Specialist Report: Vegetation Assessment For The 33 kV Powerlines Near Virgina, Free State Province

Commissioned by

Compiled by

EkoInfo CC & Associates

August 2020

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Report Status	Version	File Route
Final	1	C:\02_Projects\01_EkoInfo\20200402eko_florabirdsvisualVirginia_GreenEnv\Reports\tx\Flora BAP report Virginia 33 kV.docx

1 EXECUTIVE SUMMARY

Willem de Frey of EkoInfo CC facilitated the flora assessment concerning the Environmental Impact Assessment (EIA) for the proposed 33 kVA power line near Virginia, Free State Province. Willem de Frey is a registered scientific professional in the fields of ecological – and botanical science with more than 20 years' experience.

The fieldwork was done in July 2020.

Eight plots were surveyed using the Braun-Blanquet approach.

The survey confirmed the presence of two regional vegetation units as indicated in the regional review. The two regional vegetation units are: Vaal-Vet Sandy Highveld and Higveld Alluvial Vegetation, of which the first's conservation status is Vulnerable.

No protected species listed in terms of the National Environmental Management Biodiversity Act (Act No. 10 of 2004, Notice 389 of 2013) was recorded with the plots surveyed.

The presenc of the vulnerable. *Brachystelma incanum* could not be confirmed during the survey, but potential habitat is associated with the Vaal-Vet Sandy Highveld.

Plant with medicinal properties, as well as declared alien invasive species occur within the area, of which the latter should be managed in terms of the Conservation of Agricultural Resources Act and the National Environment Management Biodiversity Act.

The sensitivity analysis indicated that 41 ha or 22% of the study area is of high flora sensitivity, mainly due to the overall threatened status of the remaining natural vegetation and the potential for a threatened plant to occur. However, overall, the area is highly transformed, mainly due to agricultural activities, specifically cultivation.

The impact assessment indicated that option A should be preferred as it keeps to the transformation associated with the mining activities, it is also the shorter route.

The generic flora environmental management focus on curtailing indirect impacts related to the construction and operation of the power line.

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2 INTRODUCTION

EkoInfo CC's sole member and principal consultant, a registered scientific professional in the fields of ecological – and botanical science facilitated the vegetation component of the Basic Assessment Process (BAP) report for the proposed 33 kV power line near the town of Virgina in the Free State Province (Figure 1).

2.1 Scope of work/ Terms of reference

Scope of work is based on the information received from the EAP (Green Environmental) and EkoInfo CC's experience of more than 20 years of facilitating vegetation studies with regards to Environmental Impact Assessment. The study involves a regional overview of the vegetation communities and a local assessment of the species of concern. The aim of the regional overview is to flag the presence of threatened ecosystems, while the local assessment will flag and evaluate habitat for species of concern along the the proposed route alignment.

Based on the results of the regional and local assessment, the possible impacts will be highlighted, and mitigation suggested and contributions made to a generic Environmental Management Plan (EMP).

3 METHOD STATEMENT

3.1 Regional Context

The regional context is obtained through a literature – and desktop review process, which involves the following data sources:

1. Scientific – and popular publications
2. Internet searches of government -, academic and research institution websites
    a. Vegetation species information – provincial and topocadastral: http://posa.sanbi.org/searchspp.php
    b. Red Data plants: http://redlist.sanbi.org/?
3. Small scale spatial datasets
    a. Geology – 1: 1 000 000 scale, source – Council for Geoscience
    b. Climate – Weather Stations, source - SA Weather Bureau
    c. Topography - Shuttle Radar Topography Mission digital elevation model (100 x 100 m pixels), source – ESRI World Data/ Glovis[1]
    d. Soil – 1: 250 000 scale, source – Institute for Soil, Climate and Water
    e. Regional vegetation (Vegmap) – 1: 250 000 scale, source - South African National Biodiversity Institute
    f. Land cover – 1: 50 000 scale, source – Department of Environmental Affairs
    g. National biodiversity priority layer – 1: 250 000 scale, source - South African National Biodiversity Institute
    h. Free State Biodiversity Sector Plan – 1: 50 000 scale, source - South African National Biodiversity Institute
    i. Landsat 8 Satellite Imagery – 1: 50 000 scale (25 x 25 m pixels), source – Glovis
    j. Topocadastral maps – 1: 50 000 scale (vector format), source – Surveyor - General

The above datasets were modelled and analysed using the following Geographic Information System software packages: Idrisi Selva, ESRI Arcview 10.1 and SAGA GIS. The main deliverables from the regional context is a flora sensitivity map.

[1] http://glovis.usgs.gov/

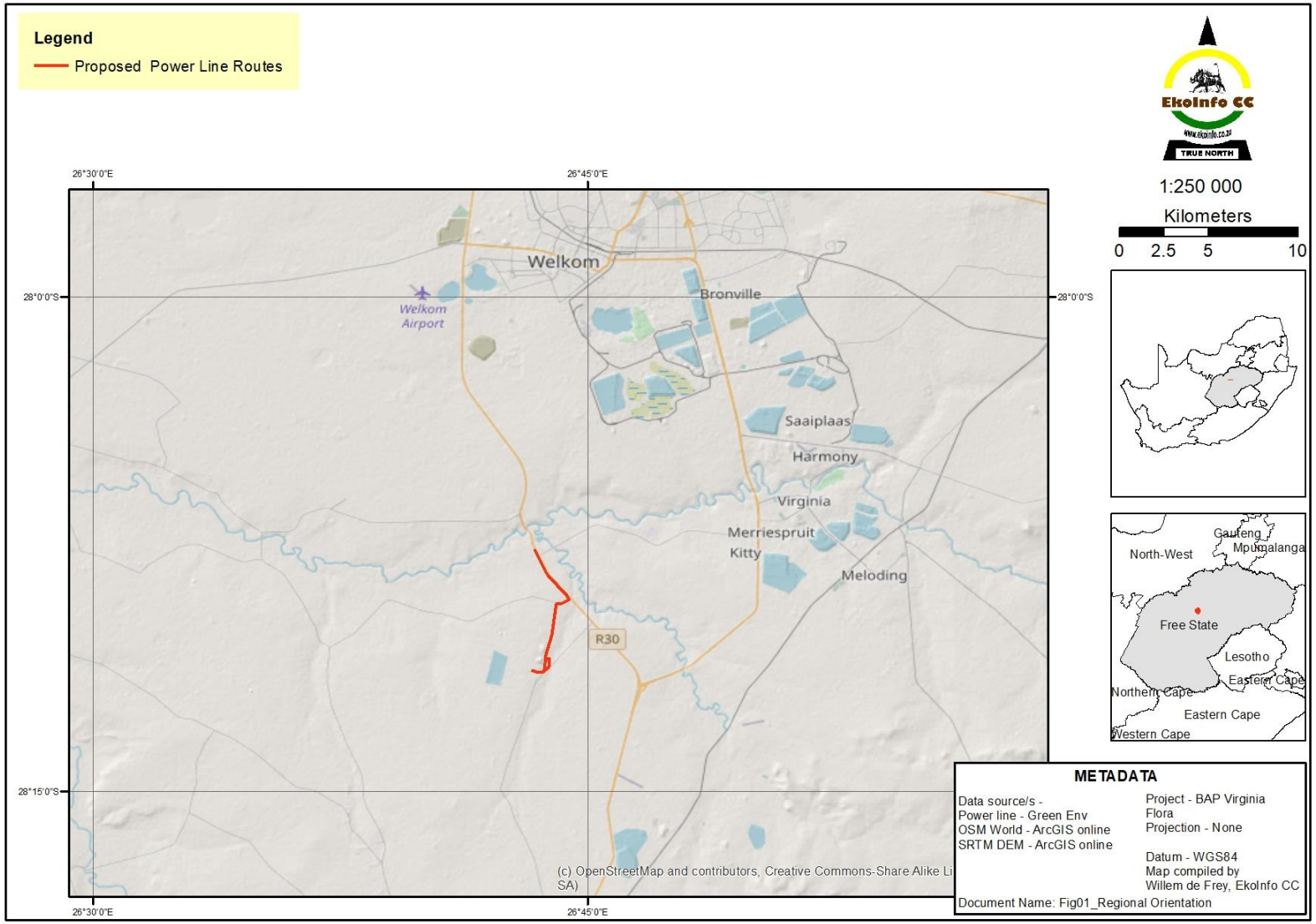

Figure 1: Regional orientation of the proposed power line to the west of the town of Virginia, Free State Province

3.2 Local Context

The aim of the local context survey was to verify and refine the results from the regional context assessment. Eight (8) Braun-Blanquet surveys formed the basis of the assessment. These eight plots were surveyed over a two-day period in July 2020 (Figure 2).

At the 28 Braun-Blanquet plots the following information was collected:

1. GENERAL INFORMATION
    a. Relevé number
    b. GPS coordinates (Decimal degrees, Datum WGS84)
    c. Date (yy/mm/dd)
    d. Surveyor
    e. Photo no
    f. Photo direction (Bearing)
    g. Notes
2. ENVIRONMENTAL DATA
    a. Altitude (m)
    b. Aspect (Bearing)
    c. Slope (%)
    d. Terrain unit
    e. Local topography
    f. Stratigraphy
    g. Petrology
    h. Lithology
    i. Soil form
    j. Termitaria present
    k. Cover Gravel
    l. Cover Small stones
    m. Cover Medium stones
    n. Cover Large stones
    o. Rock
    p. Soil depth (mm)
    q. Erosion categories
    r. Surface crusting
    s. Estimate % Clay (A - horizon)
    t. Cover open water (%)
    u. Cover bare rock (%)
3. VEGETATION CHARACTERISTICS
    a. Cover total (%)
    b. Cover tree layer (%)
    c. Cover shrub layer (%)
    d. Cover herb layer (%)
    e. Cover grass layer (%)
    f. Cover forbs layer (%)
    g. Height (highest) trees (m)
    h. Height lowest trees (m)
    i. Height (highest) shrubs (m)
    j. Height lowest shrubs (m)
    k. Aver height (high) herbs (cm)
    l. Aver height lowest herbs (cm)
    m. Maximum height herbs (cm)

A list of all species within an approximate 100 m^2 area was recorded in the following growth form categories: grasses, forbs and woody species (shrubs and trees). Cover abundance values was estimated for each species within the sample plot. Unknown species or potential red data species was identified using field guides (Van Oudtshoorn 1991, Van Wyk & Malan 1988, Van Rooyen 2001, Van der Walt 2009), the University of Pretoria's herbarium and specialists from the National Botanical Institute.

A single team consisting of a professionally registered scientist in the fields of ecological – and botanical science and a field assistant facilitated the fieldwork.

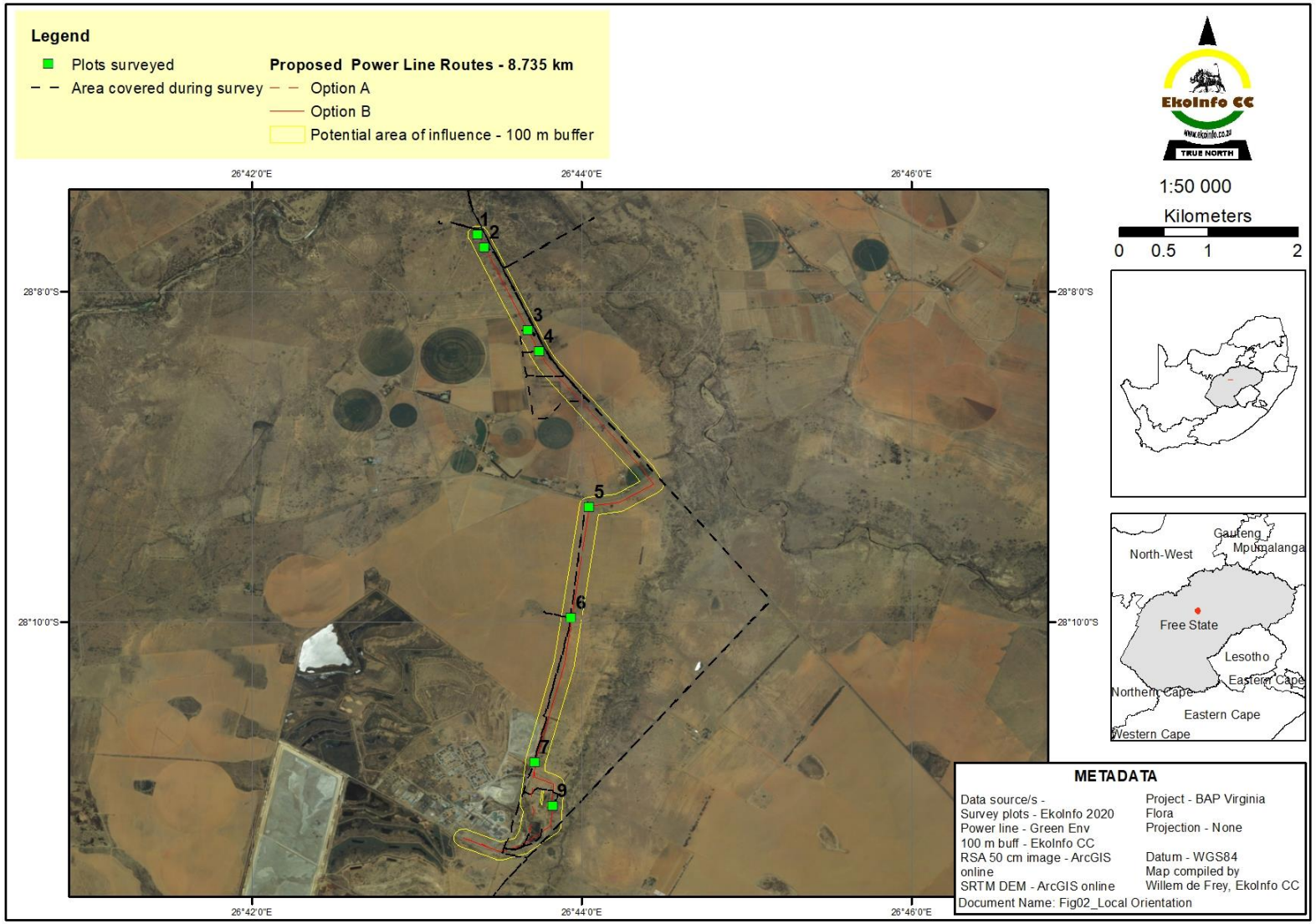

Figure 2: Overview of the distribution of the surveyed flora plots along the proposed power line route

The survey results were entered into a relational database for record purposes and analysis of the abiotic and vegetation characteristics. The species data was entered into TURBOVEG (Hennekens 1996) and analysed with Juice[2]. A vegetation map was compiled and refined, based on the results of the phytosociological table and boundaries of the homogenous units.

This approach follows the guidelines recommended for phytosociological studies on a national level with regards to the classification and description of vegetation in southern Africa (Brown *et al.* 2013).

The above information was used to refine the flora sensitivity model and guide the least environmental corridor assessment.

3.3 Limitations And Assumptions

1. It is assumed that all the information from third parties (government -, academic – and research institutions) is accurate.
2. The main aim of the actual surveys was to assess the presence of ecological trends related to species of concern.
3. Although the survey was done during the winter, due to the delays resulting from COVID-19 lockdown, the nature of the project makes it possible to avoid potential sensitive areas with limited influence on the project or costs.

4 STUDY AREA

4.1 Environmental Overview

An environmental overview is provided based on the two main components of ecosystems namely abiotic and biotic. The abiotic component consists of the non-living component, while the biotic component consists of the living component, with specific reference to the plants.

4.1.1 Abiotic component

The proposed power line is located with a plain, which imply slopes are less than 5º or 8%, and transects three lithological units from south to north along the slopes from an altitude of 1 355 m above sea level towards 1 272 m above mean sea level (Figure 3). The lithological units to the south consist of mudstone and arenite, while the northern section transects shales. It expected that the geology will give origins to fine textured soils which will influence the vegetation. The power line mainly transects water courses which will flow sporadic/ temporary during catastrophic rain events (cloud bursts). It is evident that most of the ridges are linked to the water courses.

4.1.2 Biotic component

Two regional vegetation units are associated with the study area, namely the endangered Vaal Vet Sandy Grassland within the Grassland Biome, and the least threatened Highveld Alluvial Vegetation associated with azonal vegetation of water courses (Figure 4). It is evident that these two regional vegetation units correlate very well with two land type units, namely Bd 20 and Dc8. Soils of the Bd soil pattern is associated with a plinthic catena in which eutrophic, red apedal soils are not widespread, with upland duplex and margalitic soils being rare. Prismacutanic and/ or pedocutanic diagnostic horizons are dominant in soils associated with the Dc soil pattern, in addition, one or more of: vertic, melanic, red structured diagnostic horizons occur. The vegetation on both a regional and local scale is expected to vary according to the changes in geology and soil, with additional variation due to the potential for water to accumulate in certain areas of the landscape (wetland potential).

4.1.3 Conservation Priorities

On a national level[3], the sensitivity for the area in terms of plant species are low (Figure 5), therefore it is not expected to find species of concern (threatened Red Data or protected species) in the area.

[2] http://www.sci.muni.cz/botany/juice/
[3] https://screening.environment.gov.za/screeningtool/#/app/screen_tool/Powerline

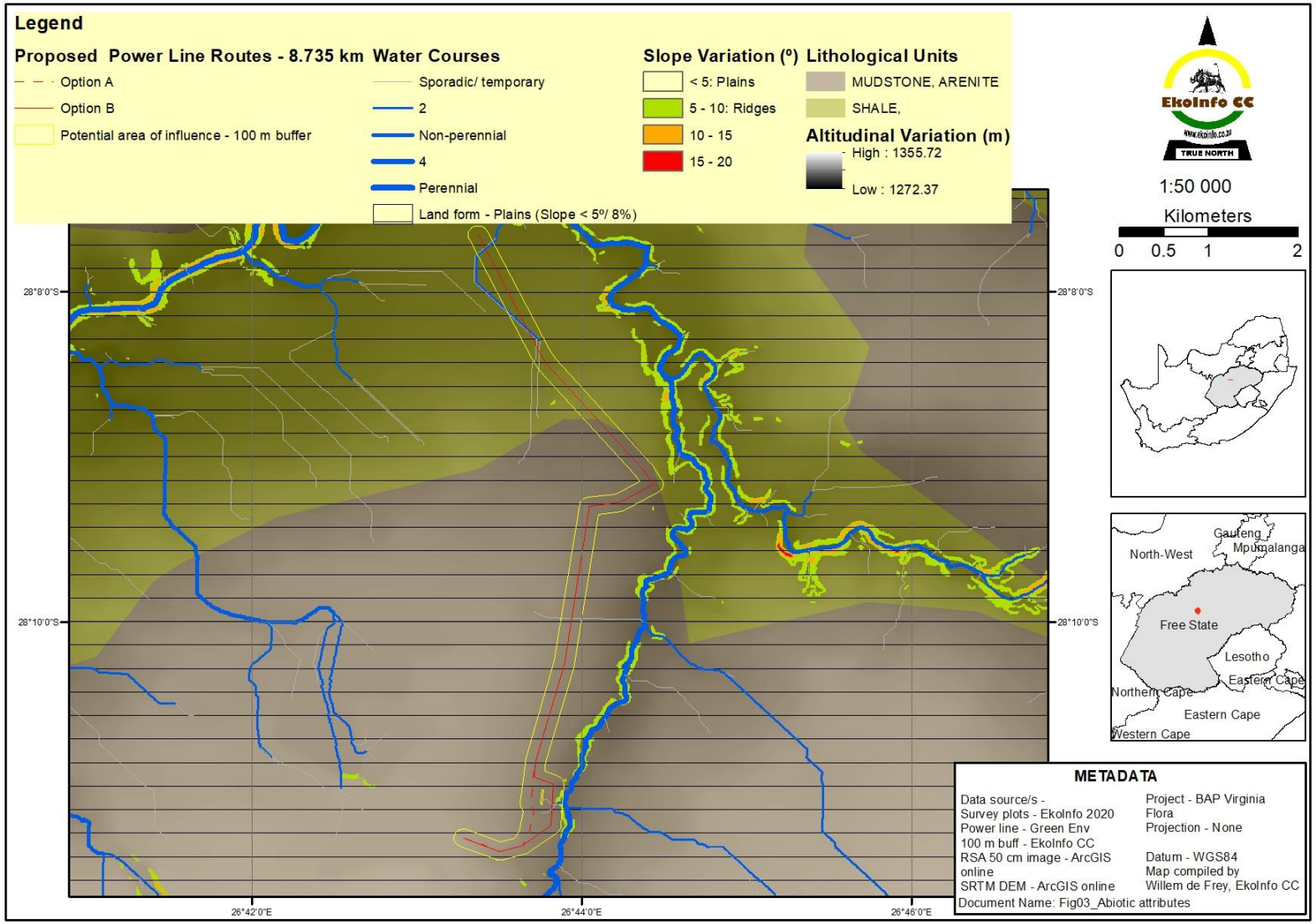

Figure 3: Abiotic attributes associated with the proposed power line (study area)

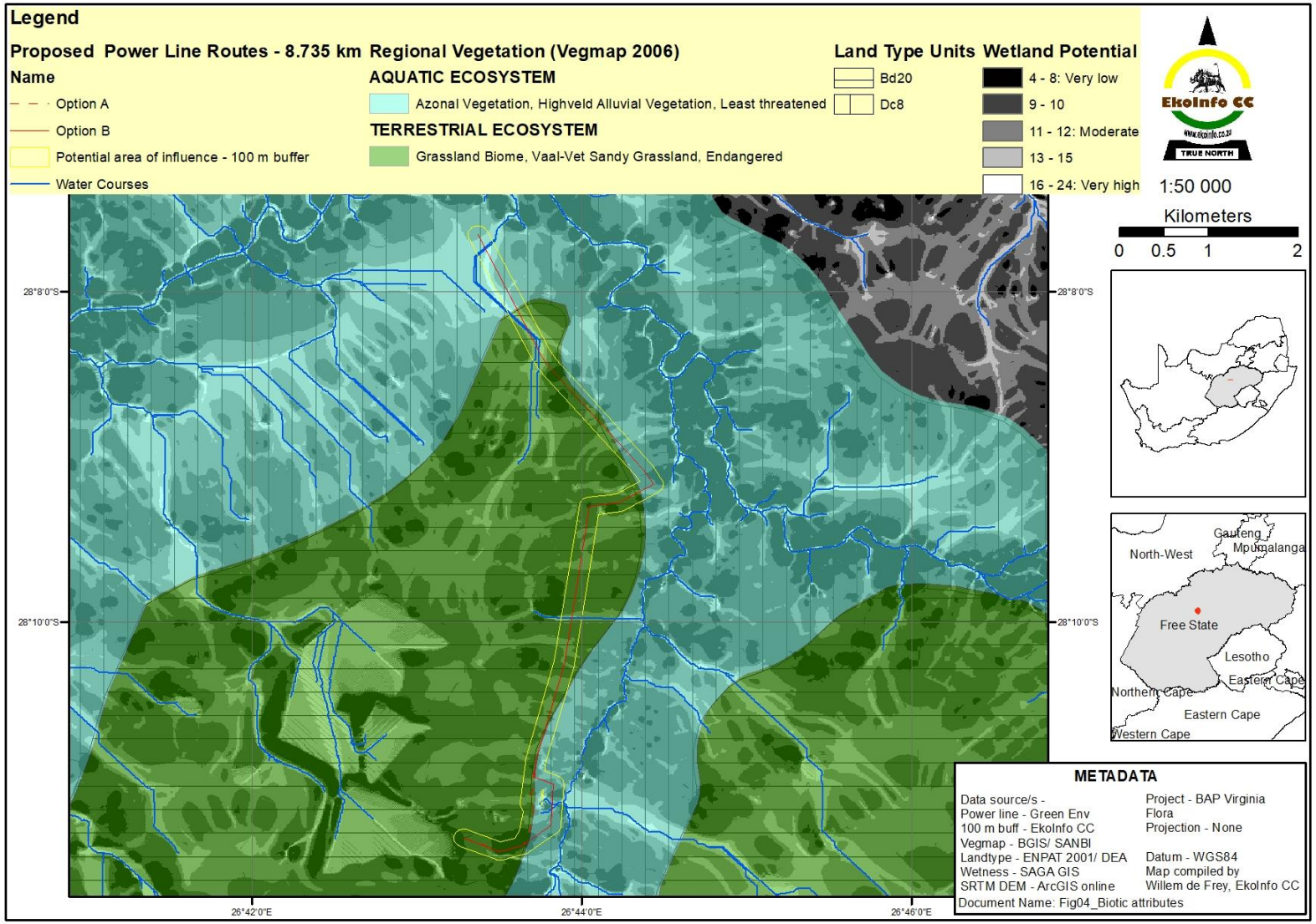

Figure 4: Biotic attributes associated with the power line (study area)

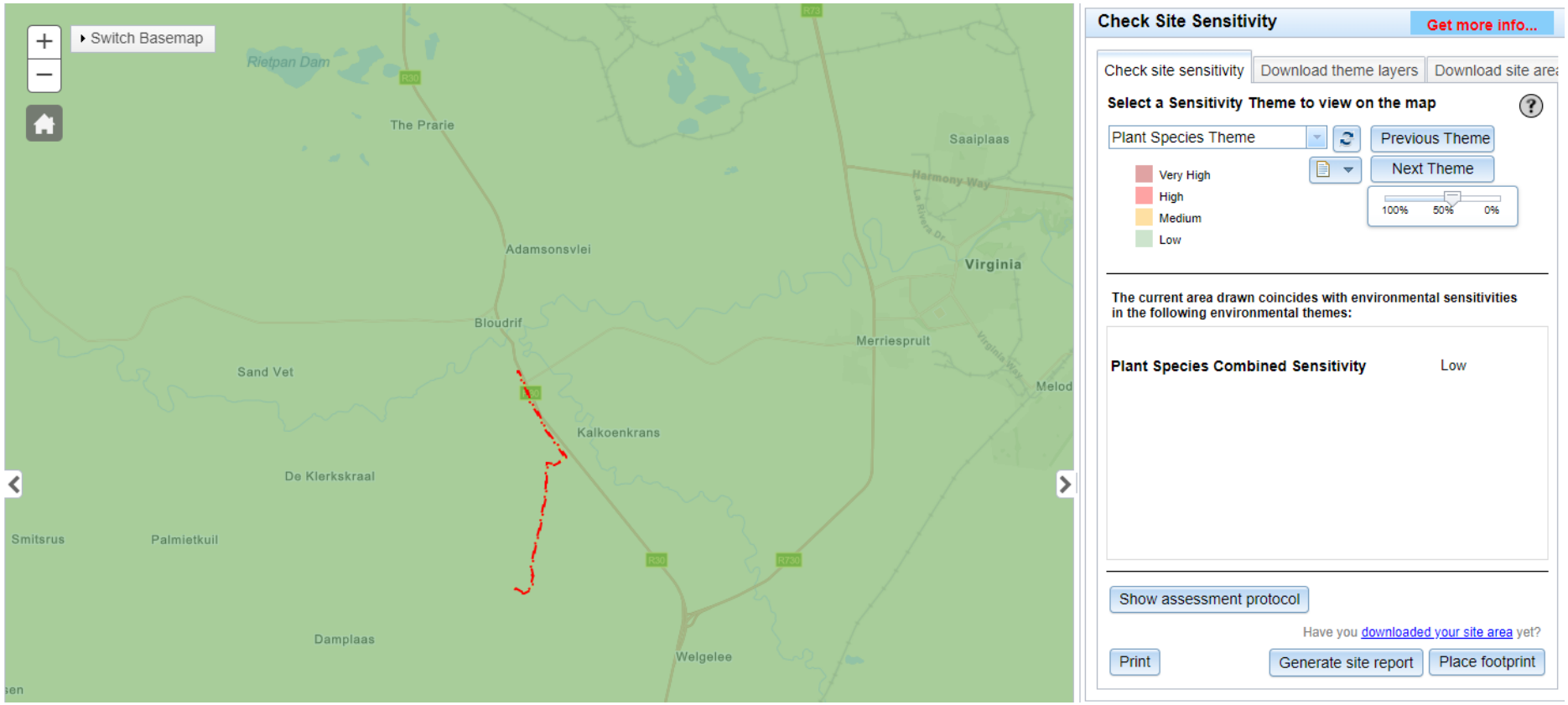

Figure 5: Sensitivity of the study area in terms of plant species on a national level

With regards to animal species, the proposed power line will transect mainly through low sensitivity areas, with the potential of medium sensitive habitat occurring to the east (Figure 6). However, with regards overall terrestrial biodiversity the areas is classified as very high (Figure 7), most probably due to the overall potential for habitat loss and – fragmentation due to agricultural, mining and infrastructure development.

On a provincial level (larger scale), the study area transects in terms of the Free State Biodiversity Sector Plan (2015) (, two patches of Critical Biodiversity Areas (CBA level1), one patch Ecological Support Area (ESA level 1) and eight patches of Ecological Support Area (ESA level 2), one patch of other natural vegetation and 4 patches of degraded habitat.

The actual presence or absence of species of concern or potential habitat for them was assessed as part of the fieldwork completed.

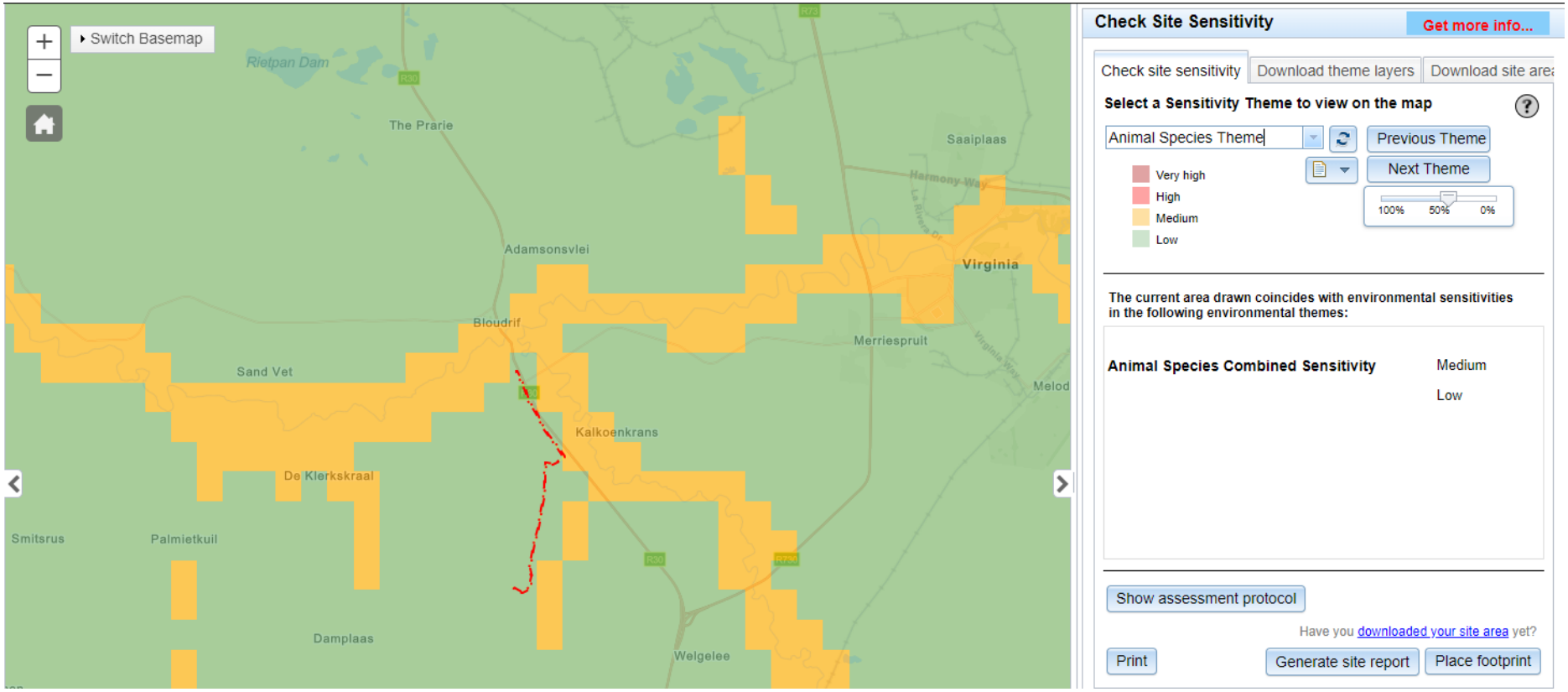

Figure 6: Sensitivity of the study area in terms of animal species on a national level

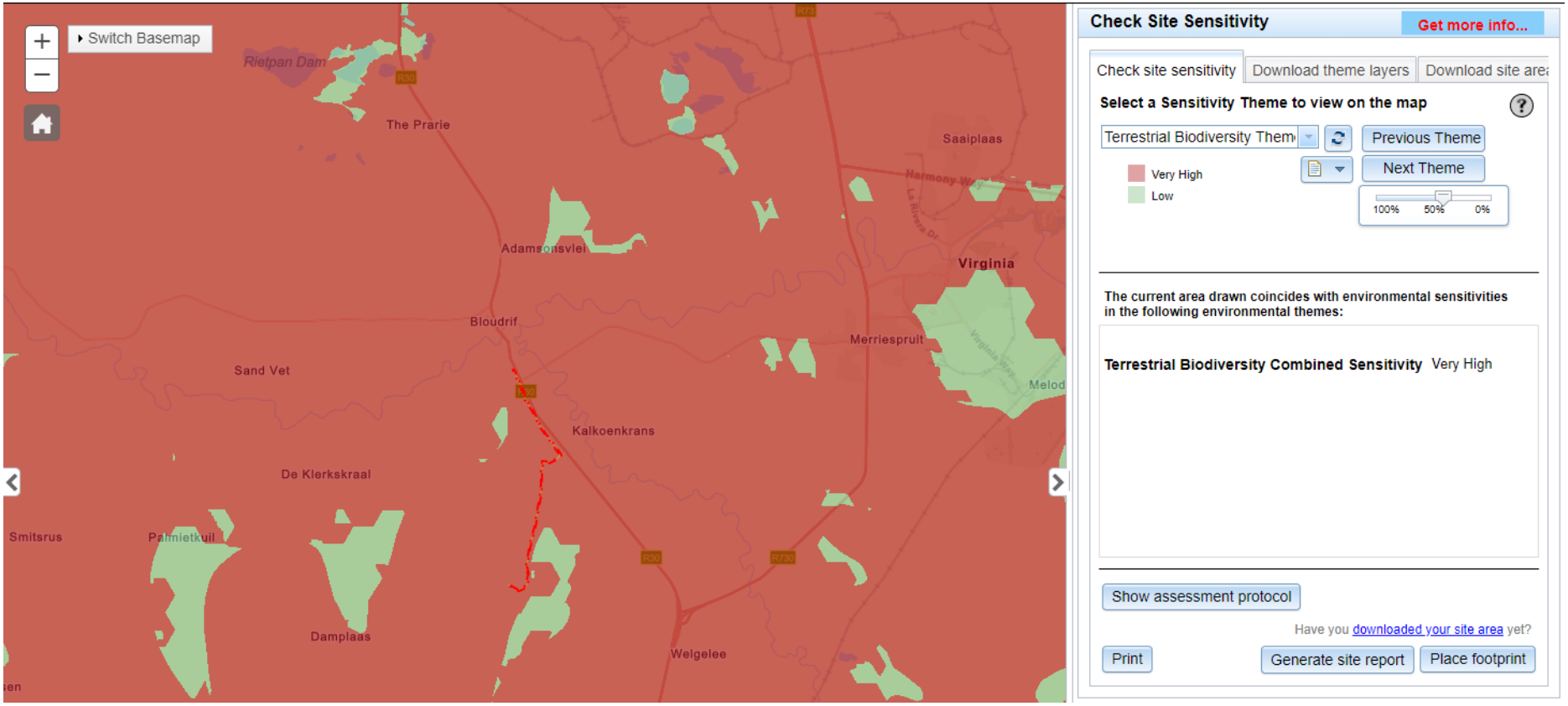

Figure 7: Sensitivity of the study area in terms of overall terrestrial biodiversity on a national level

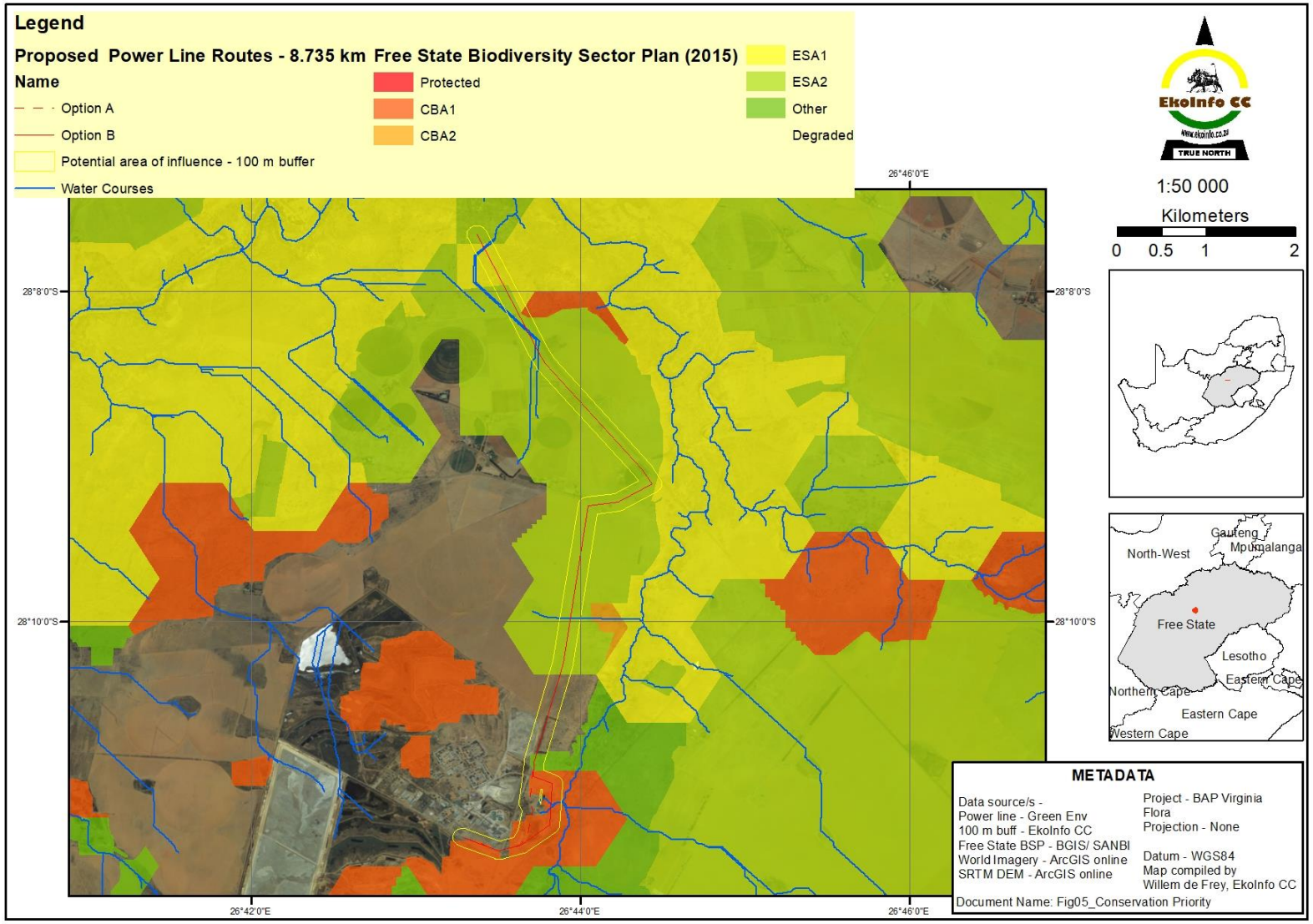

Figure 8: Free State Biodiversity Sector Plan (2015) areas of conservation concern in relation to the study area

5 RESULTS

The results aim to evaluate the two aspects indicated in the National Environmental Management Biodiversity Act (No 10 of 2004), namely: ecosystem and species on both a regional level and local level

5.1 Regional Context

5.1.1 Ecosystem Diversity

On a national scale, the study area transects two regional vegetation units, namely the endangered Vaal-Vet Sandy Grassland and the least threatened Highveld Alluvial Vegetation (Figure 4).

5.1.1.1 Vaal-Vet Sandy Grassland

This vegetation unit is described as (Mucina & Rutherford 2006):
"Plains-dominated landscape with some scattered, slightly irregulas undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of Themeda triandra is an important feature of this vegetation unit. Locally low cover of T. triandra and the associated increase in Elionurus muticus, Cymbopogon pospischilii and Aristida congesta is attributed to heavy grazing and/ or erratic rainfall.

It conservation status is Endangered, the conservation target is 24%. Only 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3%) and low (11%)."

Important species recorded within this regional vegetation unit are:
Anthephora pubescens, Anthospermum rigidum subsp*. rigidum, Aristida congesta* subsp*. congesta, Barleria macrostegia, Berkheya onopordifolia* var*. onopordifolia, Brachiaria serrata, Bulbine narcissifolia, Chamaesyce inaequilatera, Chloris virgata, Cymbopogon excavatus, Cymbopogon pospischilii, Cynodon dactylon, Digitaria argyrograpta, Digitaria eriantha, Elionurus muticus, Eragrostis chloromelas, Eragrostis curvula, Eragrostis lehmanniana* var*. lehmanniana, Eragrostis obtusa, Eragrostis plana, Eragrostis superba, Eragrostis trichophora, Felicia muricata* subsp*. muricata, Geigeria aspera* var*. aspera, Helichrysum dregeanum, Helichrysum paronychioides, Hermannia depressa, Heteropogon contortus, Hibiscus pusillus, Ledebouria marginata, Monsonia burkeana, Panicum coloratum* var*. coloratum, Panicum gilvum, Pentzia globosa, Pogonarthria squarrosa, Rhynchosia adenodes, Selago densiflora, Setaria sphacelata* var*. sphacelata, Stachys spathulata, Themeda triandra, Tragus berteronianus, Trichoneura grandiglumis, Tripteris aghillana* var*. integrifolia, Triraphis andropogonoides, Ziziphus zeyheriana*.

Lessertia philipsiana is an endemic species to this regional vegetation unit.

5.1.1.2 Highveld Alluvial Vegetation

This vegetation unit is described as (Mucina & Rutherford 2006):
"Flat topography supporting riparian thickets mostly dominated by Acacia karroo, accompanied by seasonally flooded grasslands and disturbed herblands often dominated by alien plants.

It conservation status is Least threatened, the conservation target is 31%. Nearly 10% statutorily conserved in the Barberspan (a Ramsar Site), Bloemhof Dam, Christiana, Faan Meintjies, Sandveld, Schoonspruit, Soetdoring and Wolwespruit Nature Reserves. More than a quarter has been transformed for cultivation and by building of dams (Bloemhof, Erfenis, Krugersdrif, Mockes and Vaalharts Dams). The highveld alluvia are prone to invasion by a number of weeds, obviously encouraged by the high nutrient status of soils and ample water supply. The under growth of the alluvial riparian thickets and the accompanying grasslands suffer from heavy overgrazing in many places."

Important species recorded within this regional vegetation unit are:

Acacia karroo, Agrostis lachnantha var. *lachnantha, Alternanthera sessilis, Andropogon appendiculatus, Andropogon eucomus, Asparagus laricinus, Asparagus suaveolens, Barleria macrostegia, Brachiaria marlothii, Celtis africana, Chloris virgata, Clematis brachiata, Corchorus asplenifolius, Crinum bulbispermum, Cynodon dactylon, Cyperus denudatus* var. *denudatus, Cyperus longus* var. *longus, Diospyros lycioides* subsp. *lycioides, Echinochloa holubii, Ehretia rigida* subsp. *rigida, Equisetum ramosissimum* subsp. *ramosissimum, Eragrostis obtusa, Eragrostis plana, Eragrostis porosa, Felicia muricata* subsp. *muricata, Fimbristylis ferruginea, Galium capense* subsp. *capense, Gomphocarpus fruticosus* subsp. *fruticosus, Grewia flava, Gymnosporia buxifolia, Haplocarpha lyrata, Hemarthria altissima, Hibiscus pusillus, Imperata cylindrica, Ischaemum fasciculatum, Lobelia angolensis, Lycium hirsutum, Miscanthus junceus, Myriophyllum spicatum, Nidorella resedifolia subsp. resedifolia, Panicum coloratum* var. *coloratum, Panicum maximum, Paspalum distichum, Persicaria amphibia, Persicaria hystricula, Persicaria lapathifolia, Phragmites australis, Pollichia campestris, Pseudognaphalium oligandrum, Pulicaria scabra, Pycreus mundii, Rhus lancea, Rhus pyroides* var. *pyroides, Rorippa fluviatilis* var. *fluviatilis, Salix mucronata* subsp. *capensis, Salix mucronata* subsp. *woodii, Salsola rabieana, Senecio inornatus, Setaria verticillata, Sporobolus africanus, Sporobolus fimbriatus, Stachys hyssopoides, Themeda triandra, Urochloa panicoides, Vahlia capensis* subsp. *capensis, Ziziphus mucronata* subsp. *mucronate*.

5.1.2 Species Diversity

5.1.2.1 Species Richness

SANBI's Red Data list[4] lists 2 389 plant species for Free State Province. The two dominant regional vegetation units which the study area (power line) transect, contains 102 species (Appendix B). Of the two regional units, the ecosystem with the most species is the Highveld Alluvial Vegetation, with 66 species, and 45 species for the Vaal-Vet Sandy Highveld. The combined species list of the two regional vegetation units have the potential to contain 4% of the species recorded for the Free State Province.

5.1.2.2 Species Of Concern

Of the 2 389 known plant species listed for Free State Province, seven species are classified as threatened (Vulnerable (4), Endangered (2), Critcal Endangered (1)). Of the seven species (Table 1), only one species (*Brachystelma incanum* R.A.Dyer) is expected to occur in the Vaal-Vet Sandy Highveld. The majority (71%) of the seven species are associated with wetland conditions.

No nationaly protected species in terms of the the National Environmental Management Biodiversity Act (No 10 of 2004) are listed in the regional vegetation units.

In terms of provincially protected flora, two genera of which all species within these genera are procted is listed for the two regional vegetation units, namely: *Crinum* and *Helichrysum*. The *Crinum bulbispermum* is expected to occur in the Highveld Alluvial Vegetation, and the *Helichrysum* species in the Vaal-Vet Sandy Grassland. **If Eskom is not the owner of the land, permits would be required to remove the plants.**

No nationally protected trees are listed within the two regional vegetation units which the power line transect.

Therefore, it is highly likely that either provincially or nationally protected species would occur within the proposed route corridors.

Any nationally protected plants would require a permit for their destruction.

[4] http://redlist.sanbi.org/

Table 1: Overview of the seven threatened Red Data plants listed for Free State Province (Species in BOLD could occur in Vaal-Vet Sandy Highveld)

Botanical Name	Red Data – Threatened Categories			Grand Total	Ecosystem	
Habitat Description	Vulnerable (VU)	Endangered (EN)	Critical Endangered (CR)		Terrestrial	Aquatic
Alepidea cordifolia B.-E.van Wyk		1		1		
Forest margins, west and south facing mountain slopes and near drainage lines or islands within wetlands (Hutchinson 2016).				1		1
Brachystelma dimorphum R.A.Dyer subsp. dimorphum	1			1		
Alluvial soils and large, shallow pans in grassland.				1		1
Brachystelma dimorphum R.A.Dyer subsp. gratum R.A.Dyer			1	1		
Clay pans in open grassland.				1		1
Brachystelma incanum R.A.Dyer	1			1		
Sandy loam soils in thornveld and Themeda-grassland.				1	1	
Dioscorea sylvatica Eckl.	1			1		
Wooded and relatively mesic places, such as the moister bushveld areas, coastal bush and wooded mountain kloofs.				1	1	
Kniphofia ensifolia Baker subsp. autumnalis Codd		1		1		
Grassland, occurs in black clay soils on stream banks and low-lying, seasonally moist areas.				1		1
Nerine gracilis R.A.Dyer	1			1		
Undulating grasslands in damp areas.				1		1
Grand Total	**4**	**2**	**1**	**7**	**2**	**5**
					29%	71%

5.2 Local Context

This section is based on the results of the actual vegetation surveys using the Braun-Blanquet approach during July 2020. Eight plots located in remaining stands of natural vegetation based on the 2014 land cover (Figure 9) were targeted over a two-day period. Within the remaining stand of natural vegetation, potential areas where wetlands could occur was taregeted. In addition to the Braun-Blanquet plots, georeferenced digital images (Figure 10) were taken from aerial based platforms (Appendix C). At each plot surveyed georeferenced digital images were taken of the surrounding landscape and soil form observed (Appendix E)

5.2.1 Ecosystem Diversity

Based on the abiotic – and vegetation data collected (Appendix D), it was determined that the remaining vegetation within the study area and specifically along the proposed powerline route are representative of the two prominent regional vegetation units, namely the Vaal-Vet Sandy Highveld and Highveld Alluvial Vegetation.

5.2.1.1 Vaal-Vet Sandy Highveld

Five of the eight plots surveyed are associated with this regional vegetation unit (Appendix D). This vegetation unit is associated with the higher lying areas, away from the water courses (Table 2), at a mean altitudinal heigh of 1 310 meters (Table 3). In terms of probability of wetness it is slighty drier at a mean value of 11.7, with the topsoil (A-horizon) at a mean percentage of clay of 16.2 or sandy loam (Table 3). The mean soil depth at 1 000 mm, implies that the soils are deep. It has an overall moderate vegetation cover at a mean value of 50%, with limited shrub cover, and grasses dominating the forbs in terms of cover (Table 3). The mean height of tall shrubs are below 3 meters, and the herbaceous layer is of low height at a mean value of 37 cm (Table 3). The remaining patches of this vegetation unit within a 100 m vicinity of the proposed power line covers 41 ha or 22% of the study area.

The following species had been recorded within these remaining patches of natural vegetation associated with the Vaal-Vet Sandy Highveld:
Forbs: *Bidens pilosa, Conyza bonariensis, Delosperma* species (1_2079), *Felicia muricata, Homeria pallida, Osteospermum muricatum, Pseudognaphalium luteo-album, Tagetes minuta, Verbena bonariensis*
Gramnoids (Grasses & Sedges): *Aristida congesta, Chloris virgata, Cymbopogon excavatus, Cynodon dactylon, Digitaria eriantha, Eragrostis curvula, Eragrostis plana, Eragrostis rigidior, Fingerhuthia africana, Hyparrhenia hirta, Paspalum urvillei, Pogonarthria squarrosa, Setaria sphacelata, Themeda triandra*
Woody species (Trees & Shrubs): *Acacia*[5] *karroo, Gleditsia* species (4_2102), *Protasparagus africanus, Protasparagus setaceus, Rhus lancea, Rhus pyroides*

If a phytosociological name had to be assigned to these remaining patches of Vaal-Vet Sandy Higheveld, it could be called *Eragrostis curvula – Cynodon dactylon* disturbed grassland on deep, sandy loam soils along the footslope to upper midslopes (Appendix D). These patches occur on the edge of the ploughed land (Photo 1) which represented the original extent of this vegetation type. These patches are most probably transitional from the drier upland areas which had been ploughed to the lower and potential more wetland and heavier soil conditions of the lower lying areas. Some of these areas had been ploughed but had been abandoned most probably due to the presence of waterlogging during period of high rainfall. Weeds are prominent in this unit; highlighting its disturbed and successional nature (Photo 2).

[5] The genus *Acacia* had been recently revised and the South African thorn tree Akasias had been changed to one of the following genera *Vachellia* or *Senegalia*, the same applies to the genus *Rhus* which had been changed to *Seersia*. However, very few field guides reflect these changes and therefore the previous genera are applied.

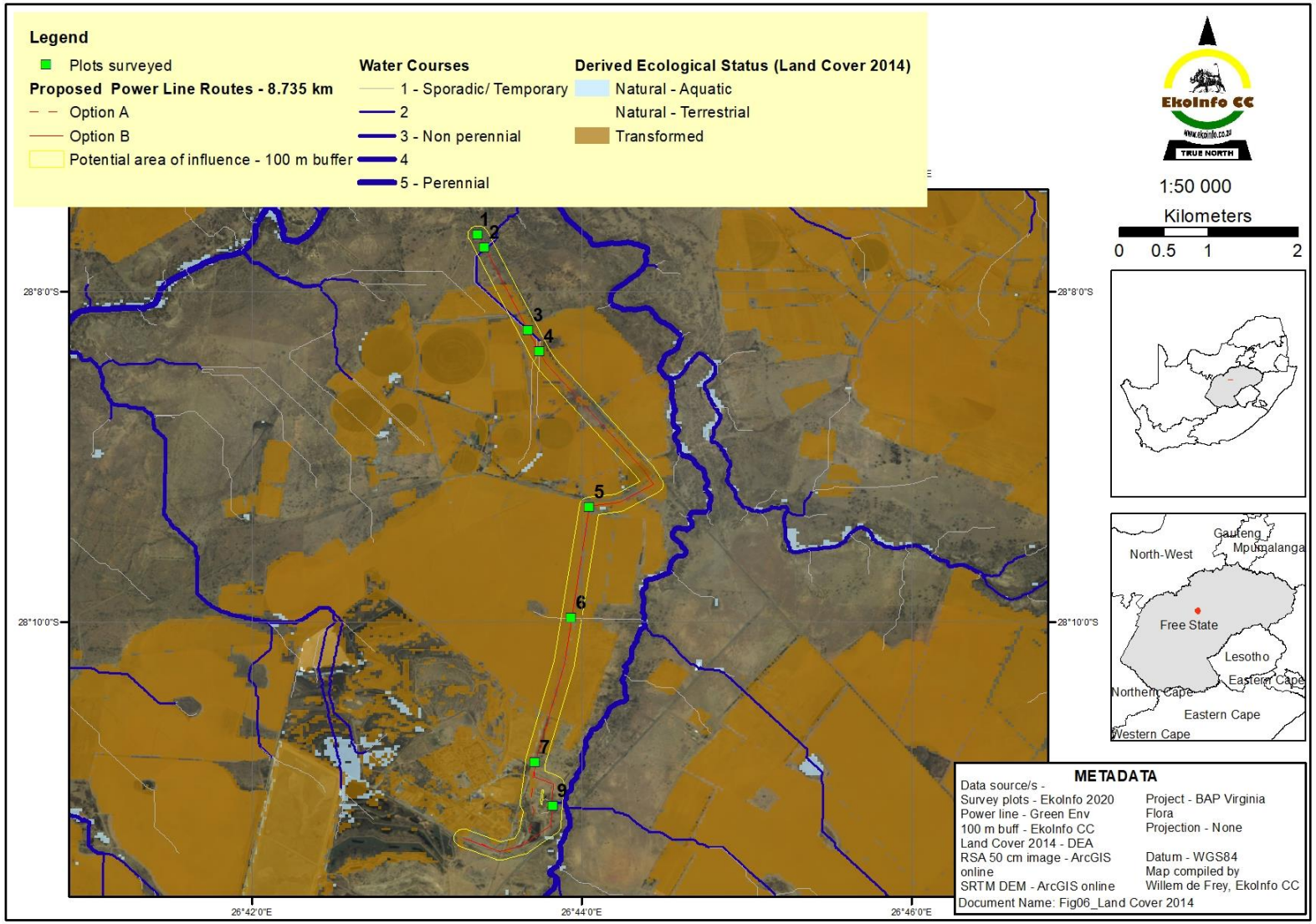

Figure 9: Overview of the distribution of the sampling plots within the remaining natural areas and potential wetlands

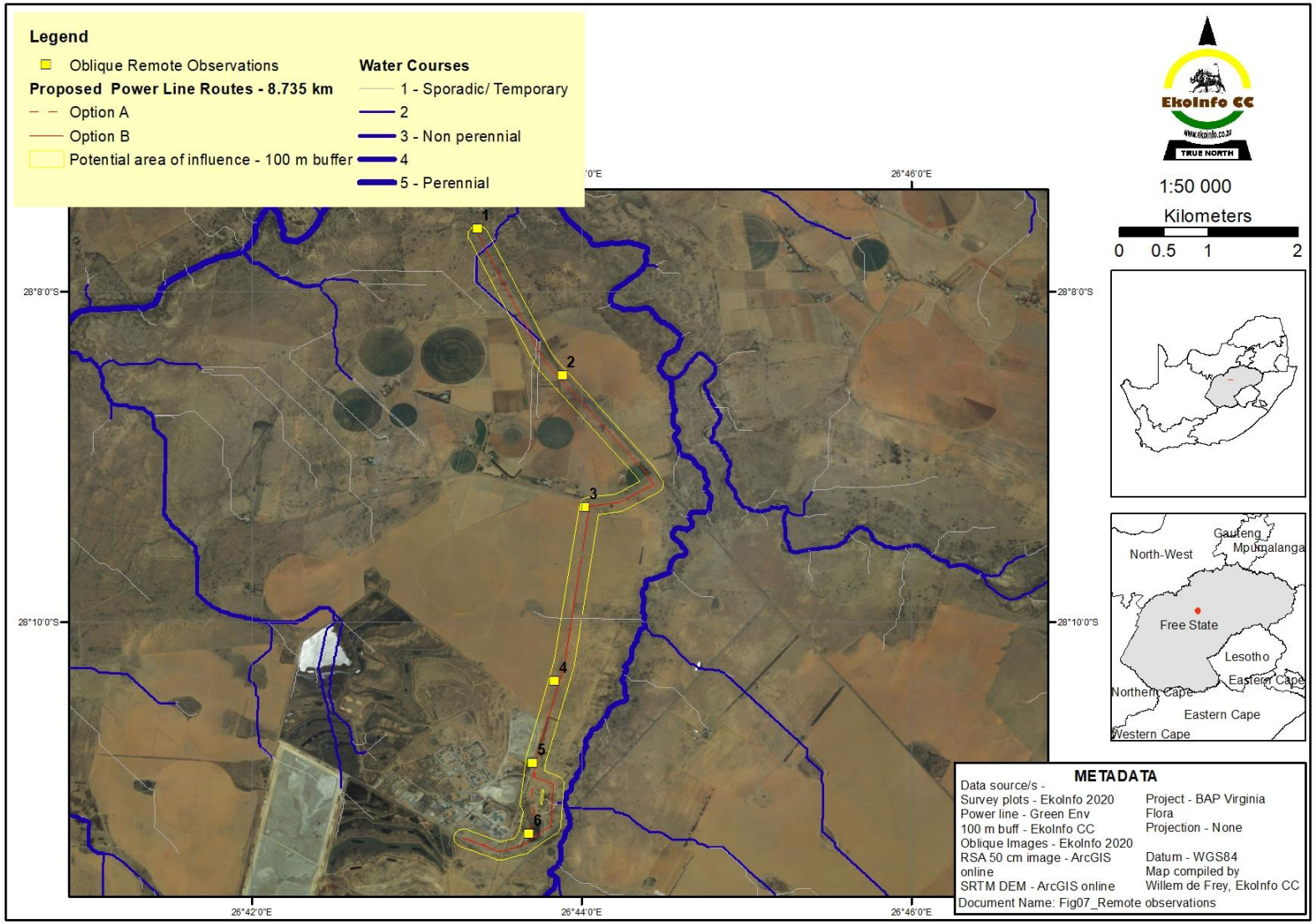

Figure 10: Distribution of the georeferenced digital observations made using aerial based platforms

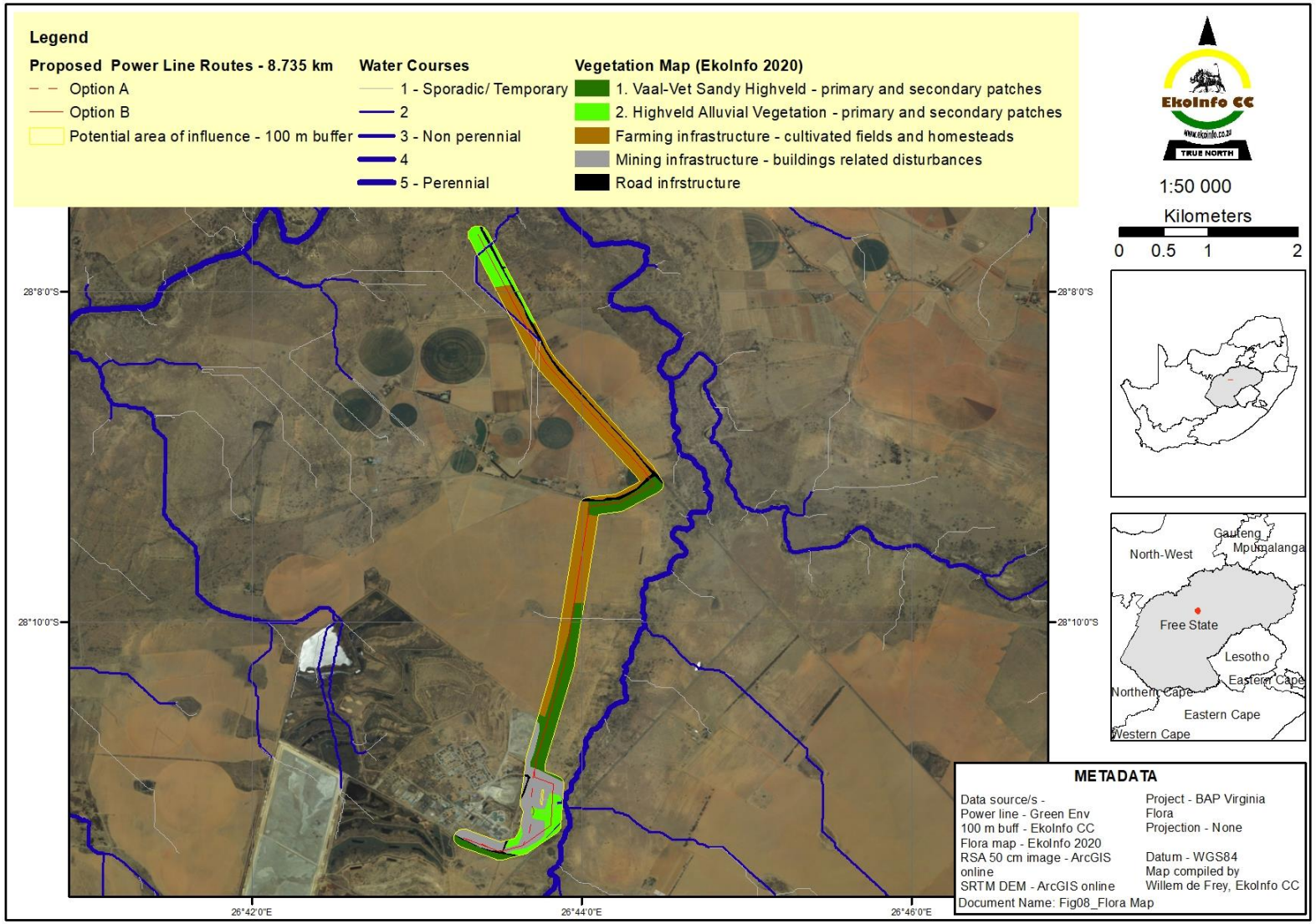

Figure 11: Vegetation map of the study area based on the July 2020 survey

Table 2: Overview of the terrain units and soil forms recorded with the remaining patches of natural vegetation associated with the two regional vegetation units within the study area

Count of Relevé number:	Terrestrial soils: well-drained			Wetland soils: Temporary/ seasonal				Major Ecosystems	
Row Labels	**Augrabies**	**Griffin**	**Sterkspruit**	**Pinedene**	**Avalon**	**Sepane**	**Grand Total**	**Terrestrial**	**Aquatic**
Vaal-Vet Sandy Grassland	**1**	**1**		**1**	**2**		**5**	**2**	**3**
1 - Crests		1					1		
2 - Midslope (Upper)	1						1		
4 - Footslope				1	1		2		
5 - Valley bottom					1		1		
Highveld Alluvial Vegetation			**1**		**1**	**1**	**3**	**1**	**2**
3 - Midslope (Lower)			1		1		2		
4 - Footslope						1	1		
Grand Total	**1**	**1**	**1**	**1**	**3**	**1**	**8**	3	5
Vaal-Vet Sandy Grassland									
Highlying areas (Crest to Midslope (Upper))	2								
Lowlying areas (Midslope (Lower) to Valley bottom)	3								
Highveld Alluvial Vegetation									
Highlying areas (Crest to Midslope (Upper))									
Lowlying areas (Midslope (Lower) to Valley bottom)	3								

Table 3: Overview of the mean values per quantitative abiotic and biotic attributes per regional vegetation unit recorded during the study

Quantitative data: Abiotic & Biotic Attributes	Regional Vegetation Units (Mean values)		
	Vaal-Vet Sandy Grassland	Highveld Alluvial Vegetation	Overall - mean
No of plots	5	3	8
Altitude (m) - Fieldwork: GPS receiver	1310.6	1302.0	1307.4
Altitude (m) - Extracted from 5 m DEM	1312.6	1300.2	1307.9
Slope (^{o}) - Extracted from 5 m DEM	1.5	1.0	1.3
Slope (%) - Fieldwork: Estimated	1.6	2.0	1.8
Wetness probability - magnitude: Extracted from 5 m DEM	11.7	12.1	11.9
Topsoil/ A - horizon estimated % clay: Fieldwork	16.2	22.7	18.6
Total soil depth (mm) - Fieldwork: measured	1000.0	983.3	993.8
Cover total (%) - Fieldwork: estimated	50.0	83.3	62.5
Cover shrub layer (%):	4.0	21.7	10.6
Cover herb layer (%):	46.0	61.7	51.9
Cover grass layer (%):	38.0	56.7	45.0
Cover forbs layer (%):	8.0	5.0	6.9
Height (highest) shrubs (m) - Fieldwork: estimated	2.7	5.7	3.8
Height lowest shrubs (m):	0.4	0.7	0.5
Aver height (high) herbs (cm):	37.0	45.0	40.0
Aver height lowest herbs (cm):	8.5	7.5	8.1
Maximum height herbs (cm):	81.0	83.3	81.9

Table 4: Overview of the surface area (ha) and percentage cover of the remaining natural patches within the study area

Vegetation Units	Ecological Status (ha)		Grand Total	% Cover
	Natural patches – primary & secondary	Transformed		
1. Vaal-Vet Sandy Highveld - primary and secondary patches	41		41	22%
2. Highveld Alluvial Vegetation - primary and secondary patches	26		26	14%
Farming infrastructure - cultivated fields and homesteads		79	79	42%
Mining infrastructure - buildings related disturbances		30	30	16%
Road infrstructure		12	12	6%
Grand Total	**67**	**120**	**188**	**100%**
	36%	64%		

Photo 1: Example of the remaining patches of Vaal-Vet Sandy Highveld on the edge of cultivated fields (DJI_0304 – 21st of July 2020)

Photo 2: Example of the remaining patches of Vaal-Vet Sandy Highveld which are over utilised (DJI_0314.JPG)

5.2.1.2 Highveld Alluvial Vegetation

Three of the eight plots surveyed are associated with this regional vegetation unit (Appendix D). This vegetation unit is associated with the lower lying areas, adjacent to the water courses (Table 2), at a mean altitudinal heigh of 1 300 meters (Table 3). In terms of probability of wetness it is slighty wetter at a mean value of 12.1, with the topsoil (A-horizon) at a mean percentage of clay of 22.7 or sandy clay loam (Table 3). The mean soil depth at 983 mm, implies that the soils are deep. It has an overall very high vegetation cover at a mean value of 83%, with a moderate shrub cover (mean 21.7%), and grasses dominating the forbs in terms of cover (Table 3). The mean height of tall shrubs are above 5 meters, and the herbaceous layer is of moderate height at a mean value of 45 cm (Table 3). The remaining patches of this vegetation unit within a 100 m vicinity of the proposed power line covers 26 ha or 14% of the study area.

The following species had been recorded within these remaining patches of natural vegetation associated with the Highveld Alluvial Vegetation:
Forbs: *Amaranthus* species (2_2088*), Berkheya carlinopsis, Bidens pilosa, Cirsium vulgare, Delosperma* species (1_2079), *Felicia muricata, Geigeria* species (1_2077), *Gomphocarpus fruticosus, Homeria pallida, Kalanchoe rotundifolia, 0steospermum muricatum, Tagetes minuta, Verbena bonariensis*
Gramnoids (Grasses & Sedges): *Chloris virgata, Cynodon dactylon, Eragrostis plana, Eragrostis rigidior, Themeda triandra*
Woody species (Trees & Shrubs): *Acacia karroo, Casuarina* species (9_2112)*, Maytenus* species (1_2083)*, Opuntia ficus-indica, Protasparagus africanus, Ziziphus mucronata*,

If a phytosociological name had to be assigned to these remaining patches of Vaal-Vet Sandy Higheveld, it could be called *Acacia karroo – Protasparagus africanus* shrubland on deep, sandy clay loam soils along the lower midslopes to valley bottoms (Appendix D). These patches occur in the vicinity of water courses (Figure 4). The woody component is prominent (Photo 3), highlighting the presence of water courses (Photo 4). These areas were most probably not ploughed due to their higher clay content, which makes them heavier soils and less preferable in terms of cultivation. Due to their association with finer textured soils and therefore higher nutrient content, these areas represent sweetveld and is favoured by livestock.

It is evident from this assessment, that the proposed power lines will transect an highly transformed landscape (Table 4), with agriculture and associated infrastructure dominating the landscape (Photo 5) and mining activities occurring to the south (Photo 6).

5.2.2 Species Diversity

5.2.2.1 Species Richness

During the survey, which involved eight plots, 39 species (Appendix D) were recorded or 38% of the 102 species listed within the two regional vegetation units associated with the study area (Appendix B). On average 11 species were recorded per plot, while the minimum was 10 species and the maximum 13 species (Table 5).

Of the 39 species, 15 species or 38% are forbs, 14 species or 36% are grasses and 10 species or 26% are woody species (trees and shrubs) (Table 6).

It should be noted that the species list cannot be considered to be comprehensive due to the number of plots sampled but does reflect the level of human influence in the area, as the species list also include invasive species.

Photo 3: Example of a large patch of Highveld Alluvial Vegetation towards the north of the study area (DJI_0292 – 20th of July 2020)

Photo 4: Example of the dense patches of Highveld Alluvial Vegetation along the water courses in the landscape (DJI_0310 – 21st of July 2020)

Photo 5: Example of extensive cultivated fields and associated infrastructure present in the area (DJI_0307 – 21st of July 2020).

Photo 6: Examle of mining activities and a agricultural activities (DJI_0316 – 21st of July 2020)

5.2.2.2 Threatened Red Data and Protected Plants

No nationally protected species were recorded within the plots surveyed, whether in terms of the National Environmental Biodiversity Act or the National Forest Act.

No provincially protected species had been recorded in the plots surveyed.

No threatened Red Data plants were recorded within the plots surveyed, however in terms of habitat, the vulnerable species, *Brachystelma incanum, could occur in the Vaal-Vet Sandy Highveld.*

5.2.2.3 Medicinal Plants

The following three species with medicinal properties were recorded within the seven plots surveyed, namely: *Acacia karroo, Gomphocarpus fruticosus* and *Ziziphus mucronate* (Van Wyk, Van Oudtshoorn & Gericke 2000) (Table 7). The majority of these species were recorded within the Highveld Alluvial Vegetation unit.

5.2.2.4 Alien invasive species

Two declared alien invasive species were recorded in the plots surveyed, mainly within the patches belong to the Highveld Alluvial Vegetation, namely: Cirsium vulgare and *Opuntia ficus-indica*. Both these species are Category 1 in terms the Conservation of Agricultural Resources Act, as well as the Alien Invasive Regulation (AIS) of the National Envirionmental Management Biodiversity Act, this implies that they need to be eradicated.

6 SENSITIVITY ANALYSIS

The regional and local results clearly indicates that the proposed power line will be constructed in an highly human influenced landscape (Table 4**Error! Reference source not found.**). Due to conservation priority of the remaining natural vegetation on both a national (Figure 7) and provincial scale (Figure 8), and the potential suiteable habitat for a threatened plant in the Vaal-Vet Sandy Highveld, the remaining natural vegetation is classified as either high or moderate sensitive (Figure 12). The cultivated areas are of low sensitivity, as the natural vegetation had been removed, and the soil chemistry altered due to the introduction of fertilisers, which favours colonisation by weeds rather than indigenous species. The areas with the lowest conservation importance are the areas influenced by construction activities such as mining and road infrastructure, which in addition to removing the vegetation, had also resulted in hard surfaces, which inhibits plant growth.

In terms of surface area and percentage cover of the flora sensitivity units (Table 8), 41 ha or 22% is considered to be of high flora sensitivity and 42 ha or 22% of very low flora sensitivity, with 79 ha (42%) classified as low, and 26 ha or 14% as moderate.

7 ENVIRONMENTAL IMPACT ASSESSMENT

It should be evident from the sensitivity analysis that most of the power line will transect through very low and low flora sensitivity.

In the absence of detailed design (final alignment, roads, wetland crossings, construction camps) and construction (duration, human resources) information, it is not possible to do a detailed impact assessment, and is therefore limited to those direct impacts generally associated with the construction of a power line, namely:

1. Removal of vegetation in general
2. Removal of species of concern (Red Data, protected – national and provincial)

Table 5: Overview of the number of species recorded per sample plot

Plot no	No of species
1	12
2	12
3	10
4	10
5	11
6	12
7	10
9	13
Minimum	**10**
Mean	**11**
Maximum	**13**

Table 6: Overview of the major growth forms recorded during the survey

Major Growth Forms	No of species	% frequency
Forbs	15	38%
Grasses	14	36%
Woodies	10	26%
Grand Total	**39**	**100%**

Table 7: List of plants with medicinal properties recorded across the seven plots surveyed

Regional Vegetation Unit	Botanical Name
Highveld Alluvial Vegetation	Acacia karroo
	Gomphocarpus fruticosus
	Ziziphus mucronata
Vaal-Vet Sandy Grassland	Acacia karroo

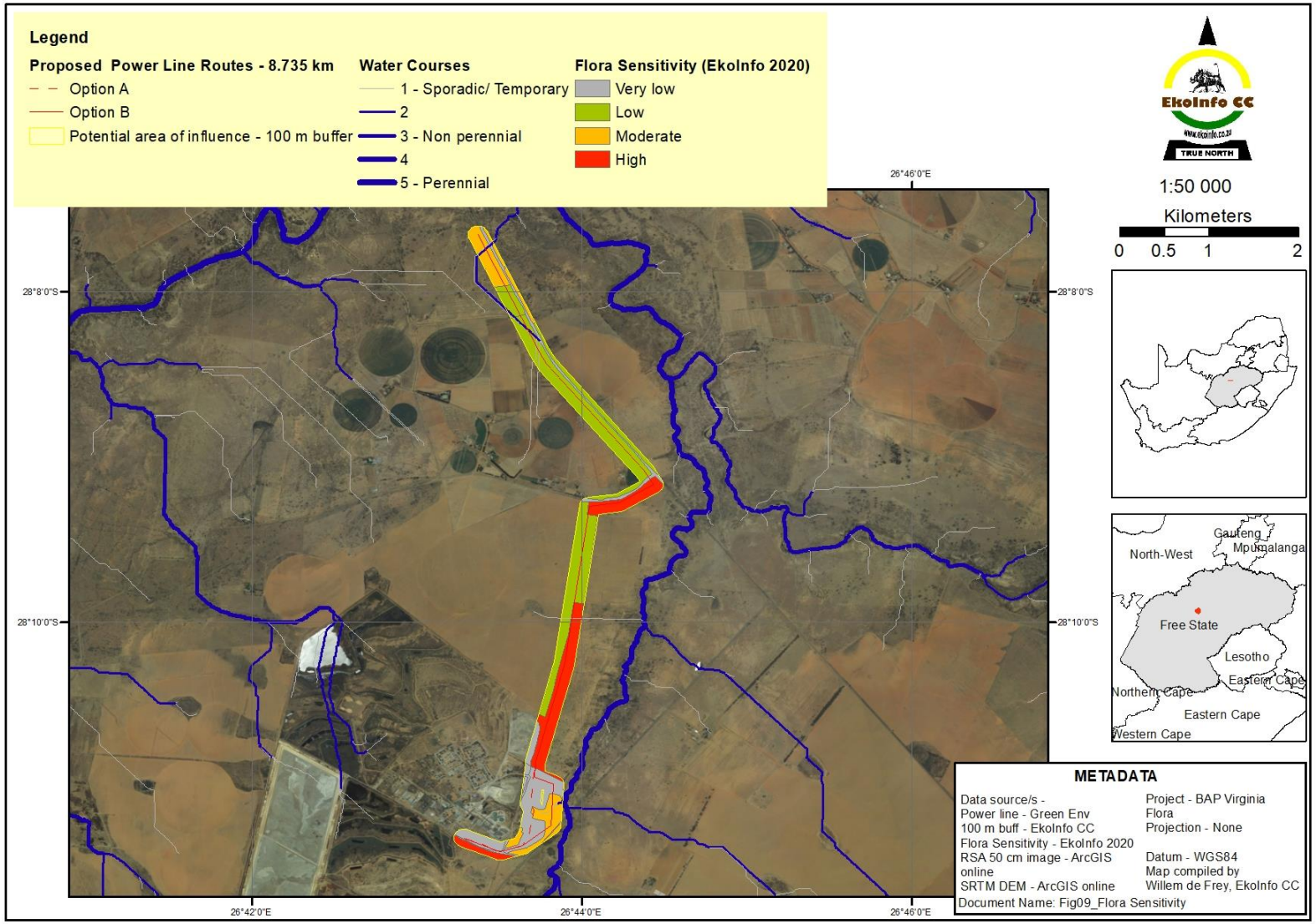

Figure 12: Flora sensitivity based on the literature review (regional context) and field observations (local context)

Table 8: Overview of the extent and percentage cover of the flora sensitivity areas

Flora sensitivity	Surface (ha)	% cover
Very low	42	22%
Low	79	42%
Moderate	26	14%
High	41	22%
Grand Total	**188**	**100%**

Removal of both, vegetation in general and of species of concern, will occur during both the construction and operational phases, within:

1. The power line servitude.
2. Pylon positions.
3. Access roads.
4. Construction camp or laydown areas.

To mitigate the above impacts associated with the removal of vegetation, the proposed power line should preferably favour already transformed or disturbed areas along the proposed power line route, for example:

1. Cultivated lands
2. Existing road infrastructure
3. Existing power lines.

Therefore, option A which transects mainly through very low flora sensitivity area should be given preference.

IMPACT: Removal of vegetation at construction camps and burrow pits
In the long term and on a local scale, the removal of natural vegetation at the construction sites and burrow pits will have a moderate negative impact.
MITIGATION: Placing construction camps in all ready transformed areas such as cultivated fields or revamping derelict homesteads or other abandoned infrastructure can mitigate this impact. New burrow pits should be kept to the minimum; existing one should rather be used than new ones created. If successfully mitigated, the impact on the vegetation could be considered low on a local scale in the long term.

IMPACT: Harvesting of medicinal plants and wood
Harvesting of medicinal plants and wood for cooking have a moderate negative impact on the population dynamics and vegetation structure on a local scale and in the long term.
MITIGATION: The following mitigation is recommended:

1. Construction companies should make sure that the necessary medical facilities are available for their staff on site. The Health and Safety Act will most probably cover this aspect.
2. Gas and electrical cooking facilities should be provided. The same apply to heating during the winter months. Open fires should be discouraged and only used under controlled circumstance.
3. Care should be especially taken during the late winter/ early spring months (June, July, August, September).

If successfully mitigated, the impact on the vegetation could be considered low on a local scale in the long term.

IMPACT: Construction of access roads
The construction of access roads will also result in the removal of natural vegetation especially in rugged terrain to obtain access. This would have a high negative impact on a local scale in the long term.
MITIGATION: Where possible existing routes into rugged terrain should be used and enhanced. If the access roads are required to cross green fields (untransformed) areas, it is strongly recommended that the plants present be surveyed, collected for documentation at SANBI, medicinal plants rescued instead of being destroyed and rare or threatened species moved to nurseries for re-establishment after construction or used for rehabilitation in areas where construction activities had result in the significant loss of natural vegetation. If successfully mitigated, the impact on the vegetation could be considered moderate on a local scale in the long term.

IMPACT: Alien vegetation control at construction camps, within servitudes and along access roads
MITIGATION: Where encountered, declared alien vegetation should be controlled and the spread thereof proactively managed. Declared alien vegetation should be controlled and removed in compliance with the Conservation of Agricultural Resource Act and the National Environmental Management Biodiversity Act. If successfully implemented, the impact on the vegetation could be considered moderately positive on a local scale in the long term.

8 FLORA GENERIC ENVIRONMENTAL MANAGEMENT PLAN

The generic EMPr provided for the development and expansion of substation infrastructure for the transmission and distribution of electricity (Figure 13), lists relevant criteria related to the remaining natural vegetation during the construction of the 400 kV power lines, in the following sections:

- Section 5.2 Site Establishment development
  - Location of camps must be within approved area to ensure that the site does not impact on sensitive areas identified in the environmental assessment or site walk through;
  - Sites must be located where possible on previously disturbed areas;
  - The use of existing accommodation for contractor staff, where possible, is encouraged
- Section 5.3 Access restricted areas
- Section 5.4 Access roads
  - Maximum use of both existing servitudes and existing roads must be made to minimize further disturbance through the development of new roads;
  - Access roads in flattish areas must follow fence lines and tree belts to avoid fragmentation of vegetated areas or croplands
- Section 5.9 Protection of watercourses and estuaries
  - Existing crossing points must be favored over the creation of new crossings (including temporary access)
- Section 5.10 Vegetation clearing
  - Indigenous vegetation which does not interfere with the development must be left undisturbed
- Section 5.35 Landscaping and rehabilitation
  - Indigenous species must be used for with species and/grasses to where it compliments or approximates the original condition;
  - The rehabilitation must be timed so that rehabilitation can take place at the optimal time for vegetation establishment

The sub points highlight those criteria, which if implemented stringently will assist in reducing the potential impacts of the powerline construction activities on the remaining natural vegetation

In addition, the following criteria should be considered:

- The footprint of the construction activity should be kept to the minimal; especially uncontrolled off-road driving should be curtailed.
- Infrastructure and storage facilities such as the construction camp should preferably be located on existing transformed areas such as cultivated land, where these areas are not within 350 m of the temporal zones of any wetlands, whether drainage line associated or hillsides.
- Unlawful harvesting of medicinal plants and woody species, especially protected species, should be prevented.

9 SPECIALIST OPINION

The results of this study did indicate that the proposed construction of the 33 kV power line will occur in an already human influenced area, with limited natural vegetation remaining. Therefore if the construction activities are restricted to mainly transformed areas, while those natural patches which cannot be avoided is spanned, then the construction of the power lines will have a limited impact on the landscape and remaining natural vegetation, and therefore cannot be considered a no-go from a vegetation perspective.

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APPENDIX 1

GENERIC ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr) FOR THE DEVELOPMENT AND EXPANSION OF SUBSTATION INFRASTRUCTURE FOR THE TRANSMISSION AND DISTRIBUTION OF ELECTRICITY

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Figure 13: Generic EMPr relevant to the development and expansion of substation infrastructure for the transmission and distribution of electicity (DEA)

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11 APPENDIX A – ABRIDGE CV, PRINCIPLE CONSULTANT

Name of firm: EkoInfo cc Environmental and Wildlife Management Consultancy
Name of staff: WILLEM HENDRIK DE FREY
Profession: Environmental and Wildlife Management consultant
Years with firm: Since 1995
Nationality: RSA
Membership of professional societies:
The South African Council for Natural Scientific Professions (Reg no 400100/02)
Categories: Botanical Science and Ecological Science
Currently in the process of affiliating to:
South African Association of Botanist (SAAB)
Grassland Society of Southern Africa
South African Institute of Ecologist and Environmental Scientists (SAIE)

KEY QUALIFICATIONS:

Mr W de Frey has been involved in the discipline of ecology since 1989. During this period he prepared himself for a profession in environmental and wildlife management, by attending courses in chemistry, geology, pedology and statistics, while majoring in Botany and Zoology. His working knowledge was obtained while completing projects for his post-graduate studies in wildlife management in both the Savanna and Grassland Biomes. In addition to his academic publications, he has contributed to numerous reports regarding EMPR's, EIA's, vegetation - and soil surveys and monitoring since the registration of his own consultation close corporation in 1995. He is actively involved in the management and marketing of his close corporation while completing tasks in his field of expertise namely soil, vegetation science and Geographical Information Systems. Mr W de Frey is task orientated with consideration of people's needs and safety. He beliefs in a holistic approach to environmental and wildlife management and has therefore established a network with individuals in related fields. He is also assisting previously disadvantaged persons in establishing a presence in the environmental industry, namely Lordwick Makhura of Baagi Environmental Consultancy CC and a joint venture company Bonolo Biodiversity And Environmental Management consisting of Baagi Environmental Consultancy CC and Disa Mphago Community Helpers CC.

EDUCATION:

1992 BSc Botany & Zoology, University of Pretoria

Course	Content	Level
Chemistry	Organic and Inorganic chemistry	1st year
Geology	Introduction/ Geomorphology, Stratigraphy, Structural, Sedimentology Palaeontology, Crystallography	1st and 2nd year
Pedology	Introduction, soil classification, soil fertility, soil ecology, soil physics	1st and 2nd year
Botany	Morphology, Anatomy, Physiology, Taxonomy, Mycology, Ecology, Reproductive biology	1st, 2nd and 3rd year
Zoology	Taxonomy (Vertebrates and Invertebrates), Physiology (mainly vertebrates), Ecology (mainly vertebrates), Animal behaviour (mainly vertebrates)	1st, 2nd and 3rd year
Statistics	Sampling methods, Statistical Analysis, Probabilities	1st year

1993 BSc (Hons) (Cum laude) Wildlife Management, University of Pretoria
Dissertation: 'N HOLISTIESE EKOLOGIESE BENADERING TOT DIE DRAKRAGBEPALING VAN 'N GEMENGDE WILD- EN BEESBOERDERY IN DIE UBOMBO DISTRIK, MET ENKELE BESTUURS AANBEVELINGS, 1993
1999 MSc (Cum laude) Wildlife Management, University of Pretoria
Thesis: PHYTOSOCIOLOGY OF THE MPUMALANGA HIGH ALTITUDE GRASSLANDS, 1999

COURSES/ WORKSHOPS ATTENDED

1. Red List And Threatened Species Assessment Training Workshop, Hosted by the Conservation Breeding Specialist Group Southern Africa & Endangered Wildlife Trust, December 2003
2. National State of the Environment Workshop, Hosted by DEAT and SRK, ESKOM Convention Centre – November 2004
3. Gauteng Red Data Flora Workshop, Hosted by SANBI and GDACE – November 2005
4. Gauteng Flora Minimum Requirement Workshop, Hosted by GDACE Nature Conservation – August 2007

EMPLOYMENT RECORD:

1986 – 1987
5 Signals Regiment, SADF

1998 – 1993 – Partime
Council of Geoscience, Palaeontology Section
University of Pretoria, Botany Department
Academy of Marksmanship, Range Officer
U Huisoppasser, Own enterprise
1994 – 1995
University of Pretoria, Botany Department, Assistant researcher

1995 – present

EkoInfo cc Environmental and Wildlife Management Consultancy, Founding member and consultant

Overall EkoInfo CC's principal consultant completed or administrated more than 58 vegetation studies as part of Environmental Impact Assessments within all of South Africa's nine provinces and adjacent countries such as Botswana and Mozambique with a focus on either terrestrial vegetation and/ or wetlands. Some projects were on provincial level such as the Mpumalanga and Gauteng Degradation Projects coordinated by the Institute for Soil, Climate and Water and sponsored by National Department of Agriculture. The majority of projects were on local scale from 5 ha to 50 000 ha or more for local developers and corporate institutions (SASOL, Anglo Coal, BHP Billington, Ingwe Coal, Deneys Rietz Attorneys, ESKOM) facilitated independently or as a subcontractor/ specialist for the following institutions: Oryx Environmental CC, African EPA, Arcuss Gibb, Digby Wells and Associates, Nature and Business Alliance and Eyethu Engineers, Strategic Environmental Focus.

COMMUNITY SERVICE

1. Substitute lecture – 2nd & 3rd year Botany Practical (Vegetation Survey Methods), University of Pretoria -1994 & 1995
2. Guest lecture – Wetland Vegetation Communities (2nd year students), Department of Landscape Architecture, University of Pretoria – 1996 & 1997
3. Guest lecture – Principles of Ecology (1st year students), Department of Landscape Architecture, University of Pretoria – 2002
4. Guest lecture – Principles of vegetation survey and mapping for EIA's (3rd year students), Department of Landscape Architecture, University of Pretoria – 2003
5. Referee – ILASA Merits Awards (Environmental Planning), Institute for Landscape Architects of South Africa - 2003

LANGUAGES:

Language	Capability
English & Afrikaans	Speak, Read, Write - sufficient
Sepedi (Northern Sotho)	Speak, Read, Write – insufficient

12 APPENDIX B – COMBINED REGIONAL AND LOCAL VEGETATION SPECIES LIST

Botanical Names	Local Species	Regional Species			Regional Species	
	Fieldwork data	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland	Grand Total	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland
Acacia karroo	1	1		1	1	0
Agrostis lachnantha var. lachnantha		1		1	0	0
Alternanthera sessilis		1		1	0	0
Amaranthus species (2_2088)	1			1	0	0
Andropogon appendiculatus		1		1	0	0
Andropogon eucomus		1		1	0	0
Anthephora pubescens			1	1	0	0
Anthospermum rigidum subsp. rigidum			1	1	0	0
Aristida congesta subsp. congesta	1		1	1	0	1
Asparagus laricinus		1		1	0	0
Asparagus suaveolens		1		1	0	0
Barleria macrostegia		1	1	1	0	0
Berkheya carlinopsis subsp. magalismontana	1			1	0	0
Berkheya onopordifolia var. onopordifolia			1	1	0	0
Bidens pilosa	1			1	0	0
Brachiaria marlothii		1		1	0	0
Brachiaria serrata			1	1	0	0
Bulbine narcissifolia			1	1	0	0
Casuarina species (9_2112)	1			1	0	0
Celtis africana		1		1	0	0
Chamaesyce inaequilatera			1	1	0	0
Chloris virgata	1	1	1	1	1	1

Botanical Names	Local Species	Regional Species			Regional Species	
	Fieldwork data	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland	Grand Total	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland
Cirsium vulgare	1			1	0	0
Clematis brachiata		1		1	0	0
Conyza bonariensis	1			1	0	0
Corchorus asplenifolius		1		1	0	0
Crinum bulbispermum		1		1	0	0
Cymbopogon excavatus	1		1	1	0	1
Cymbopogon pospischilii			1	1	0	0
Cynodon dactylon	1	1	1	1	1	1
Cyperus denudatus var. denudatus		1		1	0	0
Cyperus longus var. longus		1		1	0	0
Delosperma species (1_2079)	1			1	0	0
Digitaria argyrograpta			1	1	0	0
Digitaria eriantha	1		1	1	0	1
Diospyros lycioides subsp. lycioides		1		1	0	0
Echinochloa holubii		1		1	0	0
Ehretia rigida subsp. rigida		1		1	0	0
Elionurus muticus			1	1	0	0
Equisetum ramosissimum subsp. ramosissimum		1		1	0	0
Eragrostis chloromelas			1	1	0	0
Eragrostis curvula	1		1	1	0	1
Eragrostis lehmanniana var. lehmanniana			1	1	0	0
Eragrostis obtusa		1	1	1	0	0
Eragrostis plana	1	1	1	1	1	1
Eragrostis porosa		1		1	0	0

Botanical Names	Local Species	Regional Species			Regional Species	
	Fieldwork data	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland	Grand Total	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland
Eragrostis rigidior	1			1	0	0
Eragrostis superba			1	1	0	0
Eragrostis trichophora			1	1	0	0
Felicia muricata subsp. muricata	1	1	1	1	1	1
Fimbristylis ferruginea		1		1	0	0
Fingerhuthia africana	1			1	0	0
Galium capense subsp. capense		1		1	0	0
Geigeria species (1_2077)	1			1	0	0
Geigeria aspera var. Aspera			1	1	0	0
Gleditsia species (4_2102)	1			1	0	0
Gomphocarpus fruticosus subsp. fruticosus	1	1		1	1	0
Grewia flava		1		1	0	0
Gymnosporia buxifolia		1		1	0	0
Haplocarpha lyrata		1		1	0	0
Helichrysum dregeanum			1	1	0	0
Helichrysum paronychioides			1	1	0	0
Hemarthria altissima		1		1	0	0
Hermannia depressa			1	1	0	0
Heteropogon contortus			1	1	0	0
Hibiscus pusillus		1	1	1	0	0
Homeria pallida	1			1	0	0
Hyparrhenia hirta	1			1	0	0
Imperata cylindrica		1		1	0	0
Ischaemum fasciculatum		1		1	0	0
Kalanchoe rotundifolia	1			1	0	0

Botanical Names	Local Species	Regional Species			Regional Species	
	Fieldwork data	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland	Grand Total	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland
Ledebouria marginata			1	1	0	0
Lobelia angolensis		1		1	0	0
Lycium hirsutum		1		1	0	0
Maytenus species (1_2083)	1			1	0	0
Miscanthus junceus		1		1	0	0
Monsonia burkeana			1	1	0	0
Myriophyllum spicatum		1		1	0	0
Nidorella resedifolia subsp. resedifolia		1		1	0	0
Opuntia ficus-indica	1			1	0	0
Osteospermum muricatum subsp. muricatum	1			1	0	0
Panicum coloratum var. coloratum		1	1	1	0	0
Panicum gilvum			1	1	0	0
Panicum maximum		1		1	0	0
Paspalum distichum		1		1	0	0
Paspalum urvillei	1			1	0	0
Pentzia globosa			1	1	0	0
Persicaria amphibia		1		1	0	0
Persicaria hystricula		1		1	0	0
Persicaria lapathifolia		1		1	0	0
Phragmites australis		1		1	0	0
Pogonarthria squarrosa	1		1	1	0	1
Pollichia campestris		1		1	0	0
Protasparagus africanus	1			1	0	0
Protasparagus setaceus	1			1	0	0

Botanical Names	Local Species	Regional Species			Regional Species	
	Fieldwork data	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland	Grand Total	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland
Pseudognaphalium luteo-album	1			1	0	0
Pseudognaphalium oligandrum		1		1	0	0
Pulicaria scabra		1		1	0	0
Pycreus mundii		1		1	0	0
Rhus lancea	1	1		1	1	0
Rhus pyroides var. pyroides	1	1		1	1	0
Rhynchosia adenodes			1	1	0	0
Rorippa fluviatilis var. fluviatilis		1		1	0	0
Salix mucronata subsp. capensis		1		1	0	0
Salix mucronata subsp. woodii		1		1	0	0
Salsola rabieana		1		1	0	0
Selago densiflora			1	1	0	0
Senecio inornatus		1		1	0	0
Setaria sphacelata var. sphacelata	1		1	1	0	1
Setaria verticillata		1		1	0	0
Sporobolus africanus		1		1	0	0
Sporobolus fimbriatus		1		1	0	0
Stachys hyssopoides		1		1	0	0
Stachys spathulata			1	1	0	0
Tagetes minuta	1			1	0	0
Themeda triandra	1	1	1	1	1	1
Tragus berteronianus			1	1	0	0
Trichoneura grandiglumis			1	1	0	0
Tripteris aghillana var. Integrifolia			1	1	0	0
Triraphis andropogonoides			1	1	0	0

Botanical Names	Local Species	Regional Species			Regional Species	
	Fieldwork data	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland	Grand Total	Highveld Alluvial Vegetation	Vaal-Vet Sandy Grassland
Urochloa panicoides		1		1	0	0
Vahlia capensis subsp. capensis		1		1	0	0
Verbena bonariensis	1			1	0	0
Ziziphus mucronata subsp. mucronata	1	1		1	1	0
Ziziphus zeyheriana			1	1	0	0
Grand Total	**39**	**66**	**45**	**125**	**10**	**11**
					15%	24%

13 APPENDIX C – AERIAL PLATFORM IMAGES


1_DJI_0292


1_DJI_0293


1_DJI_0294


1_DJI_0295


2_DJI_0297


2_DJI_0298


2_DJI_0299


2_DJI_0300


3_DJI_0302


3_DJI_0303


3_DJI_0304


3_DJI_0305


4_DJI_0309


4_DJI_0310


4_DJI_0311


4_DJI_0312


5_DJI_0314


5_DJI_0315


5_DJI_0316


5_DJI_0317


6_DJI_0319


6_DJI_0320


6_DJI_0321


6_DJI_0322

14 APPENDIX D – BRAUN-BLANQUET TABLE

Relevé number:	7	6	5	3	4	9	1	2
Regional Vegetation Unit	Vaal-Vet Sandy Grassland	Vaal-Vet Sandy Grassland	Vaal-Vet Sandy Grassland	Vaal-Vet Sandy Grassland	Vaal-Vet Sandy Grassland	Highveld Alluvial Vegetation	Highveld Alluvial Vegetation	Highveld Alluvial Vegetation
Conservation Status	Endangered	Endangered	Endangered	Endangered	Endangered	Least threatened	Least threatened	Least threatened
LITHO_1	MUDSTONE	MUDSTONE	MUDSTONE	SHALE	SHALE	MUDSTONE	SHALE	SHALE
LITH0_2	ARENITE	ARENITE	ARENITE			ARENITE		
LANDTYPE	Dc8	Bd20	Bd20	Bd20	Bd20	Dc8	Dc8	Dc8
GPS - Altitude (m):	1324	1319	1317	1297	1296	1314	1298	1294
Digital Elevation Model (DEM) – 5 m contours	1325	1324	1318	1297	1299	1315	1292	1293
Slope (°) – DEM 5 m contours	3.4	1.2	2.2	0.4	0.3	2.4	0.3	0.3
Slope Intervals – 5 classes: 5° intervals	1	1	1	1	1	1	1	1
Slope (%) – Esltimated Fieldwork	2	2	2	1	1	4	1	1
Wetness probability – Magnitude (DEM 5 m)	9.0	12.2	8.1	14.3	14.9	10.5	11.7	14.0
Wetness probability – Natural Breaks: 5 classes	2	4	1	4	5	3	3	4
Terrain unit	Midslope	Midslope	Midslope	Midslope	Midslope	Valley bottom	Midslope	Midslope
Soil form	Augrabies	Avalon	Griffin	Pinedene	Avalon	Avalon	Sterkspruit	Sepane
Topsoil/ A - horizon estimated % clay (Fieldwork)	25	10	9	12	25	13	25	30
Total soil depth (mm) (Fieldwork)	650	750	1200	1200	1200	1200	550	1200
Cover total (%) – Fieldwork	45	55	45	55	50	75	85	90
Cover tree layer (%):	0	0	0	0	0	0	0	0
Cover shrub layer (%):	5	5	5	5	0	25	20	20
Cover herb layer (%):	40	50	40	50	50	50	65	70
Cover grass layer (%):	35	45	35	30	45	45	60	65
Cover forbs layer (%):	5	5	5	20	5	5	5	5
Height (highest) trees (m) - Fieldwork	0	0	0	0	0	0	0	0
Height lowest trees (m):	0	0	0	0	0	0	0	0
Height (highest) shrubs (m):	5	3	1.5	4	0	5	6	6
Height lowest shrubs (m):	0.25	0.5	0.25	1	0	0.5	0.5	1
Aver height (high) herbs (cm):	5	10	20	50	100	10	50	75
Aver height lowest herbs (cm):	2.5	5	5	5	25	2.5	10	10
Maximum height herbs (cm):	10	50	75	150	120	75	75	100
SPECIES GROUP A								
Aristida congesta	+		+	+				
Digitaria eriantha			+	+	+			
Eragrostis curvula			+	2b	+			
Conyza bonariensis				+	+			
SPECIES GROUP B								
Acacia karroo	1	1		+		3	2b	2a
Chloris virgata	+						+	+
Cirsium vulgare						+	+	
Eragrostis rigidior		+					2b	+
Geigeria species (1_2077)							+	+
osteospermum muricatum		+					+	+
Amaranthus species (2_2088)								+
Berkheya carlinopsis						+		
Delosperma species (1_2079)			+				+	
Eragrostis plana	+					+		
gomphocarpus fruticosus						+		
Kalanchoe rotundifolia								+
Maytenus species (1_2083)							+	
Opuntia ficus-indica							r	
ziziphus mucronata								+
SPECIES GROUP C - GENERAL SPECIES								
Cynodon dactylon	2b	2b	4	+	1	3		
Bidens pilosa		+		+	+			+
Verbena bonariensis		+		+	4	+		
Protasparagus africanus	+		1	+		2a	2a	2a
Felicia muricata	2a		+			+		+
Homeria pallida	1	+	+			+	r	
Themeda triandra	+	+				r	1	4
Tagetes minuta		+			+	+		
SPECIES GROUP D - FREQUENCY < 33%								
Casuarina 9_2112						1		
Cymbopogon excavatus		+						
Fingerhuthia africana			+					
Gleditsia species (4_2102)					+			
Hyparrhenia hirta			+					
Paspalum urvillei					+			
Pogonarthria squarrosa			+					
Protasparagus setaceus		+						
Pseudognaphalium luteo-album				3				
Rhus lancea	+							
Rhus pyroides		+						
Setaria sphacelata					+			

15 APPENDIX E – SURVEY GPS IMAGES

Note: Photo no in table = 1XXX to correspond with photo no of image

Relevé number:	1	2	3	4	5	6	7	9
Date (yy/mm/dd):	2020/07/20	2020/07/20	2020/07/20	2020/07/20	2020/07/21	2020/07/21	2020/07/21	2020/07/21
Photo no:	103- 106, 107	108- 111, 112	113- 116, 117	118- 121, 122	123- 126, 127	128- 131, 132	133- 136, 137	138- 141, 142
Photo direction (Bearing):	n, e, s, w, soil	n, e, s, w, soil	n, e, s, w, soil	n, e, s, w, soil	n, e, s, w, soil	n, e, s, w, soil	n, e, s, w, soil	n, e, s, w, soil
Notes	avv01 - erag rig -acac kar shubland, photo n0 1xxx, karroid elements present	avv02 - them tri - acac kar shrubland	avv03 - erag cur - pseud lut pasture/ old field	avv04 - verb bon - pecanut tree, old field	avv05 - cyno dac - prot afr old field	avv06 - cyno dac - acac kar shrubland	avv07 - cyno dac - prot afr old field	avv09 - cyno dac - cassurine
Soil form	Sterkspruit	Sepane	Pinedene	Avalon	Griffin	Avalon	Augrabies	Avalon


DSC01103


DSC01104


DSC01105


DSC01106


DSC01107


DSC01108


DSC01109


DSC01110


DSC01111


DSC01112


DSC01113


DSC01114


DSC01115


DSC01116


DSC01117


DSC01118


DSC01119


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DSC01140


DSC01141


DSC01142