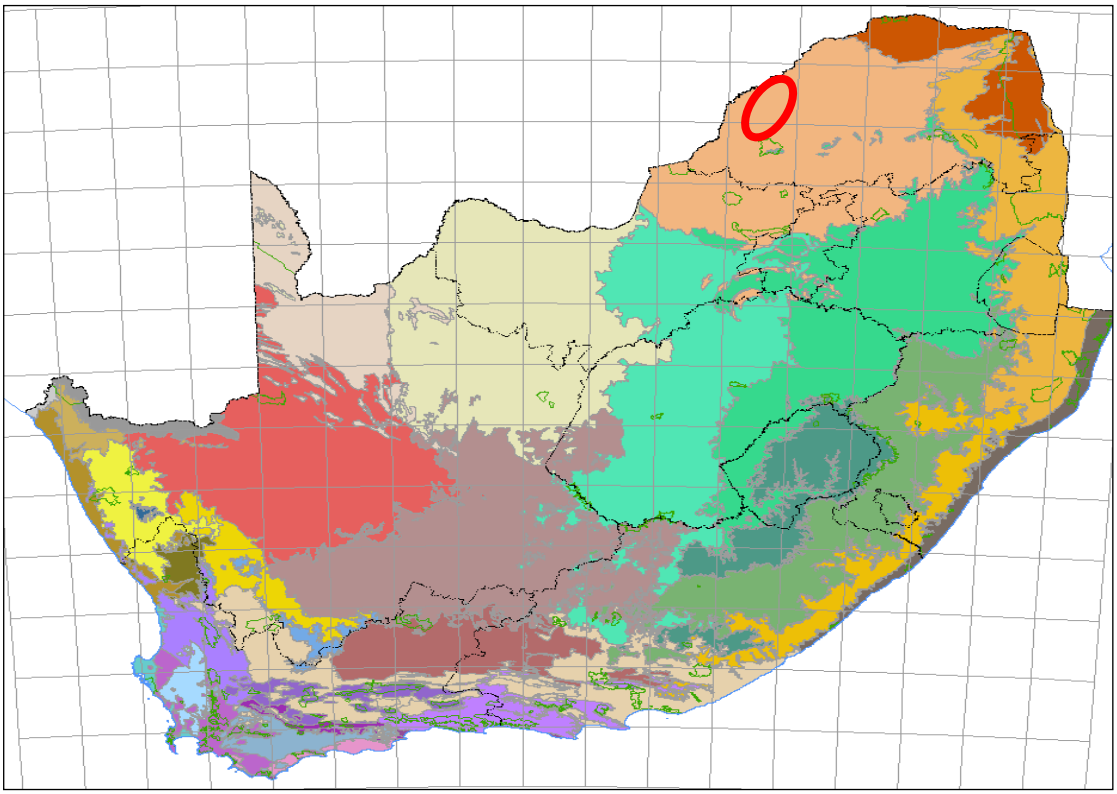


Figure 9. Different Bioregions of South Africa with red circle indicating the study areas located within the Central Bushveld Bioregion.

A Bioregion represents an intermediate level between a biome and a vegetation unit with each bioregion having specific biotic and physical features at a regional scale (Mucina & Rutherford 2006). Each Bioregion has a distinct climatic character that differs from other bioregions.

In terms of vegetation types the proposed route and substations are located within the Limpopo Sweet Bushveld (SVcb 19) and Western Sandy Bushveld (SVcb 16) (Mucina & Rutherford 2006) (Figure 10).

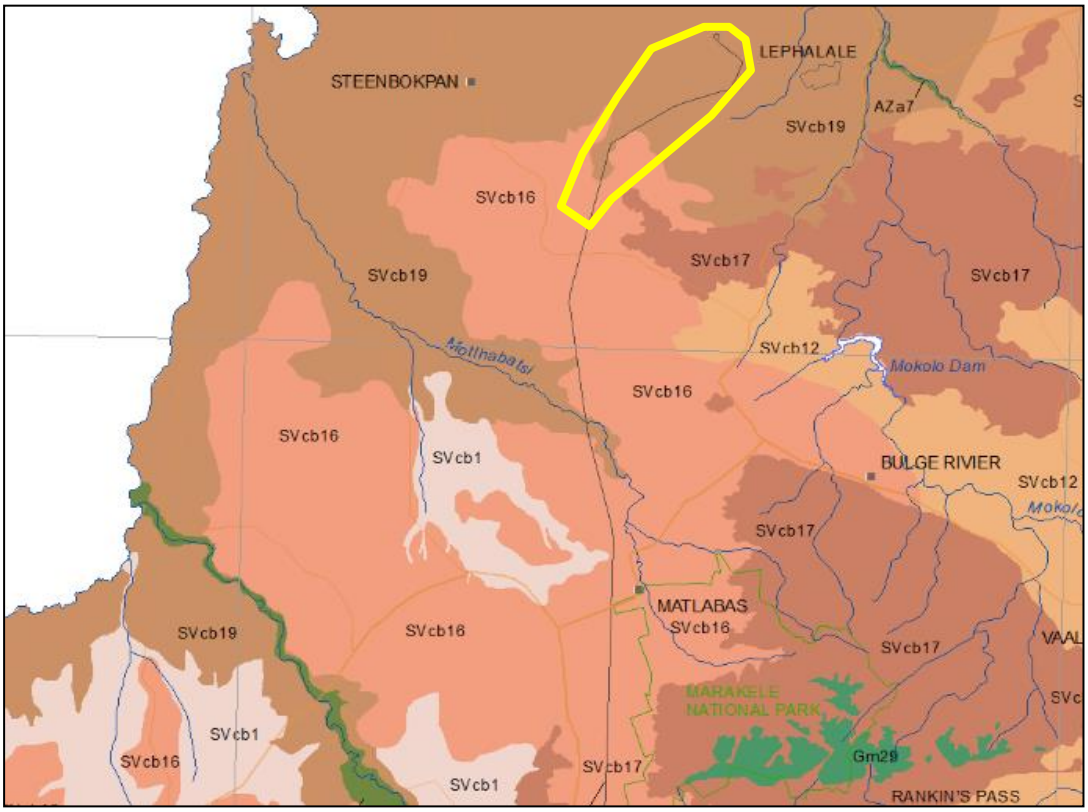


Figure 10. Location of the proposed routes within Limpopo Sweet Bushveld (SVcb 19) and Western Sandy Bushveld (SVcb 16) (Source: Mucina & Rutherford 2006)

Limpopo Sweet Bushveld (SVcb 19)

This vegetation type occurs on undulating terrain and comprises short to medium-tall open woodland. Many areas are traversed by drainage lines and tributaries. Bush densification is evident in large areas with the woody species *Senegalia erubescens, Senegalia mellifera* and *Dichrostachys cinerea* dominant in these areas. The vegetation is characterised by the dominance of the tall trees *Vachellia robusta, Senegalia burkei,* medium-sized shrubs *Senegalia erubescens, Vachellia nilotica, Boscia albitrunca, Combretum apiculatum, Terminalia sericea, Dichrostachys cinerea, Rhigozum obovatum, Cadaba aphylla* and *Commiphora pyracanthoides.* The herbaceous layer is characterised by the dominance of the grasses *Enneapogon scoparius, Eragrostis lehmanniana, Schmidtia pappophoroides, Panicum coloratum,* and the forbs *Hermbstaedtia odorata, Indigofera daleoides, Commelina benghalensis* and *Harpagophytum procumbens.*

This vegetation type is regarded as being least threatened. Although only 1% of the target of 19% is statutorily conserved in smaller nature reserves, the area is mostly used for game farming and cattle grazing purposes with an estimated 5% transformed by cultivation.

Western Sandy Bushveld (SVcb 16)

This vegetation type occurs on flat to undulating plains from Assen to Thabazimbi in the Northwest province. The vegetation is dominated by the trees *Senegalia erubescens* on the flat areas and *Combretum apiculatum* on shallow gravelly soil. Other woody species that are dominant include *Vachellia erioloba, Senegalia nigrescens, Senegalia mellifera, Vachellia nilotica, Terminalia sericea, Euclea undulata, Combretum hereroense, Combretum zeyheri,* the grasses *Digitaria eriantha, Eragrostis rigidior, Schmidtia pappophoroides, Aristida congesta subsp. congesta, Eragrostis superba,* and the forbs *Evolvulus alsinoides, Limeum fenestratum, Monsonia angustifolia* and *Kyphocarpa angustifolia.*

This vegetation type is regarded as being least threatened. Of the target of 19% only 6% is statutorily conserved, while 4% is transformed due to agricultural activities. Large sections are used for game farming also.

5.1.3 Vegetation units

Vegetation unit 1 *(Combretum apiculatum* woodland) is the largest vegetation unit and occurs all along the proposed power line route. The vegetation is typical of the Limpopo Sweet Bushveld and in most areas in a natural condition with a moderate to high species richness. The area consists of slightly undulating terrain with red sandy and gravelly soil that varies in depth with few rocks present.

The sections of this vegetation unit located to the west and north-west of the Medupi Power Station are mostly used for grazing by game and cattle. As a result, the herbaceous layer is degraded in some areas but in other areas well-developed as one would find in the natural veld. This area is therefore from a plant ecological and ecosystem functioning point of view regarded as having a **medium-high conservation value.**

The section of this vegetation unit located on both sides of the Kuipersbult Road along the southern boundary of the Medupi Power Station is somewhat degraded.

The herbaceous layer of the vegetation south of the road is degraded due to overgrazing, while various open areas occur where the woody species have been removed for current power lines, agriculture and general maintenance. The area north of the road is denser in terms of woody species with the herbaceous layer consisting of more grasses, though the woody species have become densified and are slowly outcompeting the grasses. This section of the unit also forms a narrow strip between the Medupi Power Station and the road and is mostly isolated from similar habitat though it is connected to it towards the west. This section of the proposed route is regarded from a plant ecological and ecosystem functioning point of view as having a **medium-low conservation value.**

The *Senegalia nigrescens* woodland (vegetation unit 2) forms part of the larger *Combretum apiculatum* woodland and occur as medium to small sections slightly lower-lying areas within the larger unit. Thus, this vegetation community can be classified as a variant of vegetation unit 1. The soil of these areas has a slightly higher loamy-clay content than the surrounding areas since clay particles are slowly washed towards these areas during the rainfall season from the adjacent areas. The vegetation is indicative of more sodic soil as indicated by the co-dominance and occurrence of various *Senegalia* spp. In general, the area has a similar species composition than that of vegetation unit 1, but

for the greater prominence of the *Senegalia* spp. Since these areas are also slightly more nutritious, the grasses occurring in small patches within thus unit are also more palatable to animals. As a result, some sections have become overgrazed causing the grass *Eragrostis rigidior* to establish and become co-dominant. Topographically the area is only slightly lower-lying than the surrounding area while in terms of vegetation it does not differ significantly from the larger vegetation unit 1. The species richness is also moderate. From a plant ecological and ecosystem functioning point of view this unit has a **medium-high conservation value.**

The *Senegalia erubescens* shrubland (vegetation unit 3) occurs towards the central part of the proposed power line where the line is curves in a north-western direction towards the Theunispan substation. This area is lower lying than the surrounding *Combretum apiculatum* woodland (vegetation unit 1) meaning that over the years soil and nutrients were slowly washed in this direction from the surrounding areas during high rainfall events. As a result, the soil has a higher nutrient and clay content making conditions suitable for *S erubescens* to establish as well as other *Senegalia/Vachellia* species. The area has similar species than vegetation unit 2 (*Senegalia nigrescens* woodland) but is dominated by *Senegalia erubescens* which is a species that can grow in a variety of soil types (normally shallow loamy-clayey soil) and which is well adapted to dry conditions. It seems as though sections of this vegetation unit have been overgrazed in the past resulting in a degraded herbaceous layer. That is also most probably the reason for the dominance of *S. erubescens* since this species can form dense stands in disturbed areas. The mostly shrub-like structure of this vegetation unit is also an indication of some or other disturbance in the past. In some areas open soil patches with some erosion are visible with a scanty herbaceous layer consisting of grasses and forbs. This unit has a low species richness and is from a plant ecological and ecosystem point of view regarded as having a **medium conservation value.**

Vegetation unit 4 (*Terminalia sericea* woodland) occurs as moderate to narrow belts across the proposed power line route on deep sandy leached soil. The soil of the proposed power line route varies from sandy loam to clayey to sandy with the latter deep and well-drained. This creates ideal conditions for the medium-tall tree *Terminalia sericea* to establish. This species is regarded as an indigenous encroacher that becomes dominant in sandy soil where overgrazing or disturbance of the herbaceous layer has taken place. Researchers have found differential competition between this tree and the herbaceous layer for soil water exists and that the tree can form a dense shallow root system as well as develop taproot. This acts as one of the feeding mechanisms for bush encroachment where this species becomes dominant. The herbaceous layer consists of large tufted grass plants typical of sandy soil (e.g. *Eragrostis pallens; Aristida stipitata*) that has a high canopy cover but low basal cover. There are therefore large open sandy patches between the tufts although the leaves of the grasses cover the soil up to 65%. No erosion was visible as would be expected in well-drained sandy soil. The area is relatively homogeneous and has a low-moderate species richness. From a plant ecological and ecosystem functioning point of view this area has a **low conservation value.**

The **Drainage lines and seasonally wet depressions (Vegetation unit 5)** are scattered throughout the corridor area. Two sections are distinguished namely the drainage lines that are located in the eastern part of the proposed route close to the Medupi Power Station, while the seasonally wet depressions are located in the western part of the proposed route. The vegetation of these areas are similar to that of the surrounding *Combretum apiculatum* woodland (vegetation unit 1) vegetation unit, but consists of small drainage lines that directs surface water during high rainfall events towards the tar road while the pans are level to slight depressions that collect surface water during rainfall events. The latter is normally utilised by animals for drinking purposes during summer should water collect in them. Whereas the vegetation of the drainage lines is dense, the vegetation of the depressions is open in the depression areas with open woodland along their edges consisting of *Vachellia* and *Senegalia* species. As expected of these areas, the herbaceous layer is mostly

degraded while the soil is trampled around the depression areas with some signs of erosion. These areas do not have sensitive vegetation but are considered as important ecosystems as a result of their water channelling and retention capacity and are therefore regarded as having a **medium-high conservation value**.

The **developed areas** and **old fields (vegetation unit 6)** consist of transformed land where the native species of the area have been displaced due to anthropogenic actions. These areas comprise pioneer weedy species mostly and does not resemble any natural ecosystem that occurs within the area. From a plant ecological point of view these areas are regarded as having a **low conservation value and ecosystem functioning.**

The **Diepspruit Traction substation (vegetation unit 7)** is located on level to slightly undulating terrain. The area comprises open woodland with large grassland patches in-between. The area consists of deep red sandy soil with large perennial grasses forming large tufts with low basal cover but a high canopy cover. The woody layer is more shrub-like and between 3-4m tall. The area has a moderate to low species richness and is mostly natural. The area is not unique in terms of vegetation composition and is therefore regarded as having a **medium conservation value and ecosystem functioning.** Although any of the three proposed routes would be acceptable from a vegetation ecological point of view, it is thought that the final site position (Figure 6 - also see photo right) would cause the

least disturbance since it would be erected adjacent to an existing “two-spoor” road and fence line.

The **Matlabas Traction substation (vegetation unit 8)** is located on level soil with a slight northern slope (1^0). The vegetation has a well-developed woody layer however, the herbaceous layer is degraded due to overgrazing. The proposed route towards the north is more degraded and densified in terms of the woody component than the proposed route on the southern side. The area has a low species richness and forms dense thickets as a result of woody species densification (due to overgrazing). A wide undifferentiated drainage pathway is present within this unit (see photo right) where the substations are proposed, though these areas have the same vegetation composition and structure and can only be distinguished from aerial photographs. This vegetation unit has from a plant ecological and ecosystem functioning point of view a **low conservation value and ecosystem functioning.** Four proposed sites were investigated. Proposed alternative 1 (Matlabas 1st Draft–Figure 7) is located within the undifferentiated drainage pathway while proposed alternative 2 (Matlabas 2nd Draft – Figure 7) could potentially affect it. Although the drainage pathway is not regarded as being ecologically sensitive from a plant ecological point of view the Matlabas alternative and the Final site position (Figure 7) are recommended as the most suitable sites with the least impact on the environment.

Large wide undifferentiated drainage area located along the proposed route

The **Marakele Traction substation (vegetation unit 9)** is located on level red loamy soil and has a moderate to low species richness. The vegetation consists of a mixture of different woody and grass species that are locally dominant. The vegetation forms dense mostly impenetrable thickets though the grass layer has a

moderate cover underneath the taller tree species. The area has most probably been overgrazed in the past by cattle that has resulted in the woody layer becoming more dense since the grass competition factor has been removed. This unit has from a plant ecological and ecosystem functioning point of view a **low conservation value and ecosystem functioning.** Both alternatives as indicated in Figure 8 are regarded as suitable sites for the proposes substation.

5.1.4 Ecosystem classification

The proposed routes as well as substations were also assessed in terms of their provincial classification according to the Limpopo Conservation Plan 2 (LCPv2) (Desmet *et al.,* 2013):

Proposed powerline from Medupi Power Station to the existing Theunispan substation

According to the biodiversity classification of Limpopo Province (LCPv2) vegetation units 3 and 5 and sections of vegetation unit 1 are classified as located within a Critical Biodiversity Area (CBA) 1 while vegetation unit 5 is located in a CBA 1. Sections of vegetation unit 1, 2 and 6 in the south and eastern parts are located within an Ecological Support Area (ESA) 1 (Figure 11).

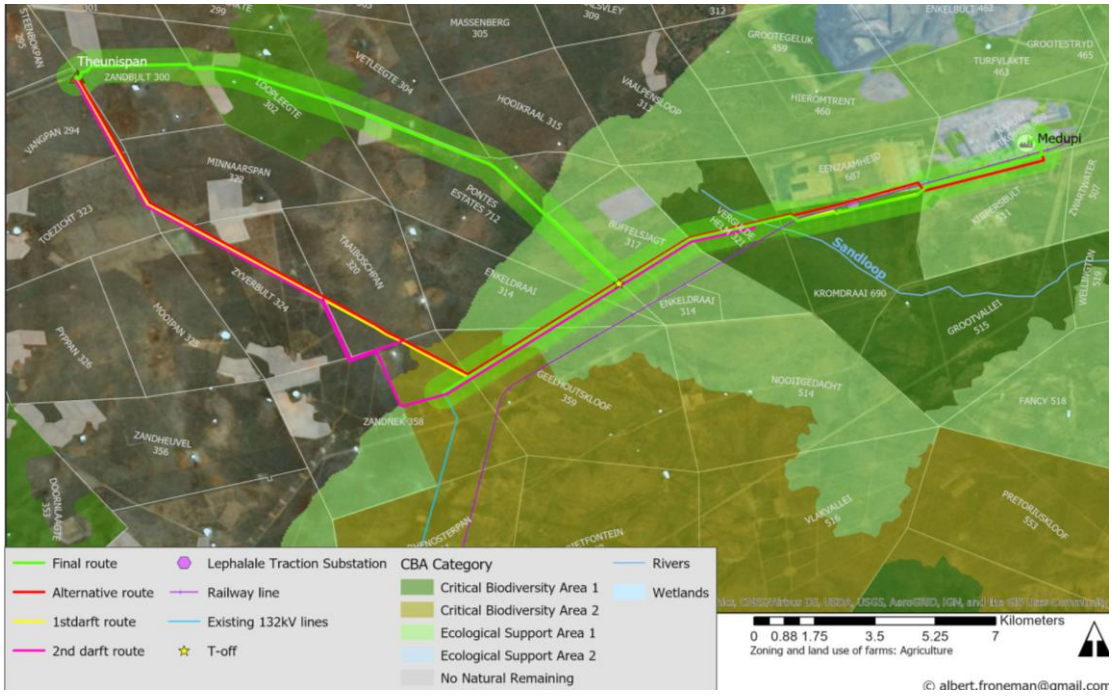


Figure 11. CBA and ESA areas along the proposed power line from Medupi to Theunispan Substation.

Diepspruit Traction substation

According to the biodiversity classification of Limpopo Province (LCPv2) the vegetation of the proposed substation and loop final location is classified as a Critical Biodiversity Area (CBA) 1 (Figure 12).

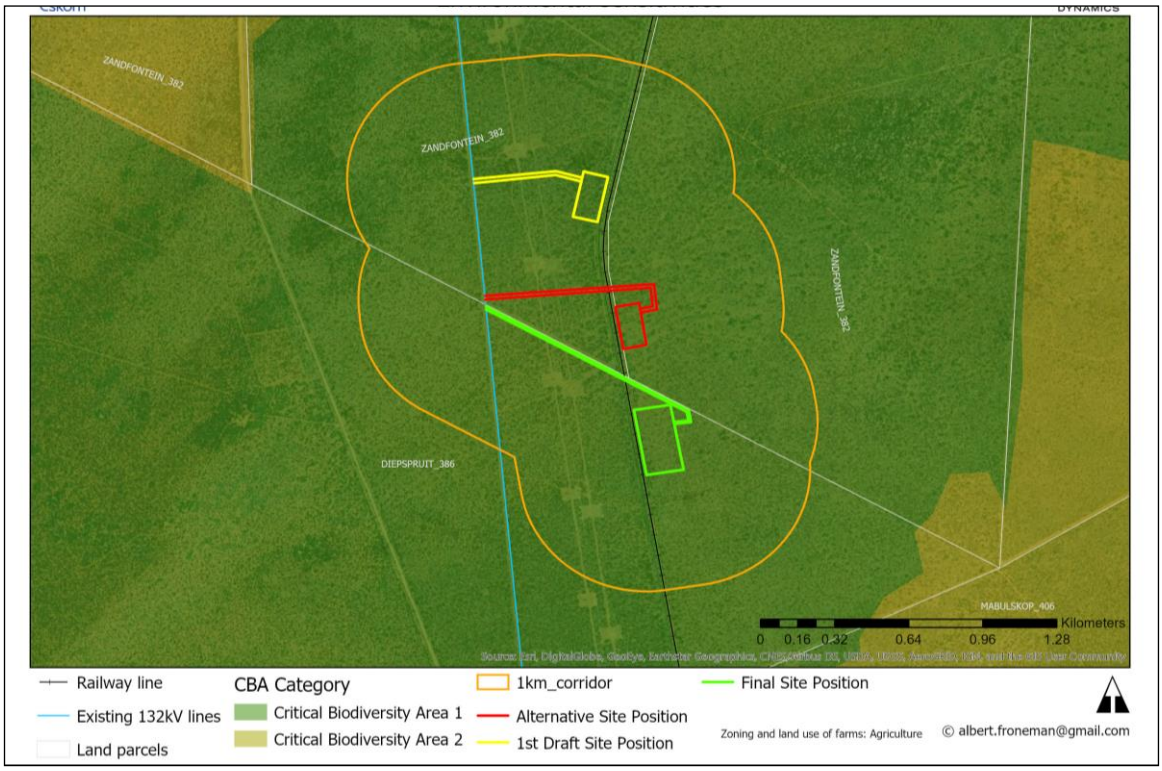


Figure 12. CBA and ESA areas for Diepspruit Traction Substation and loop.

Matlabas Traction substation

According to the biodiversity classification of Limpopo Province (LCPv2) the vegetation of the proposed substation and loop is classified as a Critical Biodiversity Area (CBA) 1 (Figure 13).

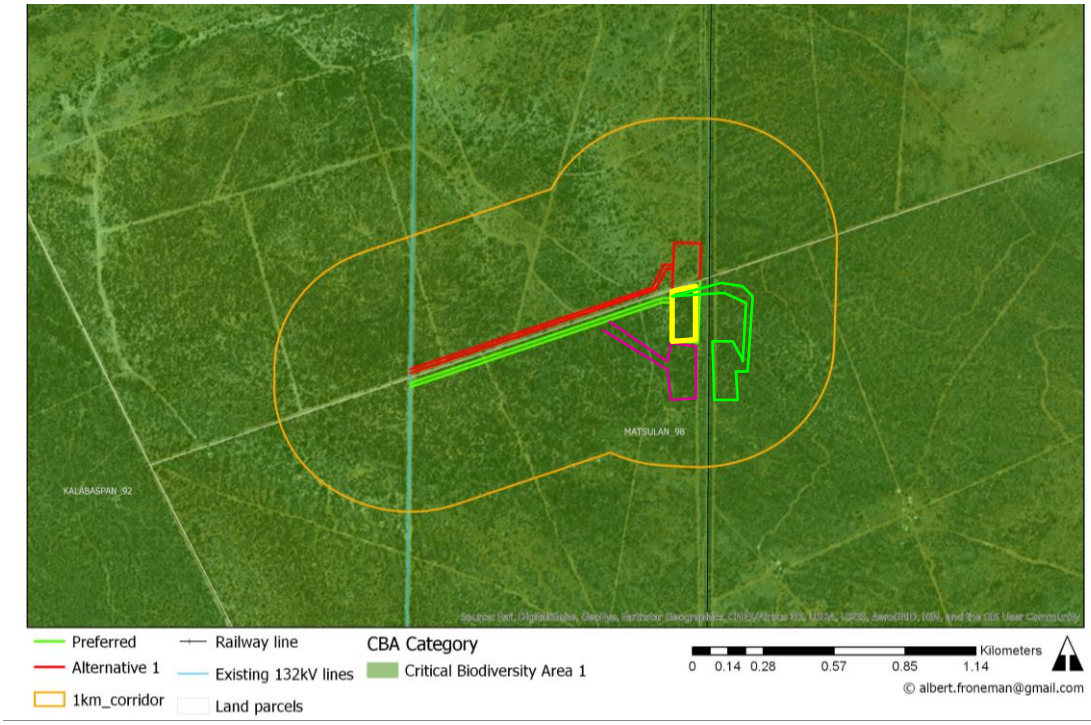


Figure 13. CBA areas for Matlabas Traction Substation and loop (Green lines = final site position).

Marakele Traction substation

According to the biodiversity classification of Limpopo Province (LCPv2) the vegetation of the proposed substation and loop is classified as an Ecological Support Area (ESA) 1 (Figure 14).

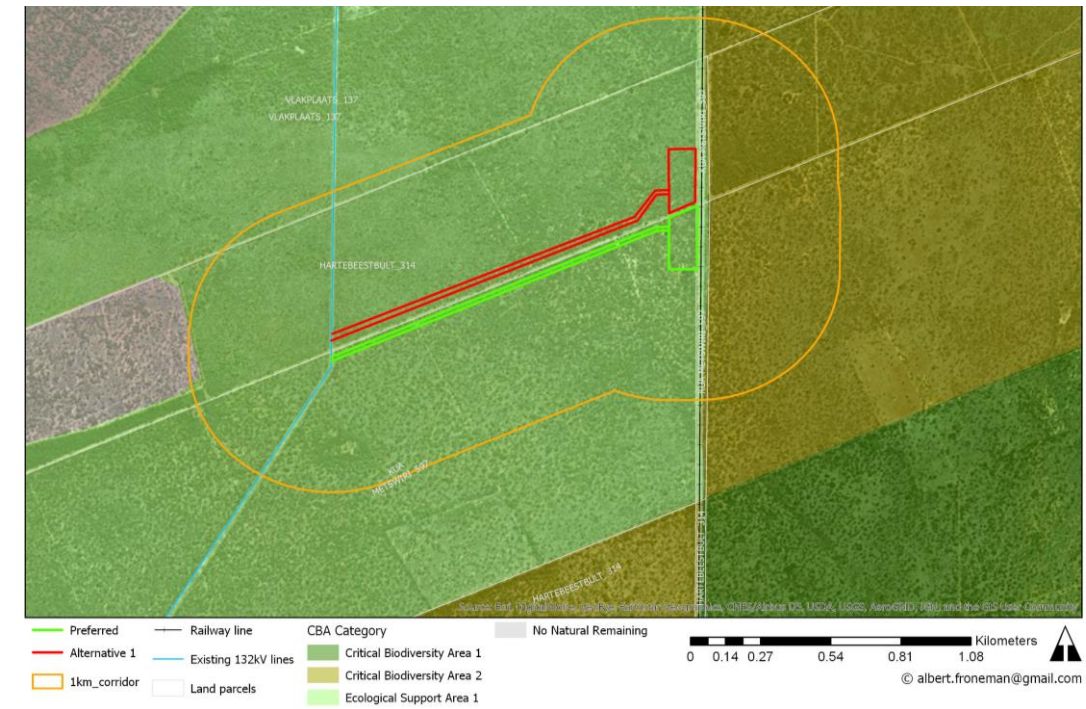


Figure 14. CBA and ESA areas for Marakele Traction Substation and loop (Green lines=final position).

Discussion

According to the Limpopo Conservation Plan 2 (LCPv2) (Desmond *et al.,* 2013) the purpose of the plan is to develop the spatial component of the bioregional plan that facilitate biodiversity conservation and also inform natural resource management plans, land-use planning, environmental impact assessments and authorisations. The plan is consistent with NEMA principles and the National Biodiversity Act. Bioregional plans are intended to support and streamline environmental decision making. Since the plan and associated maps are done on a relatively coarse scale it is important to note that it does not replace site assessments for Environmental Impact Assessment purposes and still requires specialist interpretation and assessment (Desmond *et al.,* 2013). It is furthermore important to note that the classification of an ecosystem within a specific category is based on various aspects including, birds, vegetation, herpetological data, rivers, wetlands, birds, conservation areas etc.

A CBA is regarded as an area that need to be maintained in as natural condition as possible to meet the region's biodiversity target. An ESA is an area that has been subjected to some degradation and although no longer intact, it is largely natural and important to support CBA's and to maintain landscape connectivity (Desmond *et al.,* 2013).

For the proposed powerline from Medupi Power Station to the existing Theunispan substation the southern sections of the proposed power line are located within either a CBA or an ESA. The sections of vegetation unit 1, 3 and 5 (*Combretum apiculatum* woodland, *Senegalia erubescens* shrubland & Drainage pathways and seasonally wet depressions) that are located within these units are very narrow, along existing power-lines and roads, and have become degraded due to anthropogenic activities (roads, overgrazing, land clearing, edge effect of tar and gravel roads etc.) as discussed in section 5.1.3. The vegetation of these areas consists of natural plant species but has become densified with degraded sections present. Thus, although these areas are located within the broad-scale CBA & ESA areas, they are not regarded as being sensitive from a plant ecological perspective along this part of the proposed route. No development is however planned within vegetation unit 5.

Vegetation units 2 & 6 (*Senegalia nigrescens* woodland & *Old fields*) and sections of vegetation unit 1 (*Combretum apiculatum* woodland) are located within ESA areas. These vegetation units are not regarded as being unique and are also somewhat

degraded (especially the Old fields) resulting in these units having medium and low conservation values respectively. These sections are therefore not regarded as having an important function in terms of conservation of the vegetation ecosystem.

The proposed Diepspruit and Matlabas traction substations are located within CBA areas, while the Marakele traction substation is located within an ESA. These areas are however, regarded as being degraded with the Diepspruit area having a medium and the Matlabas and Marakele substation low conservation values (see description under section 5.1.3).

Sensitivity analysis

A sensitivity analysis was done for the seven vegetation units identified. This was achieved by evaluating the different vegetation units against a set of habitat criteria (Table 6). The results indicate that units 1, 2 and 5 to have **medium sensitivity**, Unit 6 a **low sensitivity,** while units 3, 4, Diepspruit, Matlabas and Marakele all have **low-medium sensitivity** to disturbance.

Table 6. Sensitivity analysis for the vegetation units identified along the proposed power line routes and substations (Single scores range between 1 and 10 (the higher the score the more important the criterion).

Criteria	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Diepspruit	Matlabas	Marakele
Presence of protected / red data species	3	3	2	1	2	1	2	1	1
Species richness and composition	8	5	4	3	5	2	4	2	3
Dominant/prominent species ecological status	8	8	8	8	8	3	8	8	8
Sensitivity to disturbance	5	5	5	4	6	1	4	3	3
Conservation status and ecological functioning	7	7	5	3	8	3	5	3	4
Area fragmentation	6	5	5	4	5	3	5	4	6
Medicinal plants	3	3	3	3	2	1	3	3	3
Important topographical features (steep slopes, cliffs etc.)	2	5	2	1	9	2	2	1	2
TOTAL SCORE	**58**	**56**	**48**	**40**	**61**	**21**	**46**	**37**	**43**
Sensitivity rating	**Medium**	**Medium**	**Low-medium**	**Low-medium**	**Medium**	**Low**	**Low-medium**	**Low-medium**	**Low-medium**

Red data species

No red data species were found to be present in the study area (Table 7). The protected species *Sclerocarya birrea* (marula) was however found to be present within three units.

Table 7. Red data species previously recorded in the quarter degree grid of the study area (Raimondo *et al.* 2009).

Genus	National Status	Habitat	Recorded in study area
Vachellia erioloba	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops	Not found
Ansellia africana	Declining	In hot dry mixed deciduous woodlands at medium to low altitudes near rivers	No suitable habitat
Boophone disticha	Declining	Dry grassland and rocky areas	Not found
Bowiea volubilis	Vulnerable	Along mountain ranges and in thickly vegetated river valleys. Often grows under bush clumps and in boulder scree.	No suitable habitat
Brachycorythis conica	Vulnerable	Short grasslands, hillsides, on sandy gravel overlying dolomite, sometimes also on quartzites.	No suitable habitat
Callilepis leptophylla	Declining	Grassland or open woodland, often on rocky outcrops	No suitable habitat
Dioscorea sylvatica	Vulnerable	Wooded places with fair to reasonably good rainfall	No suitable habitat
Elaeodendron transvaalense	NT	Savanna or bushveld, from open woodland to thickets, often grows on termite mounds	No suitable habitat
Siphonochilus aethiopicus	CR	all open or closed woodland, wooded grassland or bushveld	No suitable habitat

Protected species

The Department of Water Affairs and Forestry (now Department of Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require

strict protection while others require control over harvesting and utilization. The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any protected tree species.

Two protected species have been recorded during the survey and are listed below in the table below:

Protected species of the study area (ACT 10 of 2004).

Species name	Recorded in study area	Unit/s	National tree number
Boscia albitrunca	✓	1, 2, 6	122
Sclerocarya birrea (Marula)	✓	1, 4, 6	360

Boscia albitrunca (Shepperd's tree) is usually found in drier environments of southern Africa. The tree has a smooth trunk that is characterised by a whitish grey colour. This small tree can grow up to 7m tall and is a source of food to various mammals, butterflies and birds while humans use the tree for medicinal purposes as well as building material. The individuals of this tree are medium to large (2-5m) in terms of height. Although not regarded as a protected tree in the Limpopo Province it is listed as a protected tree under the National Forests Act, 1988 (Act no 84 of 1998) as published with the Government Gazette of 7 September 2012.

Sclerocarya birrea (Marula) grows well in sandy loamy soil. It is a fast-growing woody species that can grow up to 13m tall. This deciduous tree is characterised by its large branches and light rounded crown. Apart from its medicinal value it provided food and habitat for a variety of animals and bird species. Except for unit 1, the individuals encountered are small – between 1-2m tall. Although not regarded as a protected tree in the Limpopo Province it is listed as a protected tree under the National Forests Act, 1988 (Act no 84 of 1998) as published with the Government Gazette of 7 September 2012.

Medicinal species

Three medicinal plant species have been identified within the study area. These plants occur throughout the southern African region on various soil types and areas and none are threatened species.

Plant name	Plant part used	Medicinal use	Vegetation unit
Elephantorrhiza elephantina	Rhizomes	Diarrhoea, dysentery, stomach disorders, haemorrhoids	1, 7
Vachellia karroo	Leaves, bark and gum	Diarrhoea & dysentery Gum: colds, oral thrush & hemorrhage.	1, 7
Ziziphus mucronata	Roots, bark or leaves	Cough & chest problems; diarrhea; pain relief	5, 7

Alien plant species

A total of two different declared alien invasive species, the forb *Verbena bonariensis* (unit 1) and the succulent *Opuntia ficus-indica* (unit 3), were found to be present as single individuals in the study area.

Opuntia ficus-indica is a succulent species with metamorphic stems resembling leaves, while the leaves have been reduced to form thorns. The plant has been used as an important crop plant (for its edible fruits) in many countries throughout the world. It originates from Central America (Mexico) where it is an economically important plant. A spineless variety of the plant was brought into South Africa as fodder and fruit plants many years ago. Subsequently a spiny form has originated from these plants that are not regularly browsed by animals due to the spines. This plant has therefore started invading various areas displacing the natural vegetation around it. Its seeds are furthermore easily dispersed via birds and baboons and other animals that eats its fruits. As a result there are thousands of hectares of land that has no more economic or ecological value due to these areas being infested with these plants.

Verbena bonariensis is a tall flowering herb (forb) that produces purple flowers on congested terminal spikes. The plant has a noticeably square stem with leaves that are thick textured, sharply toothed and strongly veined on the ventral side of the leaf. The seeds are dispersed by animals, wind and water. The plant originates South America and has become a problem plant in South Africa since it is poisonous to livestock and is regarded as an invader along disturbed areas, roadsides and moist areas and grasslands.

Opuntia ficus-indica and is a declared category 1 weed (CARA) and category 1b plants (NEMBA), while *Verbena bonariensis* a declared category 1b weed (NEMBA).

All category 1 plants must be removed and eradicated by the landowner by law, while. **It is therefore important that these plants are removed from the different vegetation units and that a programme is implemented on a long-term basis to control the spread of these plants.**

5.2 *WATER COURSES*

One small artificial concrete-lined dam, three broad open drainage pathways and scattered seasonally wet depressions were identified in the proposed powerline route (vegetation unit 5 – Figure 6), while a similar open drainage pathway occurs within unit 8 (Matlabas Traction substation – Figure 7). The drainage pathways are indiscernible from the surrounding vegetation and is at most slightly more open in terms of woody species with a slightly higher number of *Vachellia/Senegalia* species, though the tree *Combretum apiculatum* is still either dominant or prominent. These areas are only visible on aerial images and the slightly different vegetation composition. Due to the presence of the drainage pathway at the Matlabas substation the Alternative and Final position are the preferred sites (Figure7).

Two of the three alternatives of the Lephalale Traction station are located within the drainage pathways (Figure 15). The final site position (green lines - Figure 15) are located within vegetation unit 1 and would from a plant ecological point of view have the lowest impact on the environment.

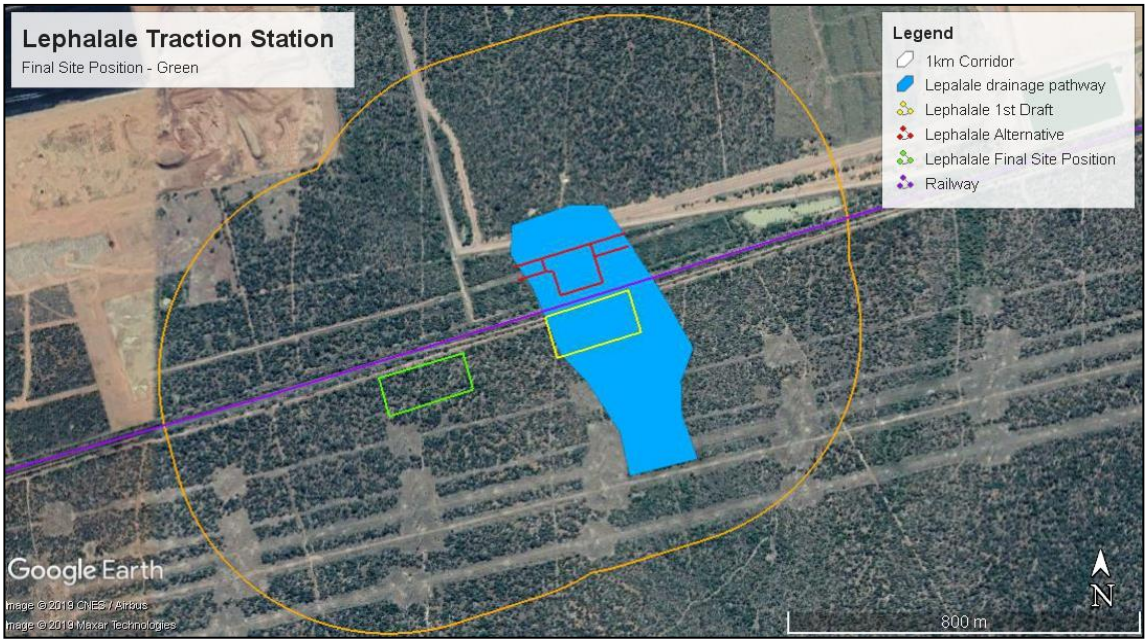


Figure 15. Proposed locations of the Lephalale Traction station (Google earth 2019).

From an ecological point of view these pathways cannot be classified as watercourses, though it does in some way channel slightly more surface water during high rainfall events than the surrounding areas. These areas were nonetheless assessed as drainage lines in terms of their Ecological Importance and Sensitivity (EIS). The results of the analysis indicate the pathways as having a **low Ecological Importance and Sensitivity** (EIS) score of **0.92** (Table 5). These areas thus at the most play a role in directing surface water from the areas and have no significant ecological value or different vegetation structure and composition from adjacent areas.

The proposed powerline route will traverse one seasonally wet depression section (Figure 16), but it is not expected that it would have any negative effect on the system provided that no pylons are placed within the depression. Similar depressions are traversed by existing powerlines along the route.

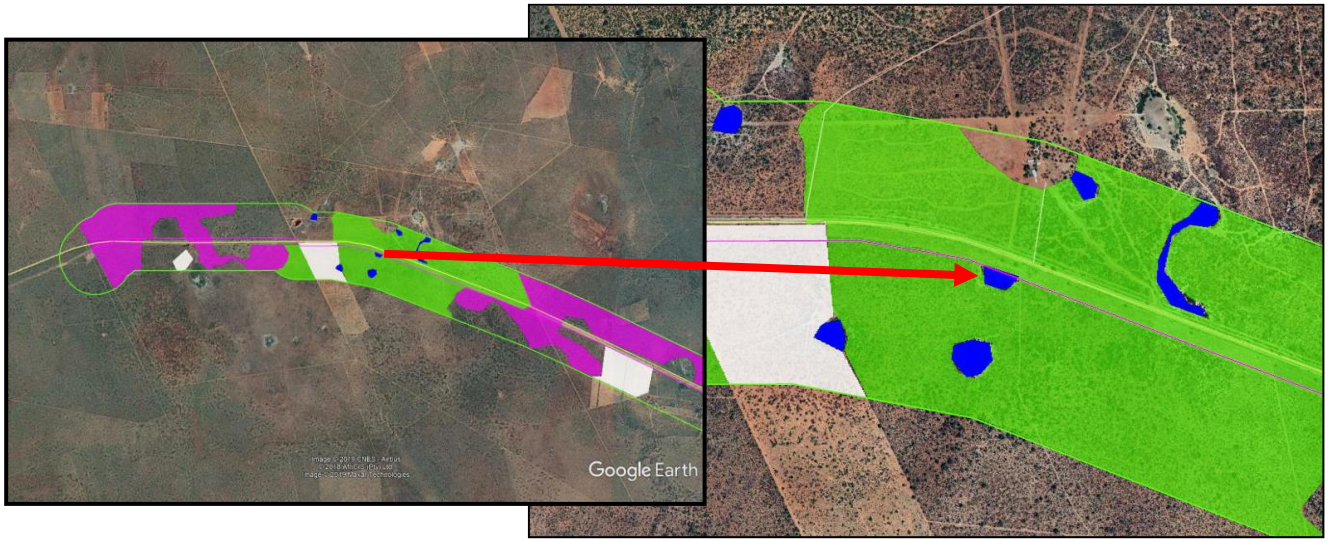


Figure 16. Seasonally wet depression that the proposed powerline will traverse along its edge (Source: Google earth 2019)

All the other seasonally wet depressions identified are not located within the proposed powerline route. The depressions are however important within the ecosystem and the results from the PES analysis indicate the **hydrology** and **vegetation** of these areas (PES = C) to be moderately modified, but overall these systems are natural. **Geomorphologically** these depressions (PES = B) are largely natural with minimal loss of ecosystem services as a result thereof.

6. POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE ASSOCIATED FLORA

The following assessment of impacts was done and was guided by the requirements of the NEMA EIA Regulations (2014) and is presented in the tables below together with the required WULA matrix:

6.1 *GENERIC DESCRIPTION OF POTENTIAL IMPACTS OF POWER LINES ON ASSOCIATED FLORA AS WELL AS RECOMMENDED MITIGATORY MEASURES*

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and humans.

Habitat destruction and disturbance

During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. The alignment occurs within open to closed woodland vegetation and grasses where vegetation clearance will be required during the construction phase of the project followed by limited (mainly maintenance clearing) clearing during the operational phase. These activities have an impact on flora and fauna (the latter breeding, foraging and roosting in or in close

Table 8a. Impact assessments for the different vegetation units

MEDIUM-HIGH CONSERVATION UNIT: 1, 2 & 5

Activity	Potential impact	Environmental significance									Reversibility	Cumulative impact	Irreplaceble loss	Mitigation measures
		Nature	Extent	Duration	Magnitude	Probability	Rating before mitigation		Rating after mitigation					
Environmental Component: Vegetation, Fauna														
Clearing of vegetation for construction	Loss of plant species	–	3	3	6	4	48	**Moderate**	32	**Low**	Irreversible	Low	Low	See potential impacts and recommended mitigation measures in report
	Loss of rare/medicinal species	–	1	1	2	1	4	**Low**	4	**Negligible**	Irreversible	Low	Low	
	Loss of animal species	–	3	3	6	4	48	**Moderate**	16	**Low**	Irreversible	Low	Low	
	Loss of biodiversity	–	3	4	6	5	65	**High**	32	**Low**	Irreversible	Low	Low	
	Increased soil erosion	–	3	4	6	4	52	**Moderate**	18	**Negligible**	Reversible	Low	Low	
	Alien plant invasion	+	3	4	8	1	15	**Neglible**	15	**Negligible**	Reversible	Low	Low	

MEDIUM CONSERVATION UNIT: 3 & 7

Activity	Potential impact	Environmental significance									Reversibility	Cumulative impact	Irreplaceble loss	Mitigation measures
		Nature	Extent	Duration	Magnitude	Probability	Rating before mitigation		Rating after mitigation					
Environmental Component: Vegetation, Fauna														
Clearing of vegetation for construction	Loss of plant species	–	3	3	6	4	48	**Moderate**	8	**Negligible**	Irreversible	Low	Low	See potential impacts and recommended mitigation measures in report
	Loss of rare/medicinal species	–	1	1	2	1	4	**Low**	4	**Negligible**	Irreversible	Low	Low	
	Loss of animal species	–	2	3	6	4	44	**Moderate**	4	**Negligible**	Irreversible	Low	Low	
	Loss of biodiversity	–	3	3	6	4	48	**Moderate**	10	**Negligible**	Reversible	Low	Low	
	Increased soil erosion	–	2	3	6	1	11	**Neglible**	8	**Negligible**	Reversible	Low	Low	
	Alien plant invasion	+	1	4	8	1	13	**Neglible**	4	**Negligible**	Reversible	Low	Low	

LOW CONSERVATION UNIT: 4, 6, 8 & 9

Activity	Potential impact	Environmental significance									Reversibility	Cumulative impact	Irreplaceble loss	Mitigation measures
		Nature	Extent	Duration	Magnitude	Probability	Rating before mitigation		Rating after mitigation					
Environmental Component: Vegetation, Fauna														
Clearing of vegetation for construction	Loss of plant species	–	1	1	2	1	4	Neglible	8	Negligible	Irreversible	Low	Low	See potential impacts and recommended mitigation measures in report
	Loss of rare/medicinal species	–	1	1	2	1	4	Neglible	4	Negligible	Irreversible	Low	Low	
	Loss of animal species	–	1	1	2	1	4	Neglible	4	Negligible	Irreversible	Low	Low	
	Loss of biodiversity	–	1	1	2	1	4	Neglible	10	Negligible	Reversible	Low	Low	
	Increased soil erosion	–	2	3	6	2	22	Low	16	Negligible	Reversible	Low	Low	
	Alien plant invasion	+	1	4	8	1	13	Neglible	4	Negligible	Reversible	Low	Low	

Table 8b. WULA matrix for water pathways

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)			
SITE NAME	Lephalale water pathways		
NAME and REGISTRATION No of SACNASP Professional member:	Prof LR Brown	Reg no.	400075/98

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																			
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Freq of activity	Freq of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
1	Construction	Construction activities of the proposed development	Vegetation clearance within the water pathway	Erosion, loss of habitat & biodiversity	1	2	1	1	1.25	1	1	3.25	1	1	1	1	4	13	LOW	95	See recommended mitigation measures in attached report		EIS: Low (0.92)
			Loss of habitat for terrestrial animals		1	1	1	1	1	1	1	3	1	1	1	1	4	12	LOW	95			
			Loss of habitat for aquatic animals		1	1	1	1	1	1	1	3	1	1	1	1	4	12	LOW	95			
			Spread of alien plants		1	1	1	2	1.25	1	1	3.25	1	1	1	1	4	13	LOW	95			
			Erosion of area		2	1	1	1	1.25	1	1	3.25	1	1	1	1	4	13	LOW	95			
2	Operational Phase	Maintenance activities of the site	Vegetation clearance	Erosion, loss of habitat & biodiversity	1	1	1	1	1	1	1	3	2	2	1	1	6	18	LOW	95	See recommended mitigation measures in attached report		EIS: Low (0.92)
			Loss of vegetation/habitat		1	1	1	1	1	1	1	3	1	1	1	1	4	12	LOW				
			Erosion		1	1	1	1	1	1	1	3	1	1	1	1	4	12	LOW	95			

proximity of the servitude), both through modification of habitat and disturbance caused by human activities. The proposed impact will be of **medium-low; short-long term impact** on remaining faunal and floral species.

Mitigation and Recommendations

The following general recommendations are made to minimise the impacts of proposed powerline construction on the immediate environment and remaining **fauna**:

- Close site supervision must be maintained during construction.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction within the corridor and access to the undeveloped areas must be strictly regulated ("no-go" areas during construction activities).
- All large indigenous tree species especially the protected *Sclerocarya birrea* should be conserved wherever possible.
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area. Mobile toilets must be provided in order to minimise unauthorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the site to prevent further invasion.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances. In particular, construction workers are to go through ongoing refresher courses to ensure that protected snakes, such as Southern African Python, are not killed or persecuted when found.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.

Surrounding Farming Activities

Construction activities must be planned carefully so as not to interfere with the farming activities (game farming). The Contractor's workforce will have to be very careful not to disturb the animals as this may lead to fatalities which will give rise to claims from the Landowners. Interference with any wildlife without the applicable permits shall not be allowed. The Contractor shall under no circumstances interfere with game and/or livestock without the Landowner being present. This includes the moving of livestock where they interfere with construction activities. Should the Contractors workforce obtain any game/livestock for eating purposes, they must be in possession of a written note from the Landowner. Speed limits must be restricted especially on dirt roads (30km/hr) preventing unnecessary road fatalities of surrounding animals/livestock.

Management objective

- Minimise disruption of surrounding farming activities
- Minimise disturbance of fauna
- Minimise interruption of breeding patterns of fauna

Measurable targets

- No hunting and poaching or intentional killing of animals (including snakes, scorpions, spiders)
- No stock losses where construction is underway
- No complaints from Landowners or Nature Conservation
- No litigation concerning stock losses and animal deaths

Access roads

Planning of access routes must be done in conjunction between the Contractor, Eskom and the respective Landowners. All access to private farmland must be negotiated in advance with land-owners. All agreements reached shall be documented in writing and no verbal agreements should be made. The condition of existing access / private roads to be used shall be documented with photographs.

The Contractor shall properly mark all access roads. Markers shall show the direction of travel as well as tower numbers to which the road leads. Unnecessary traversing

of adjacent open areas is discouraged. Where required, speed limits shall be indicated on the roads (30km). All speed limits shall be strictly adhered to at all time.

Vehicle access to the powerline servitude must as far as possible be limited to existing roads. If new access roads need to be constructed it should follow cleared areas such as game pathways.

Vegetation clearance

Management objective

- Minimise damage to surrounding vegetation
- Minimise damage to topsoil
- Successful rehabilitation of barren areas

Measurable targets

- No damage to vegetation outside the powerline servitude as well as around towers
- No loss of topsoil
- No visible erosion three months after completion of the contract
- All disturbed areas successfully rehabilitated three months after completion of the contract

The object of vegetation clearing is to trim, cut or clear the minimum number of trees and vegetation necessary for the safe mechanical construction and electrical operation of the transmission line. Only an 8m strip may be cleared flush with the ground to allow vehicular passage during construction. No scalping shall be allowed on any part of the servitude road unless absolutely necessary.

Vegetation clearing on tower sites must be kept to a minimum. Any alien invasive plant species must be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root systems are removed. Stumps shall be treated with herbicide. Smaller vegetation can be flattened with a machine, but the blade should be kept above ground level to prevent scalping. Any vegetation cleared on a tower site shall be removed or flattened and not be pushed to form an embankment around the tower.

Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion as well as alien invasive vegetation invasion. The use of herbicides shall only be allowed after a proper investigation into the necessity. Eskom's approval for the use of herbicides is mandatory. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier's specifications. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides.

It is recommended that a contractor for vegetation clearing should comply with the following parameters:

- The contractor must have the necessary knowledge to be able to identify the protected tree *Sclerocarya birrea*; (marula) interfering with the operation of the line due to their height and growth rate.
- The contractor must also be able to identify declared weeds and alien species (although very few was found during the vegetation surveys) that can be totally eradicated.
- The contractor must be in possession of a valid herbicide applicators license.

Fire Prevention

The frequent burning of the open woodland and grassland vegetation will have a high impact on remaining reptile species. Fires during the winter months will severely impact on the species undergoing brumation, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

Management objective

- Minimise risk of veld fires
- Minimise damage to grazing
- Prevent runaway fires

Measurable targets

- No veld fires started by the Contractor's work force
- No claims from Landowners for damages due to veld fires
- No litigation

Mitigation and recommendations

No open fires shall be allowed on site under any circumstance. The Contractor shall have fire-fighting equipment available on all vehicles working on site, especially during the winter months.

Threatened animals

At a local scale the study site and surrounding areas comprises limited suitable habitat for any threatened animal species.

Mitigation and recommendations

As a precautionary mitigation measure it is recommended that the developer and construction contractor as well as an environmental control officer should be made aware of the possible presence of certain threatened animal species (e.g. South African Hedgehog) prior to the commencement of construction activities. In the event that any of the above-mentioned species are discovered the animal should not be interfered with and allowed to move away from the construction activities

Drainage pathways and seasonally wet depressions

Watercourses play an important role in ecosystems and the services they provide. The systems identified within the proposed powerline and substation route/sites are located within an arid system. The drainage pathways channel surface water towards lower lying areas while the seasonally wet depressions receive surface water during the wet season that is used by animals for drinking purposes while some water is retained in the soil during the dry season on which surrounding vegetation is dependant for their survival. These systems most probably also provide habitat for migratory bird species during the wet season. Destruction of these systems would therefore have a negative effect on their ecosystem functioning. None of the final positions of the substations are located within these systems while only one seasonally wet depression will be traversed by the proposed powerline.

Mitigation and recommendations

No construction should be allowed within the watercourses.

No pylon should be erected within or closer than 20 from the edge of the seasonally wet depression.

Construction should preferably take place during the dry season when there are no water so that no ungulates, birds or aquatic organisms that rely on the water are disturbed.

No person should be allowed to access these depressions or remove any plant material.
No roads, camps should be established closer than 30m from these depressions.
No equipment should be cleaned, or chemicals/fuel discharged close to or within these systems.
The proposed powerline should cross the depression along its edge and not the centre of the depression.

6.2. *IMPACT EVALUATION*

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and humans. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and disturbance and habitat destruction during construction and maintenance activities. The construction of pylons for the power lines will inevitably have an impact on the surrounding ecosystem. The severity of the impact, however, varies, depending on the nature of the activity and mitigation measures followed. Different impacts on the vegetation will be experienced during construction and operational phase. These impacts on the total ecosystem are listed below and analysed below according to their extent, duration, intensity and probability.

- ***Impact 1 – Loss of natural vegetation***

The construction of pylons will lead to the destruction and loss of vegetation. Vegetation loss can result in degradation of the environment, loss of vegetation cover and resultant erosion and loss of topsoil, increase in water runoff and less water infiltration, loss of habitat for sensitive or secondary species, reduction of species richness and system diversity and eventual loss of ecosystem functioning and species composition. These activities have an impact on fauna breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. Thus, it is important that no unnecessary destruction of the habitat takes place during any development/construction phase. It is not foreseen that any large-scale removal (other than the areas of the servitude and where the pylons will be erected) will take place that would have a significant negative effect on the natural ecosystem.

- ***Impact 2 – Habitat fragmentation (loss of landscape connectivity)***

Habitat fragmentation refers to destruction of the habitat leading to a discontinuity in a species/populations' the environment. The remaining habitat therefore becomes smaller. The implications of habitat fragmentation are that edge effects along the fragments can cause a further reduction in the habitat while plants and sessile organisms are not able to reproduce anymore that will eventually lead to them dying out. Thus, these isolated habitats will become unsuitable to many of the original species occurring in the area. Species populations can only remain viable if large enough habitat remains or if sizeable corridors exist between the fragments. It is not envisaged that the proposed powerline and substations will have any negative effect on habitat fragmentation since the surrounding natural areas are large and mostly intact.

- ***Impact 3 – Impacts on vulnerable species***

For the purpose of this report the term "vulnerable species" to threatened, protected, medicinal and red data species. Natural populations of species not regarded as "vulnerable" usually occur in large numbers within various suitable habitats. Vulnerable species are normally species whose habitats have become smaller, usually as a result of human actions, but also as a result of natural disasters (e.g. floods, droughts, fire etc.). The result is that these species are already under stress and any further reduction in their habitat could cause their extinction. Not only will the loss of such a species cause further degradation of the environment and the conservation status of the ecosystem, but it will alter also the functioning of adjacent ecosystems and their species compositions. It is therefore recommended that buffer zones varying from 5m to a 1000m are placed around such species/ecosystems to protect their integrity and survival. It is recommended that large individuals of the protected tree *Sclerocarya birrea* and *Boscia albitrunca* are conserved as far as possible. If not, it is important that the necessary permits for their removal are obtained.

- ***Impact 4 – Establishment of invasive plants and declared weeds***

Weeds, alien invasive and indigenous invasive plants are normally aggressive growers that can out-compete other natural species growing in the environment. These species have superior reproduction and/or vegetative growth mechanisms that enable them to grow and increase faster than other species in the same habitat. Under normal conditions in a stable ecosystem they will not become dominant.

However, if a disturbance in the environment takes place whether human induced or natural, these species will normally invade these disturbed areas, displace the few natural species remaining and form a homogeneous stand of vegetation. This could then lead to an uncontrollable spread of these species into the ecosystem as well as adjacent systems. The consequences of alien plant invasions include a loss of soil water, change in nutrient status of the soil, loss of indigenous and climax vegetation, species diversity, change in plant community composition and structure and eventually loss in ecosystem functioning as well as adjacent ecosystems. The area studied are mostly natural with very few alien invasive species. It is therefore not envisaged that the construction of the powerlines and substations would enhance or speed up the spread or invasion of such species.

- ***Impact 5 – Degradation of the watercourses***

Arid environments are diverse in terms of their landscapes, topography, soil and wildlife (fauna & Flora). Ephemeral vegetation normally occurs in these areas. These are species that appear directly after rainfall and complete their life cycle during a short period before the water disappears and the habitat becomes unsuitable again. These species normally occur along the water pathways and depressions. Various migratory bird and animal species Watercourses are therefore important in that they support biodiversity, and channels and retains water. Thus, destruction of these systems could negatively affect the larger ecosystem. None of the substations are located within these areas, while the proposed powerline will traverse only one small seasonally wet depression. It is therefore not envisaged that the construction of the powerlines and substations would negatively affect the watercourses identified.

CONCLUSION

Any development will have a negative effect on the natural ecosystem in particular the vegetation thereof. The vegetation of the areas where the proposed pylons will be constructed will be damaged and some destroyed. The vegetation is however, not regarded as highly sensitive or threatened and most of these species will regrow without any huge negative effect on the environment.

The purpose of any ecological assessment is to determine areas of high sensitivity and to provide guidelines to ensure that the proposed development is ecologically sensitive and to prevent unnecessary destruction of natural ecosystems. It is mostly unavoidable to prevent all development especially power lines to cross and affect sensitive areas. It is therefore important that all possibilities for such power lines are investigated in order to provide ecologically sound recommendations on routes to be followed.

The total study area can be broadly classified as a *Combretum apiculatum* woodland with smaller sections dominated by *Senegalia/Vachellia* and *Terminalia* species. The proposed power line routes and substations are located within natural areas however, most of the areas of the proposed Medupi-Theunispan substation and the proposed Diepspruit, Matlabas and Marakele substations are regarded as being moderately degraded to natural. The sections of the power line located within CBA or ESA areas do have natural species, but the ecosystem has been negatively affected due to anthropogenic influences (current and past). The vegetation of these areas, although natural in terms of the woody component, has been affected resulting in a degraded herbaceous layer and resultant densification of woody species. The vegetation of some of the areas is mostly natural, though some sections are degraded. All of the vegetation units, although natural and part of the natural ecosystem form part of a larger and in some places more pristine ecosystem. The landscape is mostly low flat to undulating areas with sandy plains.

Fragmentation of the habitat is not expected to be of any significance with normal connectivity between ecosystems still intact due to the relatively small footprint of the pylons. Any fragmentation will also be mitigated by clearing as small an area as possible when constructing the pylons.

Three water pathways and various seasonjally wet depressions (vegetation unit 5) were identified along the proposed Medupi-Theunispan powerline and the one along the Matlabas Traction substation loop route. The drainage pathways have a low Ecological Importance and Sensitivity while the depressions have a medium-high conservation value. The alternatives provided where these sutstation locations did occur within the pathways are all outside the pathways and will therefore have no impact on these systems. Except for one seasonally wet depression, none of the substations or proposed powerline route traverses any depression. The area where one depression is traversed can be easily mitigated and should have a minimal if any effect on the ecosystem.

Two protected tree species namely *Sclerocarya birrea* (units 1, 4 & 6) and *Boscia albitrunca* (units 1, 2 & 6) were identified in different vegetation units. These trees play an important role in the ecosystem by providing food, shelter and shade to various animal and bird species. It is therefore important that these trees are not unnecessarily removed from the ecosystem. The placement of the pylons should be done in such a way as to avoid damaging these species as far as possible. If single individuals of these species have to be removed, a permit from the Department of Agriculture, Fisheries and Forestry (Forestry Branch) and Nature Conservation will have to be obtained for this purpose. It is recommended that once the final powerline route and pylon positions have been decided on and pegged that a walk down by a qualified plant ecologist is done to determine if any of these protected species must be removed.

Four medicinal plant species were recorded but none are threatened species and are common throughout the area.

Concluding remarks

This study investigated the vegetation found along the corridor for the proposed powerlines and substations. Alternative routes and substation locations were proposed and investigated. All options are located within the same vegetation unit/s and from a plant and faunal ecological point of view has the same conservation value and ecosystem functioning. Except for the protected trees *Sclerocarya birrea* (marula) and *Boscia albitrunca* (Shepperd's tree) none of the woody species recorded within the proposed route or substations are protected or threatened species. No red data species were found within the area. From the sensitivity

analysis none of the vegetation units had a high sensitivity with vegetation units 1, 2, 3, 5 and 7 having a medium sensitivity while units 4, 6, 8 and 9 all have a low-medium sensitivity (Figure 17).

All the final locations chosen for the substations will have the least impact on the ecosystem. The largest part of the proposed powerline route in the west is located along an area that has been cleared for the construction of a railway line, while the section of the route in the east are along existing powerlines and servitudes. It is therefore highly unlikely that the powerline would have a long or medium-term negative impact on the ecosystem and its functioning.

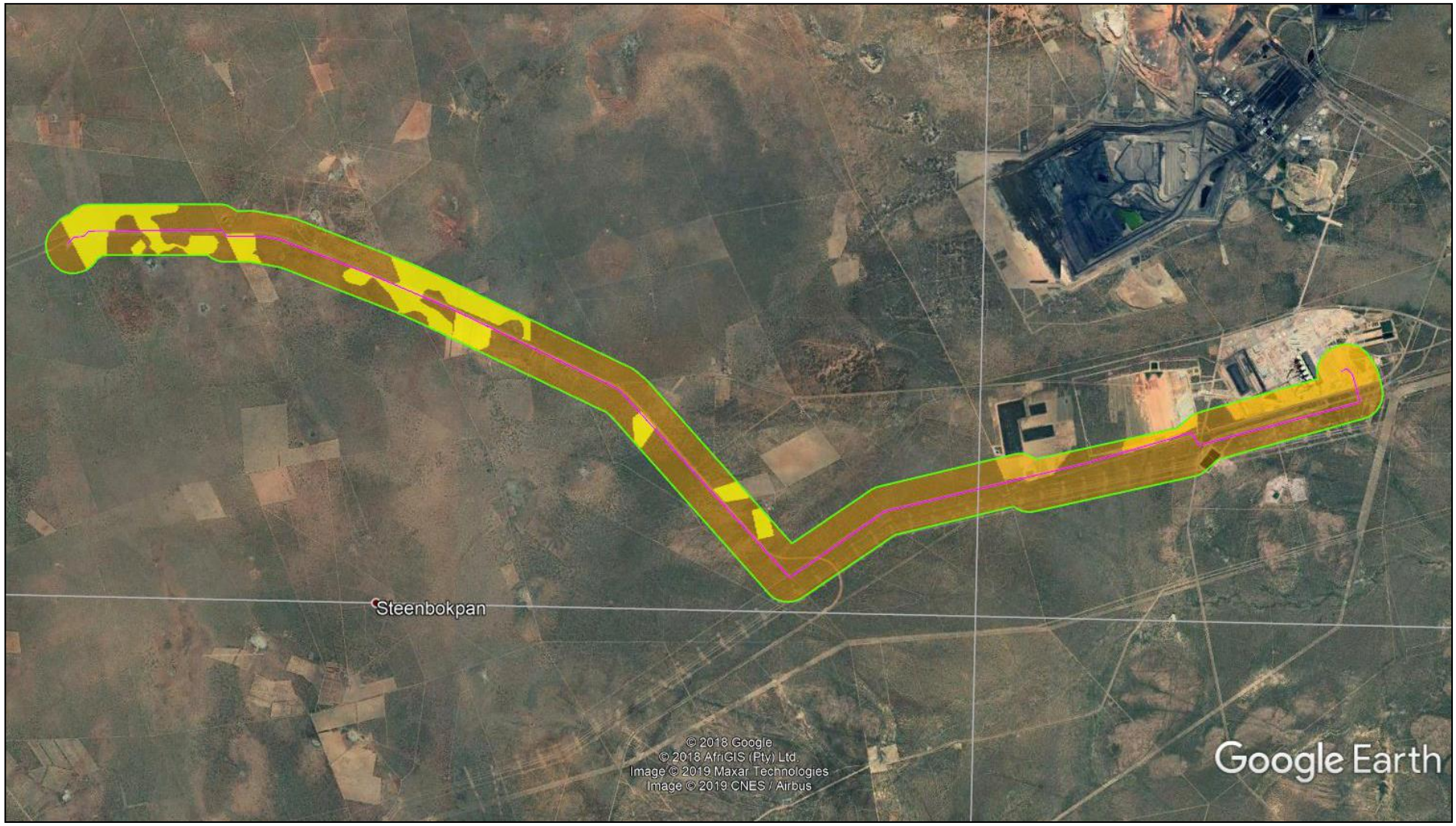


Figure 17. Ecological sensitivity of the different vegetation units along the proposed corridors (Orange = Medium; Yellow = Low-medium) (source: Google Earth 2019).

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