ECOAGENT
ECOLOGY & BIODIVERSITY CONSULTANTS

# **Construction of 2 X 400 KV Lines from Kendal Power Station to Zeus Substation and Bravo Power Station to Zeus Substation (Bravo 4)** DEA Ref No - 12/12/20/1095

May 2016

# An assessment of vegetation and flora to inform the Construction of 2 X 400 KV Lines from Kendal Power Station to Zeus Substation and Bravo Power Station to Zeus Substation (Bravo 4)

DEA Ref No - 12/12/20/1095

by

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Commissioned by

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## DECLARATION OF INDEPENDENCE

I, George Johannes Bredenkamp, Id 4602105019086, declare that I:

- Hold a DSc in biological sciences, am registered with SACNASP (Reg No 400086/83) as a professional ecological scientist which sanctions me to function independently as a specialist consultant
- Declare that, as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003, this project was my work from its inception, reflects exclusively my observations and unbiased scientific interpretations, and was executed to the best of my ability
- abide by the Code of Ethics of the SACNASP
- Am the owner of Eco-Agent CC, CK 95/37116/23
- Act as an independent specialist consultant in the field of ecology, vegetation science, botany and wetlands
- Am committed to biodiversity conservation but concomitantly recognize the need for economic development
- Am assigned as specialist consultant by Limosella Consulting for the proposed project “An assessment of vegetation and flora to inform the Construction of 2 X 400 KV Lines from Kendal Power Station to Zeus Substation and Bravo Power Station to Zeus Substation (Bravo 4) DEA Ref No - 12/12/20/1095” described in this report
- Do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work performed
- Have or will not have any vested interest in the proposed activity proceeding
- Have no and will not engage in conflicting interests in the undertaking of the activity
- Undertake to disclose to the client and the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2014
- Will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.
- Reserve the right to only transfer my intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, I recognise that written consent from the client(s) will be required for me to release any part of this report to third parties.

GJ Bredenkamp

## EXECUTIVE SUMMARY

Eskom propose to construct two new 400 kV power lines, one from Bravo to Zeus substation (near Secunda) and the other one from the Kendal Power Station to the Zeus substation, Mpumalanga. A section of existing line joins the Bravo substation to the new proposed kV line. These lines will run parallel to each other and will be approximately 90 km in length. EcoAgent CC, was appointed by Limosella Consulting to do a vegetation assessment of the transect of this powerline.

According to the most recent vegetation map of South Africa the powerline transect is located within the Eastern Highveld Grassland and Soweto Highveld Grassland. Although these two vegetation types are not rare and occur quite widespread, they are considered to be vulnerable as about half is transformed, mainly by agriculture, mining and urban sprawl. Grassland in general is considered to be rich in plant species and is regarded as an ecologically sensitive ecosystem. The powerline will have to cross several spruits and associated wetlands.

Six plant communities (ecosystems, mapping units) were identified along the transect. The vegetation and plant species composition of these mapping units are discussed. The spruit and wetland systems are considered to be ecologically sensitive. The various grassland systems have a medium-low to medium-high ecological sensitivity. Two red data species were noted within the powerline transect.

The impact assessment indicated that the impact on the grassland vegetation will be low, while the spruits and wetland will be crossed easily without having any pylons close to these systems, therefore there will be negligible impacts on the vegetation of the spruits and wetlands.

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Should the conservation authority of Mpumalanga regard it as feasible and acceptable to develop the proposed powerline, it is suggested that, from a vegetation and flora point of view, the development of the powerline can be supported.

## 1. BACKGROUND AND ASSIGNMENT

Eskom has been experiencing a growing demand for electricity which increasing pressure on the current existing power generation and transmission capacity. Eskom aims to improve the reliability of electricity supply to the country, and in particular to provide for the growth in electricity demand in the Gauteng and Mpumalanga provinces. To this end the Bravo Integration Project was launched. This project was broken down into smaller individual Environmental Impact Assessments spanning Gauteng and Mpumalanga, for which alternatives were evaluated during a previous phase of the project. Biophysical specialist reports (which include vegetation assessments) were conducted for the route alternatives by Cymbian Enviro-Social Consulting Services in 2009. Hoare (2013) submitted a walkdown report, where the position of all pylons was assessed from an ecological perspective. The current assessment evaluates the environmental impact of the final alignments.

EcoAgent CC was appointed by Limosella Consulting to do a vegetation assessment for the Bravo 4 component of the larger Bravo Integration Project.

In accordance with The Natural Scientific Professions Act (Act 27 of 2003) only a person registered with the South African Council for Natural Scientific Professions may practice in a consulting capacity. Prof GJ Bredenkamp (SACNASP Reg No 400086/83) undertook an independent assessment of the vegetation on the site. A field survey was conducted 13-16 May 2016.

This investigation is in accordance with the EIA Regulations No. R982-985, Department of Environmental Affairs and Tourism, 4 December 2014 emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as well as the National Water Act 1998 (Act 36 of 1998) and other relevant legislation.

The assignment is interpreted as follows:

- Assess, map and describe the vegetation within the corridor of the proposed new powerline;
- Assess the flora in terms of NEMA, NEMBA and other relevant legislation (see summary below), as well as relevant minimum requirements of MTPA (though

the field survey was conducted during the late autumn / early winter season, May 2016);
- Indicate possible impacts of the proposed development on the vegetation and flora;
- Suggest mitigation measures in order to limit the impact of the proposed development.

This study does not include a wetland assessment, although the vegetation of the identified wetland ecosystems is described and included in the vegetation map.

**Assumptions and Limitations**

The most important limitation was that the vegetation survey had to be done in middle May, after a very droughty summer the vegetation was already quite dormant and many deciduous herbaceous species were already frosted down and not visible or recognisable.

Access to some properties was not possible, therefore data from all sample plots were used to compile the final vegetation maps and describe the vegetation of the mapping units.

A further limitation was that limited time was available for surveying and reporting on the vegetation along a relatively long (approx 70 km) powerline.

## 2. RATIONALE

It is widely recognised that it is of utmost importance to conserve natural resources in order to maintain ecological processes and life support systems for plants, animals and humans. To ensure that sustainable development takes place, it is therefore important that the environment is considered before relevant authorities approve any development. This led to legislation protecting the natural environment. The Environmental Conservation Act (Act 73 of 1989), the National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998), the National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004) and the National Water Act 1998 (Act 36 of 1998) ensure the protection of ecological processes, natural systems and natural beauty as well as the preservation of water resources and biotic diversity in the natural environment. It also ensures the protection of the environment against

disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes or products or human activities. A draft list of Threatened Ecosystems was published (Government Gazette 2009) as part of the National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Details of these Threatened Ecosystems have been described by SANBI & DEAT (2009) and a list of Threatened or Protected Species (TOPS) regulations is also available (NEMBA Notice 388 of 2013). International and national Red Data lists have also been produced for various threatened plant and animal taxa.

All components of the ecosystems (physical environment, including water resources, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include the development, utilisation and, where necessary, conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001).

In order to evaluate the vegetation it is necessary to make a thorough inventory of the ecosystems along the transect of the proposed power line. This inventory should then serve as a scientific and ecological basis for the planning exercises.

**Definitions and Legal Framework**

Authoritative legislation that lists impacts and activities on vegetation and biodiversity including wetlands and riparian areas that requires authorisation includes (Armstrong, 2009):

- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983);
- Environmental Conservation Act, 1989 (Act 73 of 1989);
- National Water Act, 1998 (Act 36 of 1998);
- National Forests Act, 1998 (Act 84 of 1998);
- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).

# 3. STUDY AREA

## 3.1 Location and the receiving environment

Eskom propose to construct two new 400 kV power lines, one from Bravo to Zeus substation (near Secunda) and the other one from the Kendal Power Station to the Zeus substation, Mpumalanga. A section of existing line joins the Bravo substation to the new proposed kV line. These lines will run parallel to each other and will be approximately 90 km in length. This component of the Bravo Integration Project is known as Bravo 4 (Figure 1). The other components (Bravo 3, Bravo 5 and Kyalami Strengthening) are discussed in separate reports.

The Mpumalanga Biodiversity Conservation Plan: Critical Biodiversity Areas (Terrestrial) Map shows the lines traversing areas with sensitivity scores ranging from Irreplaceable to No Habitat Remaining. The central section of the line crosses an area classified as Highly Significant (Figure 2).

Conservation status as indicated by the National Biodiversity Assessment (SANBI, 2011) shows the entire proposed powerline will cross land classified as Vulnerable (Figure 3).

The vegetation classification of South Africa (Mucina & Rutherford, 2006) classifies vegetation types crossed by the proposed lines as Eastern Highveld Grassland and Soweto Highveld Grassland (Figure 4). Both these vegetation types are listed as Endangered based on their current conservation status (Mucina & Rutherford, 2006).

The Critical Biodiversity Areas map (Figure 2) indicates that most of the area of the proposed powerline is classified as either “No Natural Habitat Remaining” or as Least Concern. Very limited areas are considered as Important and Necessary. However, the areas underlain with dolerite, and covered with Soweto Highveld Grassland, south of the N17 Highway and also a similar smaller patch north of the Zeus substation are classified as Highly Significant (Figure 2).

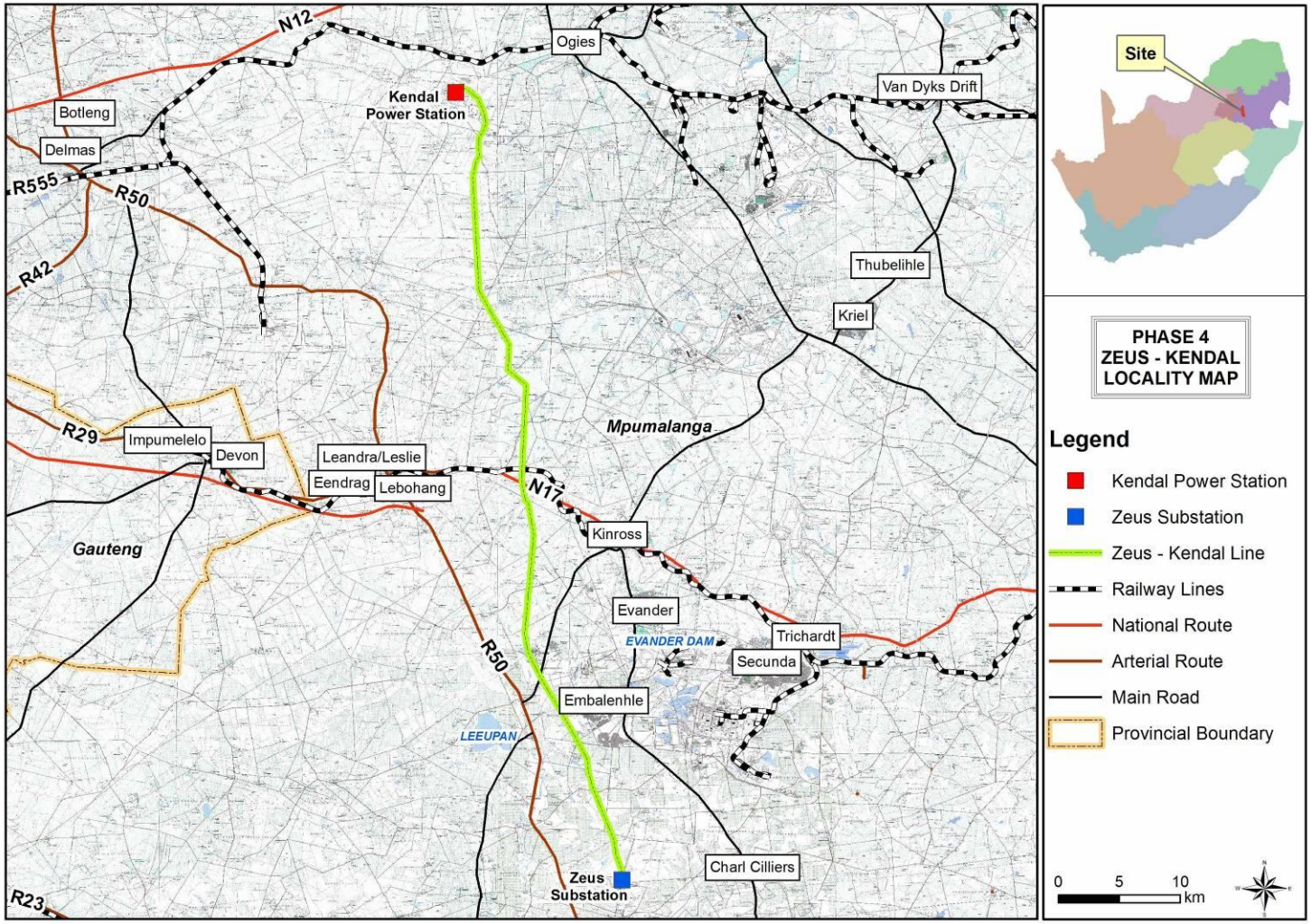


**Figure 1: The locality of the study site**

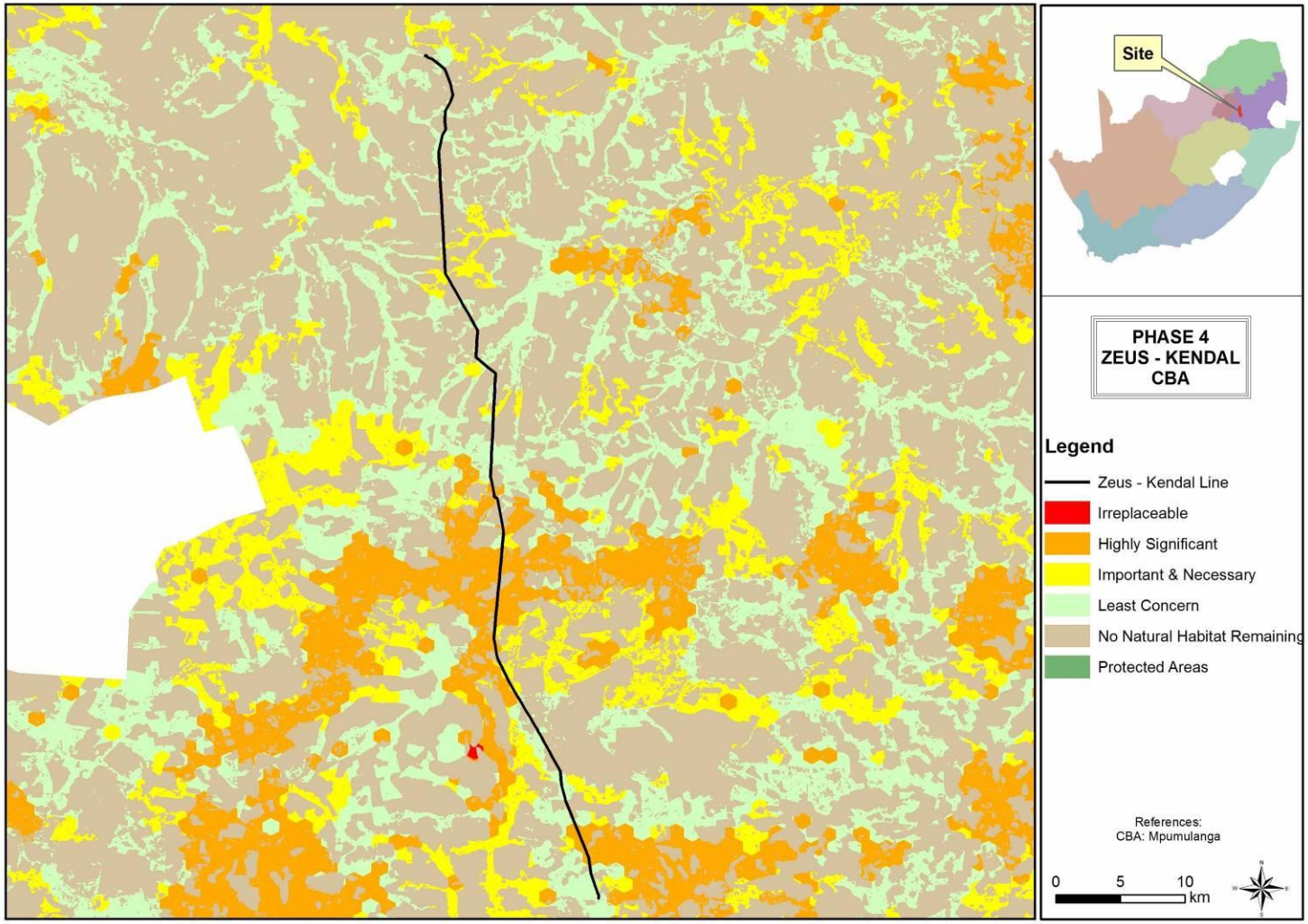


**Figure 2: The Mpumalanga Critical Biodiversity Areas and Gauteng C-Plan classification for the line.**

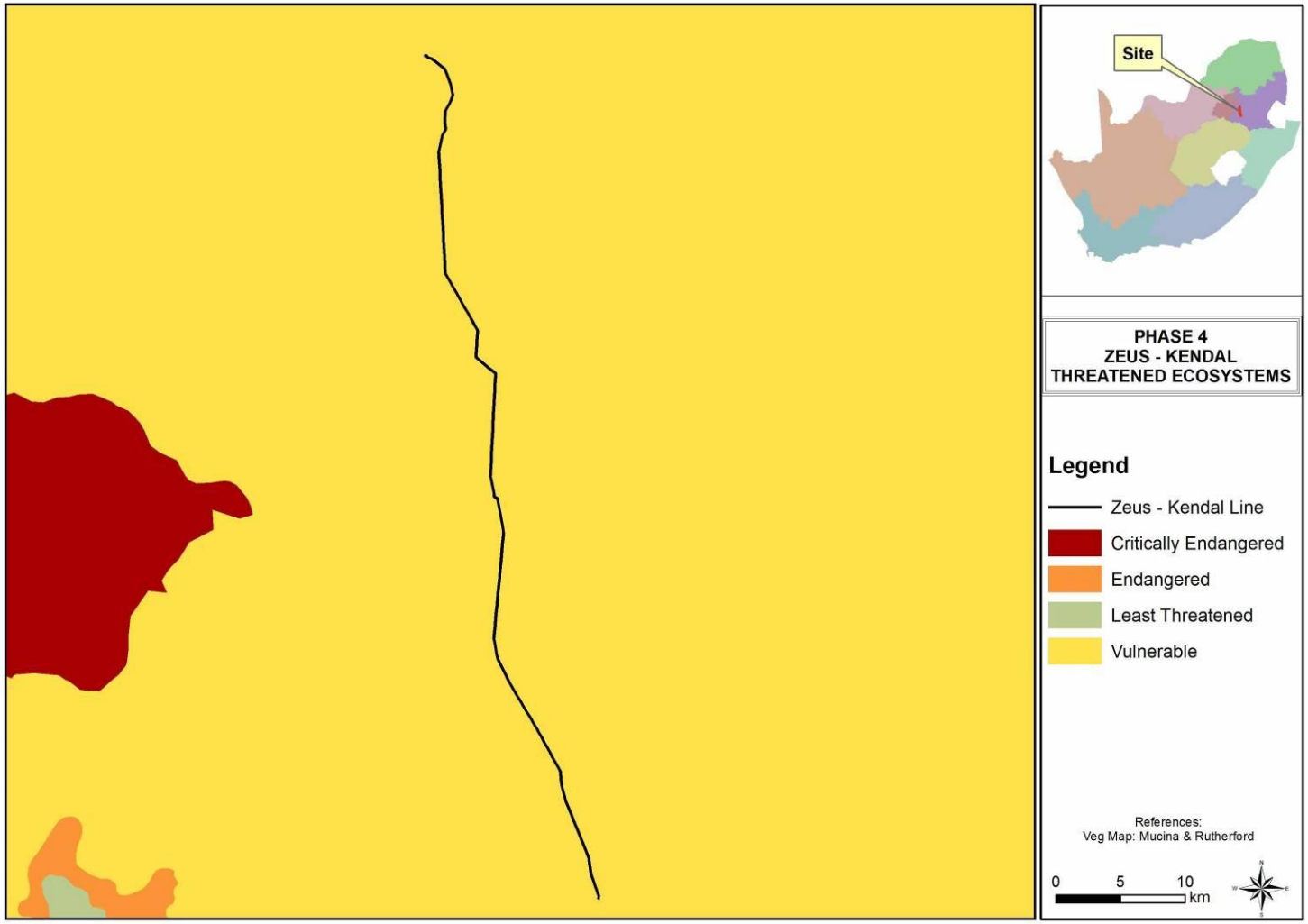


**Figure 3: The National Biodiversity Assessment classification for the line**

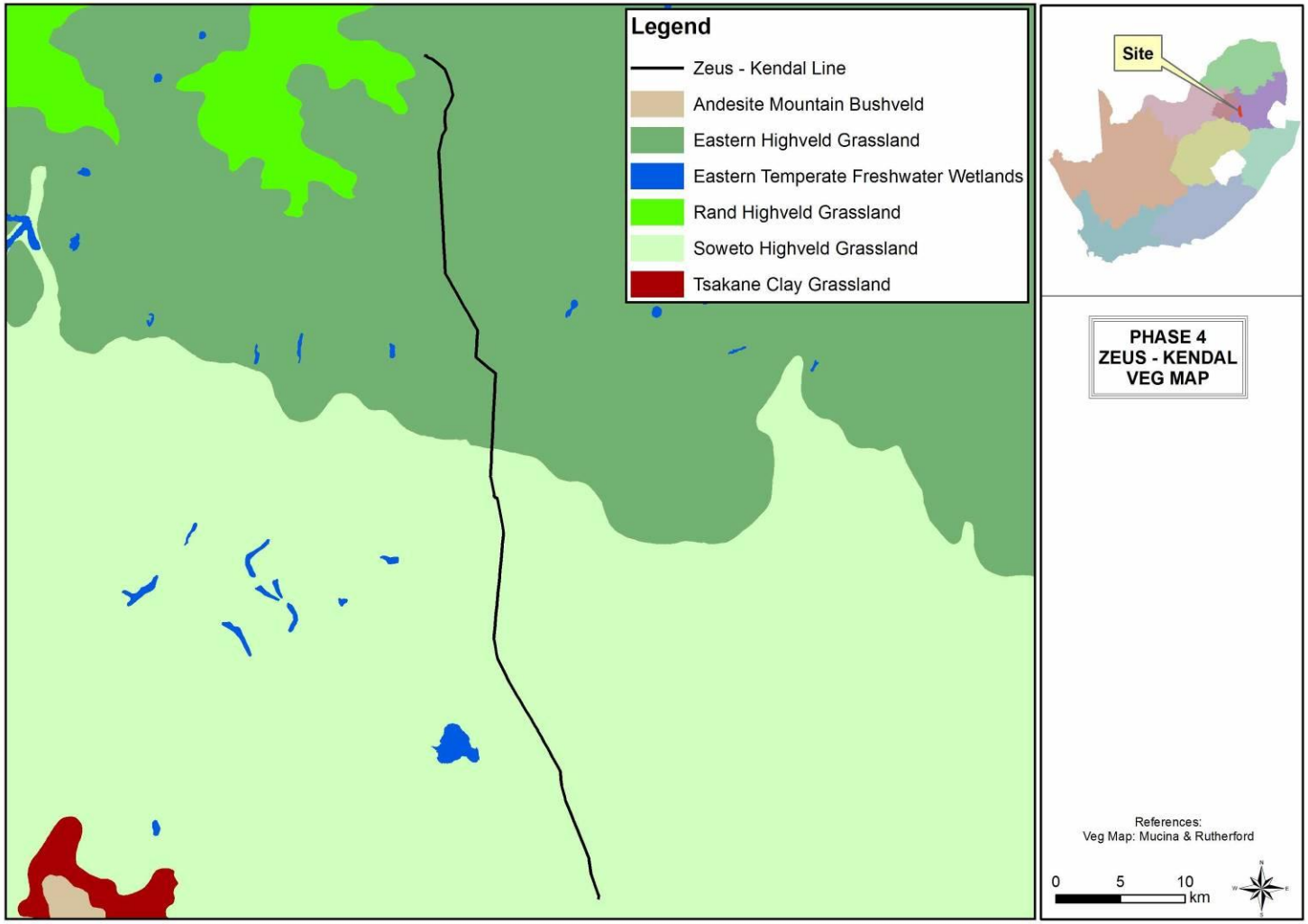


**Figure 4: Regional vegetation (Mucina & Rutherford 2006)**

### 3.2 Physical Environment

#### Regional Climate

Climate is characterised by warm summers and cold winters with frequent frosts typical of the Highveld region. Rainfall occurs in the summer mainly as thunderstorms. Mean Annual Precipitation (MAP) is approximately 662 mm. Average daily maximum temperatures range from 32°C in December to 20°C in July, with daily minimum temperatures ranging from 15°C in January to 3°C in July. The mean annual potential evaporation (MAPE) is approximately 2 606 mm (Land Type Survey Staff (1987).

#### Geology and soil

The geology of the study area is characterised by shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup), or the intrusive Karoo Suite Dolerites which feature prominently in the area (Figure 5). Large areas (particularly to the south are underlain by Dolerite. Small sections of Granite, Shale and Tillite also occur within the study area (DDPLG, 2002), but not along the current powerline. Arenite weathers to form the main agricultural red and brown soils of the province and Dolerite weathers to a dark clayey soil that is not ideal for cultivation (Figure 5) and is mostly used for grazing (Cymbian, 2008).

#### Topography and drainage

The topography of the region is gently undulating to moderately undulating landscape of the Highveld plateau. Some small scattered wetlands and pans occur in the area. Rocky outcrops and ridges also form part of significant landscape features in the area, but the powerlines rarely cross ridges. Altitude ranges between 1420-1800 metres above mean sea level (mamsl) (Cymbian, 2009).

Wetland and river systems affected by the proposed powerline are discussed in detail in a wetland assessment conducted by Wetland Consulting Services in 2012. In general, the powerline crosses 5 Quaternary Catchments (B20E, B20F, B11E, C12D and C12F). Several perennial and non-perennial watercourses are crossed by the proposed powerline (Figure 7). Water drains mainly in two main directions. The main river in the northern section of the site is the Wilge River along with the Kromdraai Spruit and the Riet Spruit. All these watercourses drain primarily northwards towards the Olifants River. The southern section of the line drains into

the Rolspruit and the Kaapspruit and eventually into the Vaal River. Several non-perennial streams and drainage lines also occur throughout the area, draining towards the main rivers

**Land-use**

The Land-Use along the proposed powerline routes is dominated by cultivated fields (maize), grazed grasslands, urban centres, coal mines and power stations (Cymbian, 2009).

**Vegetation Types**

The vegetation classification of South Africa (Mucina & Rutherford, 2006) classifies vegetation types crossed by the proposed lines as Eastern Highveld Grassland and Soweto Highveld Grassland (Figure 4). Both these vegetation types are listed as Endangered based on their current conservation status (Mucina & Rutherford, 2006) and as Vulnerable by the National Biodiversity Assessment (SANBI, 2011).

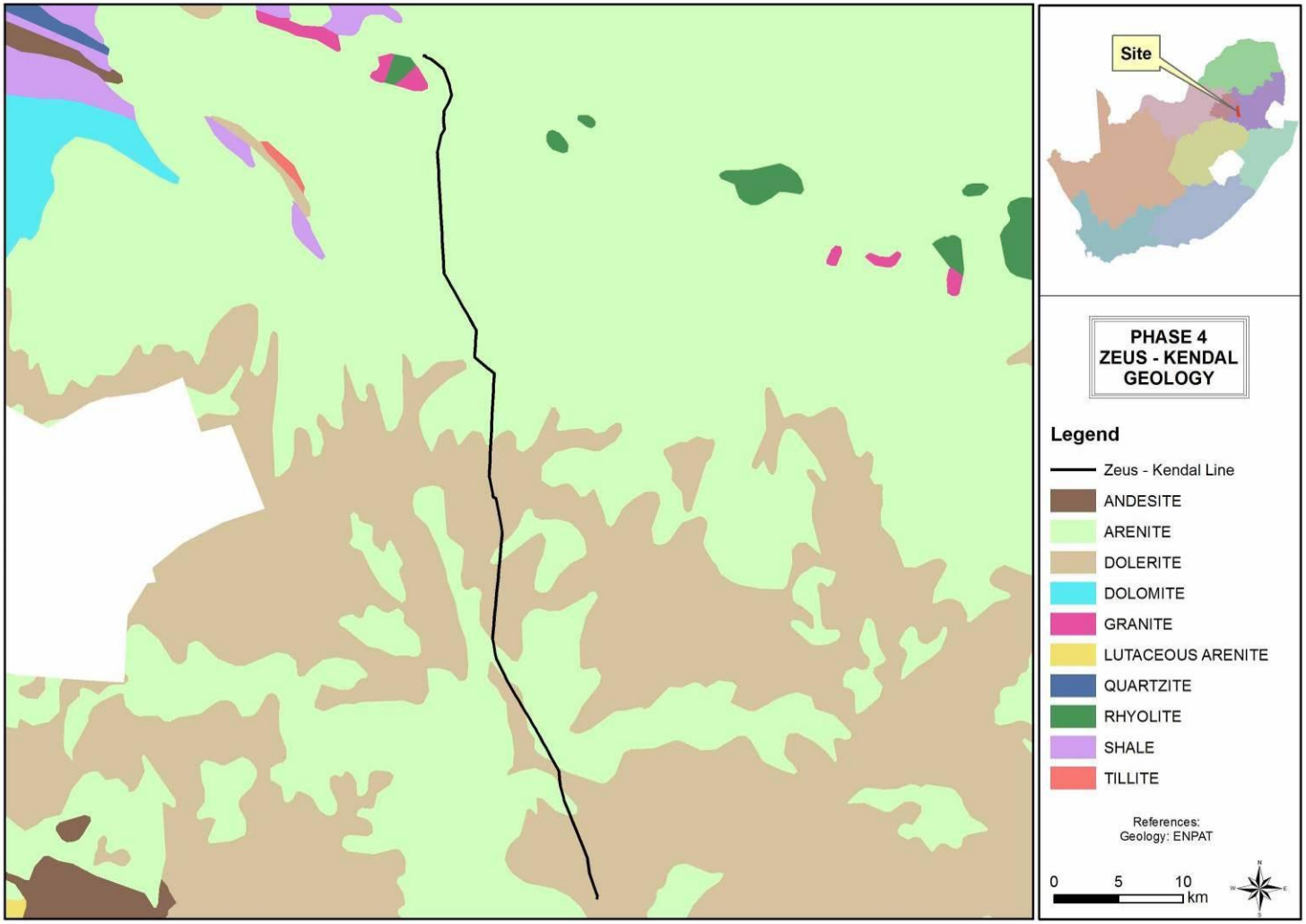


Figure 5: Geology. Note that the line mainly transects arenite in the north and dolerite in the south.

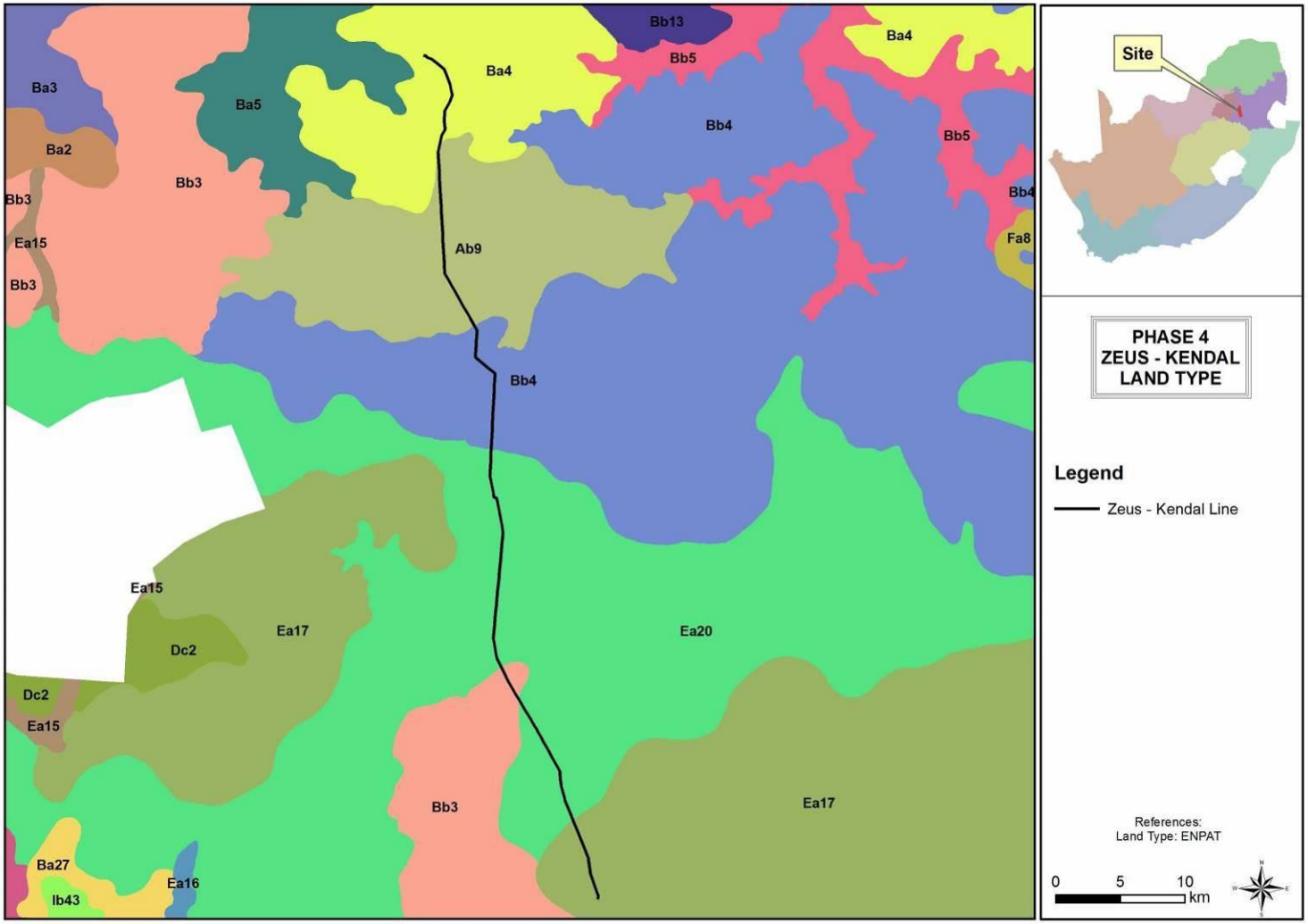


Figure 6: Land types. Note that the line crosses mainly A and B land types in the north and E land types in the south.

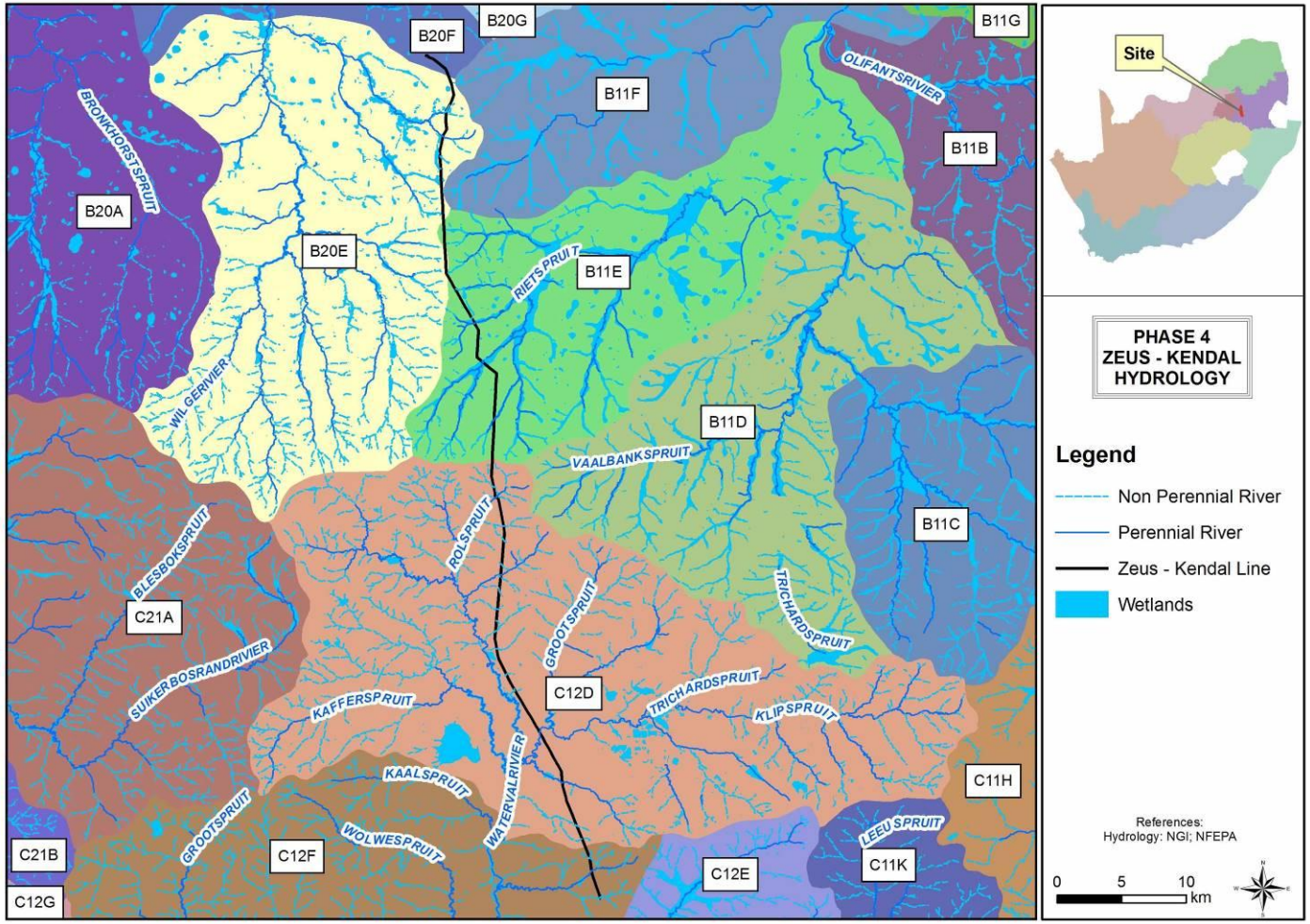


**Figure 7: Hydrological data for the proposed powerline. Note that drainage in the north is northwards (to the Olifant River) and in the south, southwards (to the Vaal River).**

## 4. METHODS

**Initial preparations:**

For background information, the relevant maps, aerial photographs and other information on the natural environment of the concerned area were obtained.

**Site visit and vegetation survey**

The field survey was done on 13-16 May 2016 by Prof GJ Bredenkamp, accompanied by Dr IL Rautenbach (mammalogist).

The vegetation / habitats were stratified into relatively homogeneous units on recent Google Earth images of the area. At several sites within each relatively homogeneous unit a description of the dominant and characteristic species was made. These descriptions were based on total floristic composition, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). Data recorded included a list of the plant species present, including trees, shrubs, grasses and forbs. Comprehensive species lists were therefore derived for each plant community / ecosystem present on the site. These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina *et al*. 2000) and are considered to be an efficient method of describing vegetation and capturing species information. Notes were additionally made of any other features that might have an ecological influence.

The identified systems are not only described in terms of their plant species composition, but also evaluated in terms of the potential habitat for red data plant species.

Critically Endangered, Endangered, Vulnerable and Protected Species (NEMBA species, TOPS species) are evaluated against the list published in Department of Environmental Affairs and Tourism Notice No. 2007 (National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)).

Protected trees are identified in accordance with the list of nationally protected trees published in Government Notice No. 29062 3 (2006) (National Forests Act, 1998 (Act No. 84 0f 1998), as Amended (Department of Water Affairs Notice No 897, 2006).

Lists of Red Data plant species for the area were obtained from the SANBI data bases, with updated threatened status, (Raimondo *et al* 2009) as well as MTPA for the map grid 2628BD. These lists were then evaluated in terms of habitat available on the site, and also in terms of the present development and presence of man in the area.

Alien invasive species, according to the Conservation of Agricultural Resources Act (Act No.43 of 1983) as listed in Henderson (2001) and other weeds in Bromilov (2010) are indicated.

Medicinal plants are indicated according to Van Wyk, Van Oudthoorn & Gericke (1997).

Threatened ecosystems are in accordance with SANBI & DEAT (2009).

**Conservation Value**

The following conservation value and sensitivity categories were used for each site:

**High**: Ecologically sensitive and valuable land with high species richness and/or sensitive ecosystems or red data species that should be conserved and no development allowed.

**Medium-high**: Land where sections are disturbed but which is in general ecologically sensitive to development/disturbances.

**Medium**: Land on which low impact development with limited impact on the vegetation / ecosystem could be considered for development. It is recommended that certain portions of the natural vegetation be maintained as open space.

**Medium-low**: Land of which small sections could be considered for conservation but where the area in general has little conservation value.

**Low**: Land that has little conservation value and that could be considered for development with little to no impact on the vegetation.

**Ecological Sensitivity**

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent & Coker

1992). Therefore, the vegetation of an area will largely determine the ecological sensitivity thereof.

The vegetation sensitivity assessment aims to identify whether the vegetation within the study area is of conservation concern and thus sensitive to development:

In order to determine the sensitivity of the vegetation (ecosystem) on the site, weighting scores are calculated per plant community. The following six criteria are used and each allocated a value of 1-3. The maximum score that can be attained is therefore 18 (6x3).

- Conservation status of a regional vegetation unit;
- Listed ecosystem (e.g. wetlands, hills and ridges etc)
- Legislative protection (e.g. threatened ecosystems ,SANBI & DEAT 2009)
- Plant species of conservation concern (e.g. red listed, nationally or provincially protected plant species, habitat or potential habitat to plants species of conservation concern, protected plants or protected trees);
- Situated within ecologically functionally important features (e.g. wetlands or riparian areas; important habitat for rare fauna species)
- Conservation importance (e.g. untransformed and un-fragmented natural vegetation, high plant species richness, important habitat for rare fauna species).

Sensitivity is calculated as the sum the values of the criteria. The vegetation with the lowest score represents the vegetation that has the least / limited sensitivity). A maximum score of 18 can be obtained, a score of 13-18 indicated high sensitivity

The sensitivity scores are as follows:

| **Scoring** | 13-18 | 7-12 | 0-6 |
|---|---|---|---|
| **Sensitivity** | High | Medium | Low |

A score of Medium-High (10-12) or Medium-Low (7-9) can also be allocated.

Development on vegetation that has High sensitivity will normally not be supported, except that specific circumstances may still lead to support of the proposed development.

Portions of vegetation with a Medium sensitivity should be conserved**.**

Development may be supported on vegetation considered to have a Low sensitivity.

**Plant Species Status**

Plant species recorded in each plant community with an indication of the status of the species by using the following symbols:

A = Alien woody species; D = Dominant; d = subdominant; G = Garden or Garden Escape; M = Medicinal plant species; P = Protected trees species; p = provincially protected species; RD = Red data listed plant; W = weed.

**Plant Species Richness**

Species Richness is interpreted as follows: Number of indigenous species recorded in the sample plots representing the plant community. Alien woody species and weeds are not included.

Categories of plant species richness are as follows:

| **No of species** | **Category** |
|---|---|
| 1-24 | Low |
| 25-39 | Medium |
| 40-59 | High |
| 60+ | Very High |

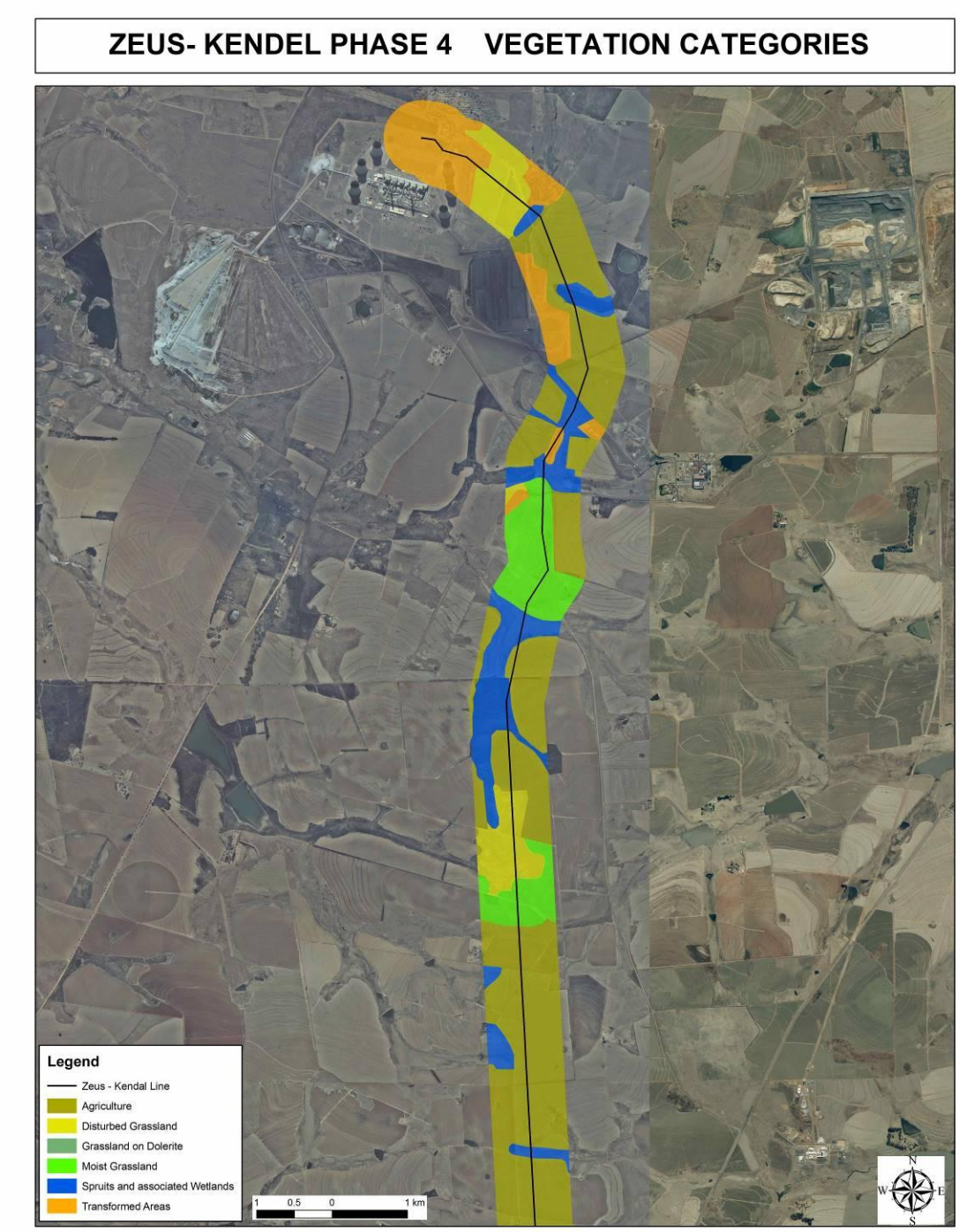


Figure 8 map 1: Vegetation map of the study site with the position of the powerline

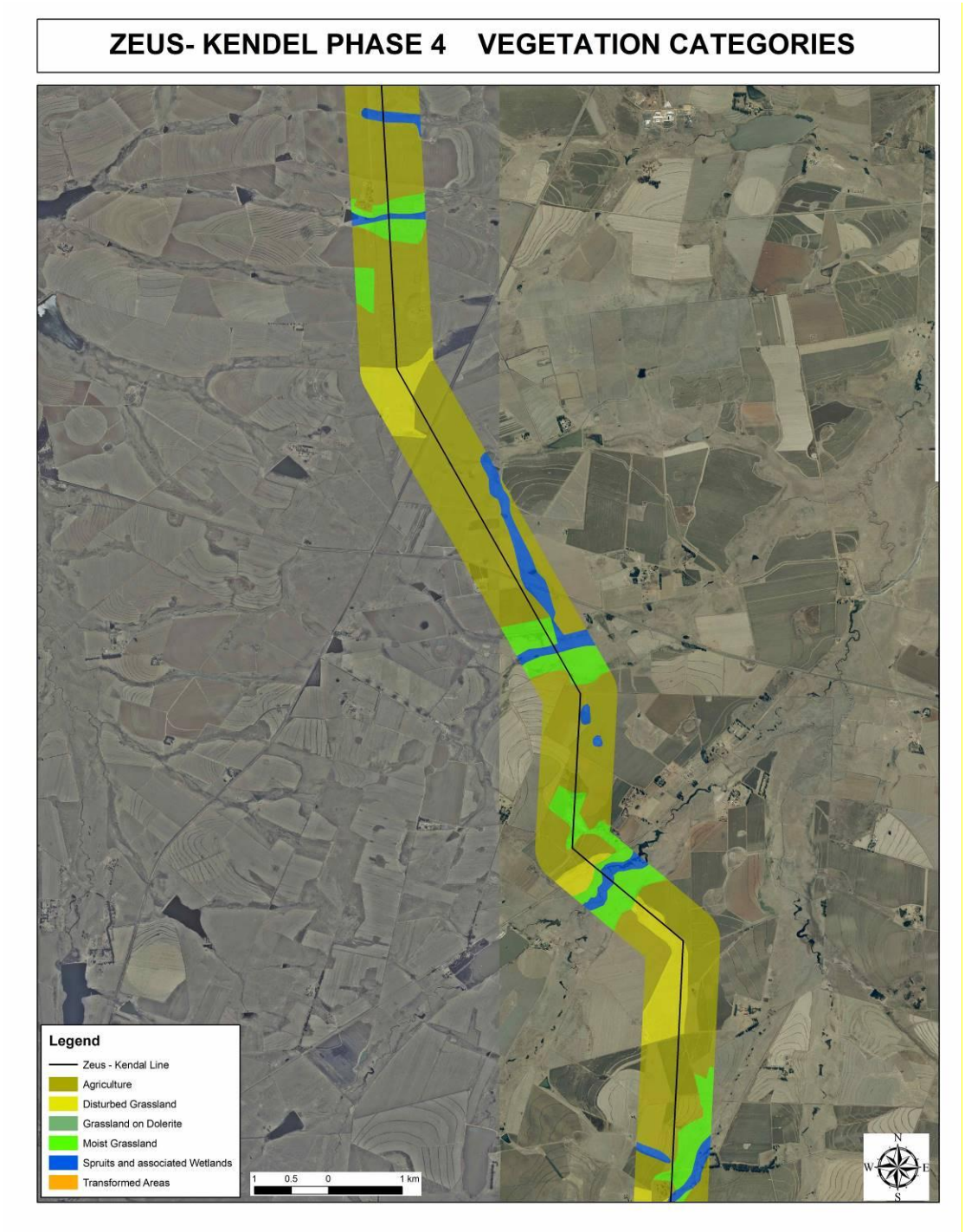


Figure 8 continued map 2: Vegetation map of the study site with the position of the powerline

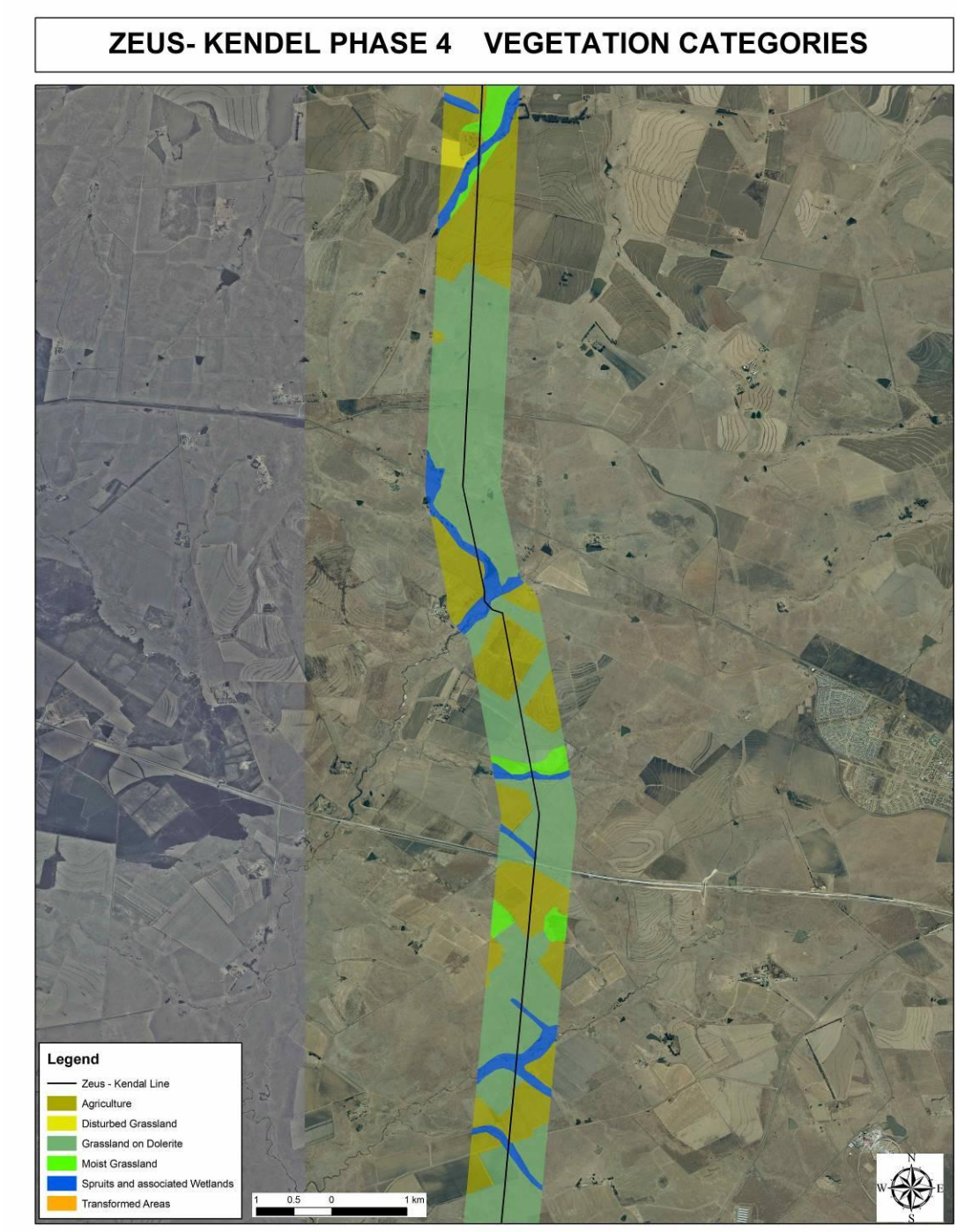


Figure 8 continued map 3: Vegetation map of the study site with the position of the powerline

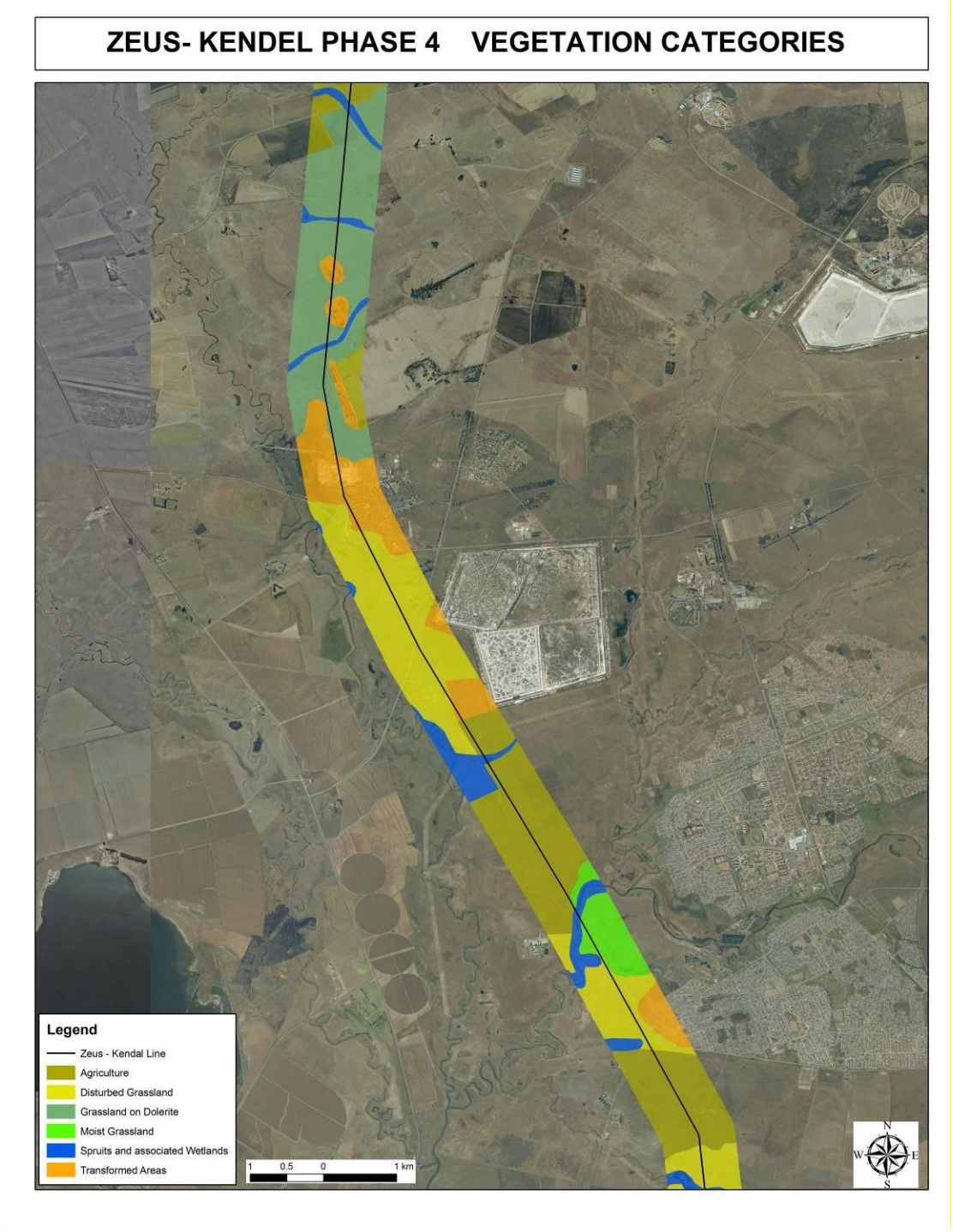


Figure 8 continued map 4: Vegetation map of the study site with the position of the powerline

## ZEUS- KENDEL PHASE 4 VEGETATION CATEGORIES

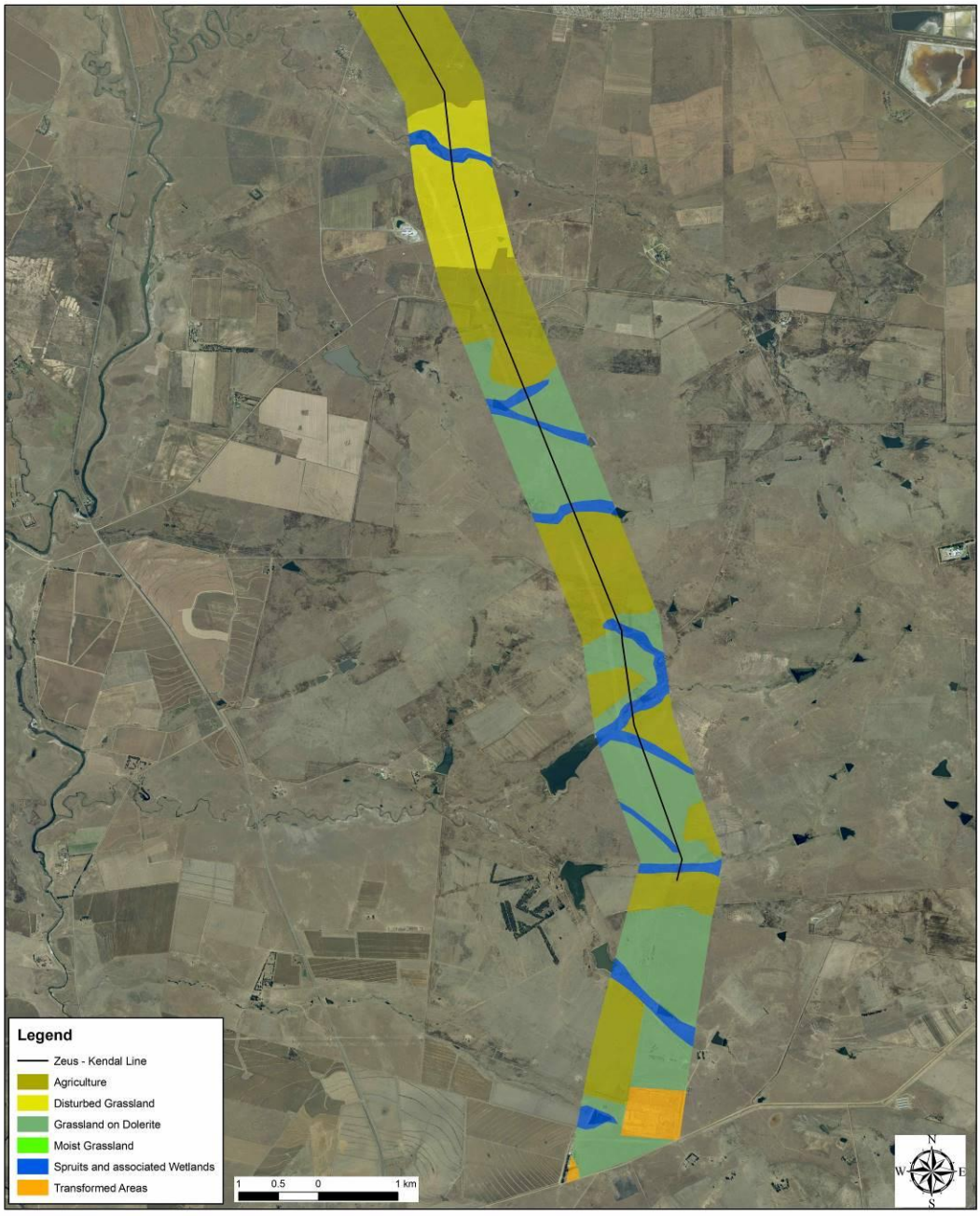

Figure 8 continued map 5: Vegetation map of the study site with the position of the powerline

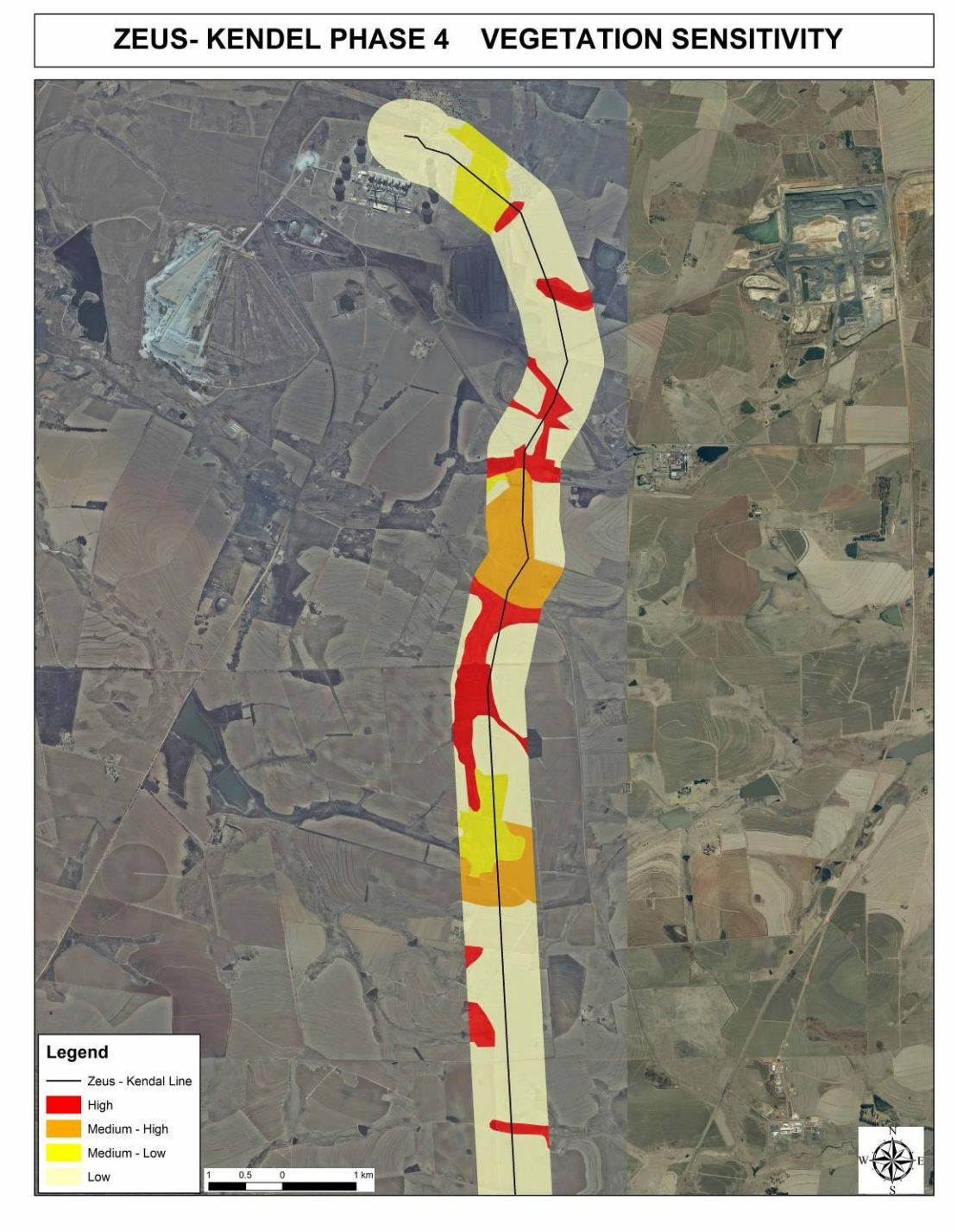


Figure 9 map 1: Sensitivity map of the study site with the position of the powerline

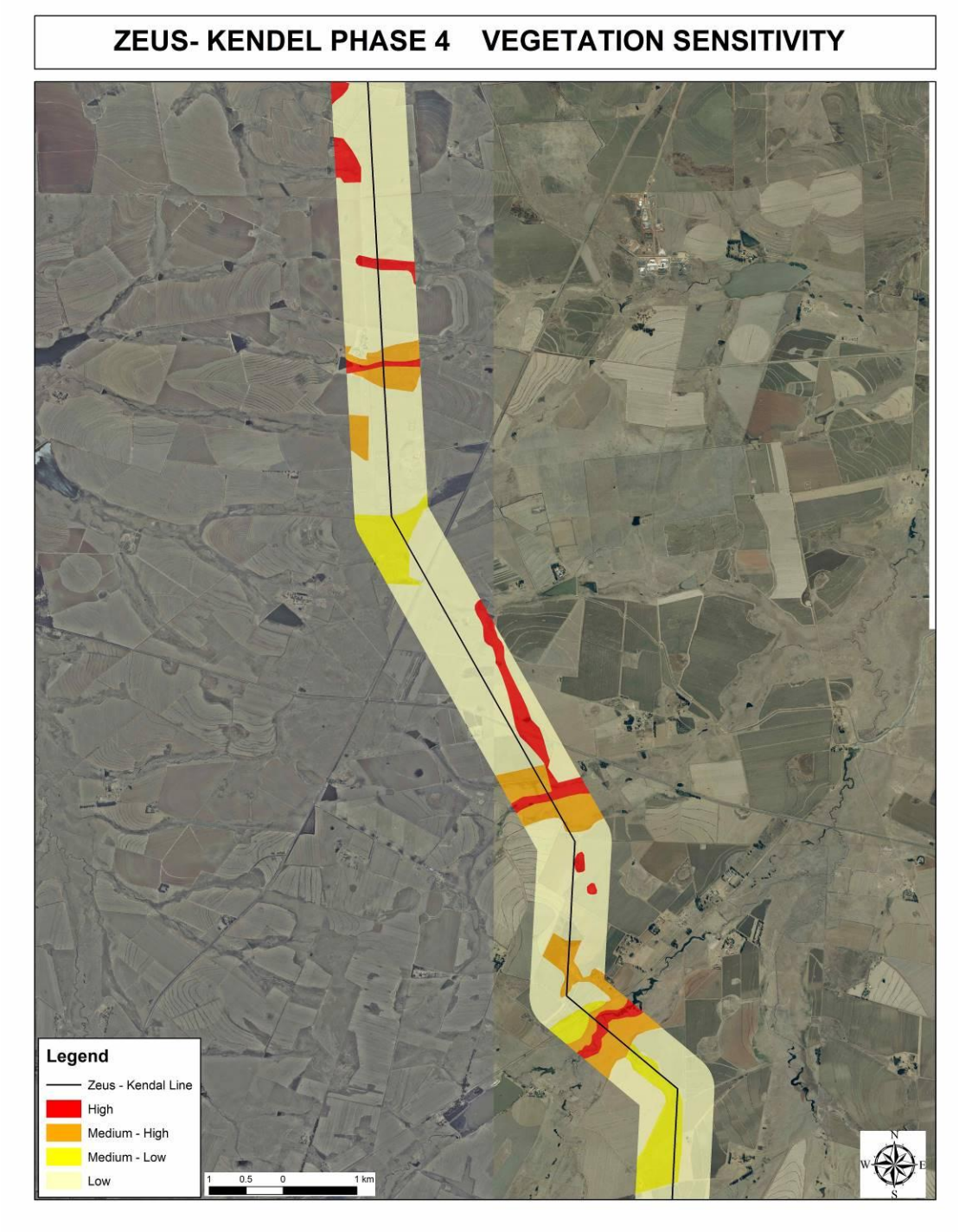


Figure 9 continued map 2: Sensitivity map of the study site with the position of the powerline


Figure 9 continued map 3: Sensitivity map of the study site with the position of the powerline

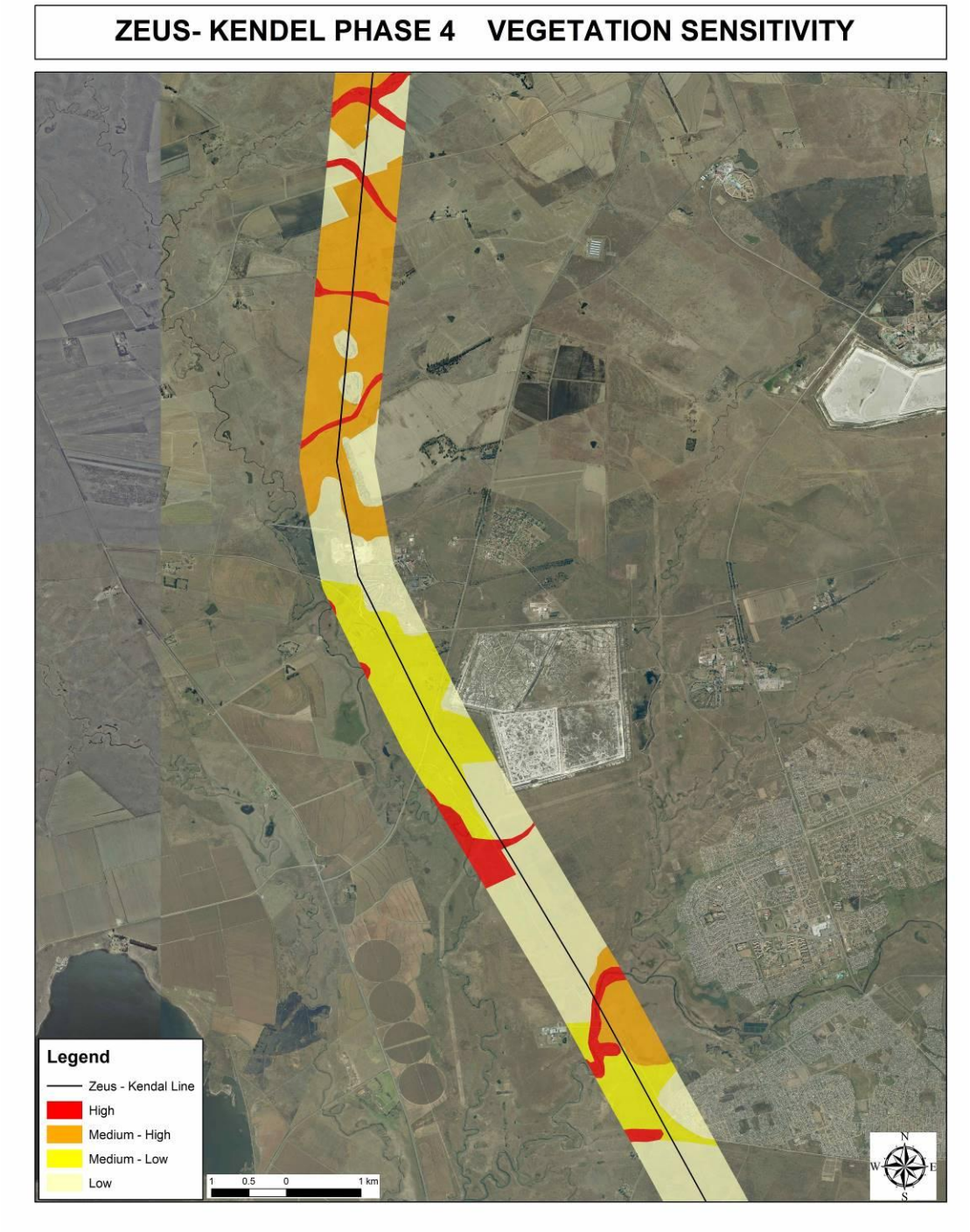


Figure 9 continued map 4: Sensitivity map of the study site with the position of the powerline

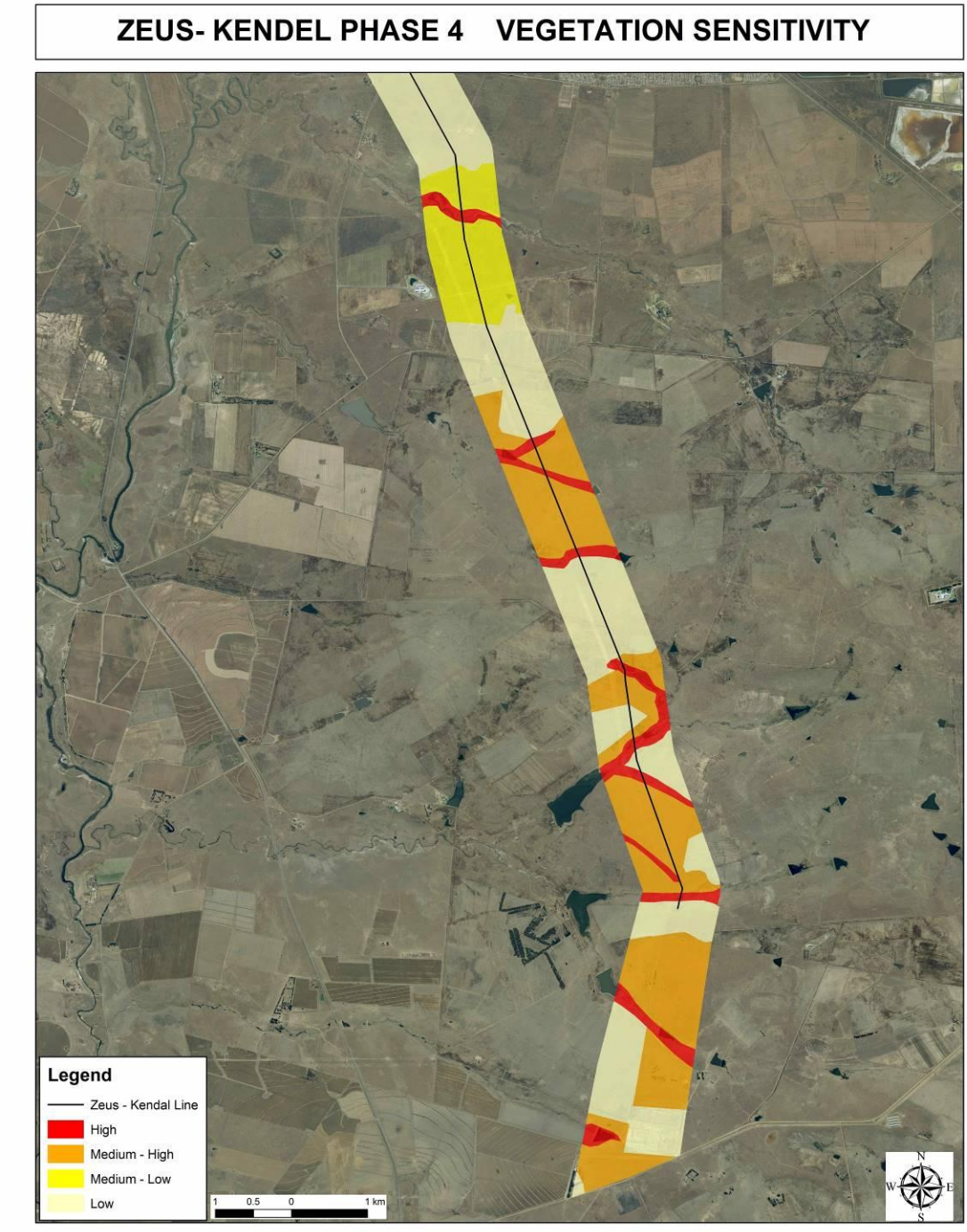


Figure 9 continued map 5: Sensitivity map of the study site with the position of the powerline

## 5. RESULTS: VEGETATION AND FLORA

### 5.1 Classification of the vegetation

The vegetation types (Mucina & Rutherford 2006) that are represented along the transect of the powerline. These are:

- The Eastern Highveld Grassland in the north and
- The Soweto Highveld Grassland in the south.

Both these vegetation types are listed as Endangered based on their current conservation status (Mucina & Rutherford, 2006) or Vulnerable by the National Biodiversity Assessment (SANBI, 2011).

The **Eastern Highveld Grassland** is associated with arenite, mostly shale and this area is coal-bearing (Figure 5). The A and B land types are typical of this area (Figure 6), with clay-loam soils highly suitable for agriculture, with the result that large areas have been ploughed for cultivation of crops. Therefore, as far as Critical Biodiversity Area goes, the transect of the powerline is mainly transformed, i.e. No Natural Habitat Remaining, or Least Concern (Figure 2). The latter mainly represents drainage lines, which are still in tact and, except for pollution, not under threat.

The transect of the powerline within the **Soweto Highveld Grassland** is mainly associated with dolerite (Figure 5), with the E land type predominant (Figure 6). The soils are vertic or close to vertic, dark-coloured smell-and-shrink clays. Limited agriculture occurs here, and consequently more natural grassland remained. Patches of Highly Significant Critical Biodiversity Areas are present, but large areas are either No Natural Habitat Remaining, or Least Concern (Figure 2).

Six mapping units were identified along the transect (Table 5.1).

**Table: Mapping units**

| Mapping units / Plant Community | Sensitivity |
|---|---|
| 1. Spruits and associated Wetlands | High |
| 2. Moist Grassland | Medium-High |
| 3. Grassland on Dolerite | Medium-High |
| 4. Disturbed Grassland | Medium-Low |
| 5. Agriculture | Low |
| 6. Transformed Areas | Low |

### 5.2 Description of the plant communities

The distribution of the plant communities identified in this study is shown in the vegetation map (Figure 8) while the sensitivity of the plant communities is indicated in Figure 9.

#### 5.2.1 Spruit and Wetland vegetation

The study area is transected and drained by several smaller tributaries that confluence to form several larger spruits (Figure 8). All these spruits and tributaries, result in a mosaic of Grassland, Moist Grasslands and Wetlands.

The main river in the northern section of the site is the Wilge River along with the Kromdraai Spruit and the Riet Spruit. All these watercourses drain primarily northwards towards the Olifants River. The southern section of the line drains into the Rolspruit and the Kaapspruit and eventually into the Vaal River. The central part of the study area is the watershed between these two large draining systems.

Wetlands are mostly found in the upper catchment areas of the drainage lines or occur on floodplain areas along the drainage lines.

The vegetation of most of the spruits and associated wetlands is mainly herbaceous, dominated by hygrophilous grass and sedges, with limited other hygrophilous forbs present. Woody vegetation is very limited, if present mostly a few alien species, not of any concern.

The most prominent alien woody species are *Salix babylonica* and *Eucalyptus* sp.

In wetter areas patches of *Typha capensis* and even *Phragmites australis* occur locally on the water edge. Within the channels the vegetation is herbaceous, mostly quite dynamic (often changes with intermittent flooding and drier periods), weedy and temporary, due to regular flooding. Locally, due to intermittent flooding, patches dominated by *Imperata cylindrica* occur. The limited flood plains occur along the larger spruit. These may become flooded during high rainfall periods, resulting in wetland vegetation.

The spruit vegetation is typical of spruits in the area, often with *Salix babylonica* and locally with *Eucalyptus* sp *Populus x canescens* and *Populus alba*. The sedges *Cyperus congestus* and *Cyperus longus* are locally prominent, and often with patches of *Typha capensis, Persicaria serrulata* and *Rumex crispus*. In many cases where the spruit banks are deeply cut, the grassland with grassland species occur up to the spruit edges.

| **Spruits and wetlands summary** | | | |
|---|---|---|---|
| **Status** | Spruit and wetland | | |
| **Soil** | Black vertic to near-vertic clay | **Rockiness** | 0% |
| **Conservation value:** | High | **Ecological sensitivity** | High |
| **Species richness** | Low | **Need for rehabilitation** | Low |
| **Dominant spp.** | *Cyperus* sp, hygrophilous grasses, *Typha capensis* | | |

The following plant species were recorded in this plant community:

**Trees and shrubs, dwarf shrubs**

| | | | |
|---|---|---|---|
| E*ucalyptus* sp | A | *Salix babylonica* | A |
| *Populus alba* | A | *Stoebe vulgaris* | |
| *Populus x canescens* | A | | |

**Grasses and sedges**

| | | | |
|---|---|---|---|
| *Agrostis continuata* | | *Eragrostis gummiflua* | |
| *Agrostis lachnantha* | | *Eragrostis plana* | D |
| *Andropogon eucomus* | | *Hemarthria altissima* | |
| *Brachiaria eruciformis* | | *Heteropogon contortus* | |
| *Cymbopogon caesius* | | *Hyparrhenia dregeana* | d |
| *Cynodon dactylon* | | *Hyparrhenia hirta* | d |
| *Cyperus longus* | | *Imperata cylindrica* | |
| *Cyperus spp* | | *Leersia hexandra* | |
| *Eragrostis chloromelas* | | *Leptochloa fusca* | |
| *Eragrostis curvula* | d | *Paspalum dilatatum* | |

| | | | |
|---|---|---|---|
| *Paspalum distichum* | | *Setaria sphacelata* | |
| *Paspalum scrobiculatum* | | *Sporobolus africanus* | |
| *Pennisetum clandestinum* | A | *Sporobolus pyramidalis* | |
| *Pennisetum thunbergii* | | *Themeda triandra* | |
| *Phragmites australis* | | *Typha capensis* | |
| *Schoenoplectus corymbosus* | | | |

**Forbs**

| | | | |
|---|---|---|---|
| *Berkheya radula* | | *Juncus effusus* | |
| *Berkheya sp* | | *Lobelia sp* | |
| *Bidens bipinnata* | W | *Lotononis sp* | |
| *Bulbostylis hispidula* | | *Monopsis decipiens* | |
| *Carex sp* | | *Nemesia fruticans* | |
| *Centella asiatica* | M | *Oenothera rosea* | |
| *Cirsium vulgare* | W | *Oenothera tetraptera* | |
| *Conium chaerophylloides* | | *Persicaria lapathifolia* | |
| *Conyza podocephala* | | *Persicaria serrulata* | |
| *Cosmos formosa* | W | *Plantago lanceolata* | W |
| *Crinum bulbispermum* | RD | *Ranunculus multifidus* | |
| *Crotalaria sp* | | *Rumex crispus* | W |
| *Cyperus congestus* | | *Schkuhria pinnata* | WM |
| *Cyperus laevigatus* | | *Schoenoplectus corymbosus* | |
| *Cyperus longus* | | *Senecio inaequalis* | |
| *Eleocharis sp* | | *Senecio inornatus* | |
| *Equisetum ramosissimum* | | *Solanum panduriforme* | |
| *Fuirena pubescens* | | *Tagetes minuta* | W |
| *Gomphocarpus fruticosus* | W | *Typha capensis* | |
| *Haplocarpha lyrata* | | *Verbena bonariensis* | W |
| *Helichrysum nudifolium* | | *Wahlenbergia caledonica* | |

**Number of species**

| | Indigenous | Aliens / Weeds | Total | Red Data | Protected | Medicinal |
|---|---|---|---|---|---|---|
| **Trees and shrubs** | 1 | 4 | 5 | 0 | 0 | 0 |
| **Grasses and sedges** | 30 | 1 | 31 | 0 | 0 | 0 |
| **Forbs** | 33 | 9 | 42 | 1 | 0 | 2 |
| **Total** | 64 | 14 | 78 | 1 | 0 | 2 |

**Conclusion**

As they form part of the drainage system, rivers and spruits are regarded as ecologically sensitive. The high sensitivity of the spruits' systems does not only lie in its very high plant species richness, rather in its ecological function of draining and transport of water, and the importance of water in South Africa. Nevertheless, it does form a special habitat for fauna and flora; therefore, as considered as having high conservation value and high sensitivity. Of some concern is the presence of a few red data plants (*Crinum bulbispermum*) observed at few localities. This species is classified as Near Threatened indicating that is approaching thresholds for listing as threatened but there are still a number of subpopulations in existence and therefore there is need to minimise loss of habitat (Driver *et al*, 2009). It is however highly improbable that any pylon will damage this plant species.

The powerlines will easily span across the river and spruits, and will not affect the vegetation of the banks or wetland negatively. Care should be taken to avoid damage to the streams and stream banks. The pylons should be located far enough from the banks to avoid damage. Any damage caused to the spruits and spruit banks by the construction, should immediately be rehabilitated.

It was observed in previous studies that grassland vegetation is actually protected under Eskom powerlines, as no other grassland destructive developments can occur here.

Figure 10a: A collage of photographs of spruits in the study area

Figure 10: Some wetlands in the area

### 5.2.2. Moist Grassland

Much of the vegetation that remained natural on the powerline route is low-lying Moist Grassland, merging into wetland conditions. Generally these can rather be regarded as grassland in the shallow valley bottoms, with a narrow seasonal drainage line. Due to wetness, these areas are not suitable for agriculture and were consequently not ploughed. The Moist Grasslands occur along to spruits, sometimes merging into wetland on the flood plains of the spruits. Often the most prominent plant species is *Eragrostis plana*, but other grass species. Only few alien planted trees occur in this grassland and the grass layer has a high cover, but is mostly grazed by cattle. The most prominent grass species are *Eragrostis curvula* and *Eragrostis plana* and only few forb species are present.

Figure 11: Moist Grassland in the valley bottom in the background.

| **Moist Grassland summary** | | | |
|---|---|---|---|
| **Status** | Grassland merging to wetland conditions | | |
| **Soil** | Brown to Black clay | **Rockiness** | 0% |
| **Conservation value:** | Medium-High | **Ecological sensitivity** | Medium-High |
| **Species richness** | High | **Need for rehabilitation** | Low |
| **Dominant spp.** | *Eragrostis curvula, Eragrostis chloromelas, Eragrostis plana, Heteropogon contortus* | | |

The following plant species were recorded in this plant community:

**Trees, Shrubs and Dwarf shrubs**

| | | | |
|---|---|---|---|
| *Eucalyptus* sp | A | *Stoebe vulgaris* | |

**Grasses and sedges**

| | | | |
|---|---|---|---|
| *Aristida congesta* | | *Eragrostis curvula* | d |
| *Aristida diffusa* | | *Eragrostis gummiflua* | |
| *Aristida junciformis* | | *Eragrostis plana* | D |
| *Cymbopogon caesius* | | *Heteropogon contortus* | d |
| *Cynodon dactylon* | | *Hyparrhenia dregeana* | |
| *Digitaria eriantha* | | *Hyparrhenia hirta* | d |
| *Elionurus muticus* | | *Sporobolus africanus* | |
| *Eragrostis chloromelas* | d | *Themeda triandra* | |

**Forbs**

| | | | |
|---|---|---|---|
| *Acalypha angustifolia* | | *Hilliardiella natalensis* | |
| *Anthospermum hispidulum* | | *Hilliardiella oligocephala* | |
| *Berkheya onopordifolia* | | *Hypoxis rigidula* | |
| *Berkheya radula* | | *Hypochaeris radicata* | |
| *Berkheya setifera* | | *Ledebouria* sp | |
| *Commelina africana* | | *Lotononis* sp | |
| *Conyza podocephala* | | *Pelargonium luridum* | |
| *Dicoma anomala* | | *Plantago lanceolata* | |
| *Gerbera ambigua* | | *Schkuhria pinnata* | WM |
| *Gladiolus crassifolius* | M | *Schistostephium crataegifolium* | |
| *Gomphocarpus fruticosus* | W | *Senecio inornatus* | |
| *Haplocarpha lyrata* | | *Solanum incanum* | |
| *Helichrysum miconiifolium* | | *Solanum panduriforme* | |
| *Helichrysum nudifolium* | | *Tagetes minuta* | W |
| *Helichrysum rugulosum* | d | *Tephrosia capensis* | |
| *Hermannia betonicifolia* | | *Trachyandra cf gerrardiiW* | |
| *Hermannia depressa* | | *Verbena bonariensis* | |
| *Hibiscus aethiopica* | | | |

**Number of species**

| | Indigenous | Aliens / Weeds | Total | Red Data | Protected | Medicinal |
|---|---|---|---|---|---|---|
| **Trees and shrubs** | 1 | 1 | 2 | 0 | 0 | 0 |
| **Grasses and sedges** | 16 | 0 | 16 | 0 | 0 | 0 |
| **Forbs** | 32 | 3 | 35 | 0 | 0 | 2 |
| **Total** | 49 | 4 | 53 | 0 | 0 | 2 |

**Discussion**

This grassland is currently used for grazing of cattle, and is mostly shortly grazed and locally trampled. This area is often adjacent to the spruits, and may merge into intermittently flooded floodplain. Development of the powerline on this vegetation may be supported.

### 5.2.3. Grassland on Dolerite

This grassland is restricted to the central parts of the study site, for about 10 km south of the N17, and southern parts, just north of the Zeus substation (Figure 8). on the higher-lying areas of the slightly undulating plains, an where the land has not been ploughed for agriculture. The vegetation is often grazed and sometimes disturbed and degraded, but normally has a high grass cover (Figure 12). Due to the dense grass layer very few forb species and individuals occur. Alien trees occur at the farmsteads. The grassland is dominated by patches of *Themeda triandra, Eragrostis curvula* and *Eragrostis plana.* Herbaceous forbs are quite rare in this vegetation.

**Figure 12: Grassland on dolerite – left, dense grass cover, right, degraded with bare soil. Note the dark coloured soil.**

The most prominent species include:

**Trees Shrubs and Dwarf shrubs**

| | | | |
|---|---|---|---|
| *Eucalyptus* sp | A | *Stoebe vulgaris* | |

**Grasses and Sedges**

| | | | |
|---|---|---|---|
| *Aristida congesta* | | *Eragrostis plana* | D |
| *Aristida diffusa* | | *Heteropogon contortus* | |
| *Aristida junciformis* | | *Hyparrhenia hirta* | d |
| *Cynodon dactylon* | | *Hyparrhenia dregeana* | |
| *Eragrostis capensis* | | *Setaria sphacelata* | |
| *Eragrostis chloromelas* | d | *Sporobolus africanus* | |
| *Eragrostis curvula* | d | *Themeda triandra* | |
| *Eragrostis gummiflua* | | | |

**Forbs**

| | | | |
|---|---|---|---|
| *Anthospermum hispidulum* | | *Schkuhria pinnata* | MW |
| *Berkheya onopordifolia* | | *Senecio erubescens* | |
| *Berkheya* sp | | *Senecio inaequalis* | |
| *Chamaecrista mimosoides* | | *Tagetes minuta* | W |
| *Conyza podocephala* | | *Tephrosia capensis* | |
| *Eriosema cordatum* | | | |
| *Felicia muricata* | | | |
| *Gazania krebsiana* | | | |
| *Geigeria burkei* | | | |
| *Helichrysum nudifolium* | | | |
| *Helichrysum rugulosum* | | | |
| *Hermannia betonicifolia* | | | |
| *Hermannia depressa,* | | | |
| *Hypochaeris radicata* | | | |
| *Indigofera zeyheri* | | | |
| *Ipomoea crassipes* | | | |
| *Lactuca inermis* | | | |
| *Monopsis decipiens* | | | |
| *Rhynchosia totta* | | | |

**Number of species**

| | Indigenous | Aliens / Weeds | Total | Red Data | Protected | Medicinal |
|---|---|---|---|---|---|---|
| **Trees and shrubs** | 1 | 1 | 2 | 0 | 0 | 0 |
| **Grasses and sedges** | 15 | 0 | 15 | 0 | 0 | 0 |
| **Forbs** | 22 | 2 | 24 | 0 | 0 | 1 |
| **Total** | 38 | 3 | 41 | 0 | 0 | 1 |

| **Grassland on dolerite summary** | | | |
|---|---|---|---|
| **Status** | Grazed and Disturbed grassland | | |
| **Soil** | Clay loam | **Rockiness %** | 0-1 |
| **Conservation priority:** | Medium-High | **Sensitivity:** | Medium-High |
| **Species Richness:** | Medium | **Need for rehabilitation** | Low |
| **Dominant spp.** | *Eragrostis curvula, Eragrostis chloromelas, Hyparrhenia dregeana* | | |

**Discussion**

The species richness in this area is medium, probably due to its disturbed condition. The development of the powerline can be supported.

### 5.2.4. Disturbed Grassland

This grassland is mainly located in the northern and central southern parts of the study site (Figure 8), within the Eastern Highveld Grassland and Soweto Highveld Grassland. In this area most of the land has been ploughed for cultivation. Areas not ploughed are found scattered and in isolated patches, and these are often disturbed and overgrazed. This is short grassland and weeds are often prominent (Figure 13). The most prominent species are the grasses *Eragrostis curvula, Eragrostis chloromelas, Cynodon dactylon* and

*Hyparrhenia hirta.* The alien trees *Acacia mearnsii, Acacia dealbata* and *Eucalyptus* sp are often present, as individual trees or in groups or plantations.

**Trees and shrubs**

| | | | |
|---|---|---|---|
| *Acacia dealbata* | A | *Solanum mauritianum* | A |
| *Acacia mearnsii* | A | *Stoebe vulgaris* | |
| *Eucalyptus* sp | A | | |

**Grasses**

| | | | |
|---|---|---|---|
| *Aristida aequiglumis* | | *Harpochloa falx* | |
| *Aristida congesta* | | *Heteropogon contortus* | |
| *Brachiaria serrata* | | *Hyparrhenia hirta* | d |
| *Cynodon dactylon* | | *Melinis repens* | |
| *Digitaria eriantha* | | *Microchloa caffra* | |
| *Elionurus muticus* | | *Paspalum dilatatum* | |
| *Eragrostis capensis* | | *Setaria sphacelata* | |
| *Eragrostis chloromelas* | d | *Sporobolus africanus* | |
| *Eragrostis curvula* | d | *Themeda triandra* | d |
| *Eragrostis gummiflua* | | *Trachypogon spicatus* | |
| *Eragrostis plana* | d | *Tristachya leucothrix* | |
| *Eragrostis racemosa* | | | |

**Forbs**

| | | | |
|---|---|---|---|
| *Albuca glauca* | | *Cyperus obtusifolius* | |
| *Anthericum fasciculatum* | | *Dicoma anomala* | |
| *Anthospermum hispidulum* | | *Felicia muricata* | |
| *Asparagus africanus* | | *Gazania krebsiana* | |
| *Becium obovatum* | | *Gnidia capitata* | |
| *Berkheya pinnatifida* | | *Gomphrena celosioides* | W |
| *Berkheya radula* | | *Haplocarpha scaposa* | |
| *Berkheya setifera* | | *Helichrysum nudifolium* | |
| *Bidens bipinnata* | W | *Helichrysum rugulosum* | |
| *Cosmos pinnata* | W | *Hermannia betonicifolia* | |
| *Guilleminea densa* | W | *Hermannia depressa* | |
| *Chamaecrista mimosoides* | | *Hilliardiella oligocephala* | |
| *Conyza bonariensis* | W | *Hypoxis hemerocallidea* | RD, M |
| *Conyza podocephala* | | *Hypoxis rigidula* | |

| | | | |
|---|---|---|---|
| *Hypoxis* sp | | *Polygala hottentotta* | |
| *Indigofera* sp | | *Pygmaeothamnus zeyheri* | |
| *Justicia anagalloides* | | *Scabiosa columbaria* | M |
| *Ledebouria marginata* | | *Schkuhria pinnata* | W |
| *Ledebouria sp* | | *Senecio erubescens* | |
| *Oenothera tetraptera* | W | *Senecio inaequilatera* | W |
| *Oxalis depressa* | | *Senecio inornatus* | |
| *Pelargonium luridum* | | *Tagetes minuta* | W |
| *Pentanisia angustifolia* | | | |

Although *Hypoxis hemerocallidea* is classified as a **Red Data species**, the category of this plant is **Declining**, due to its medicinal value. Its presence is not considered as a problem for the line. The chances that these plants will be damaged by the construction of the line are very low. The species richness is Medium.

**Number of species**

| | **Indigenous** | **Aliens / Weeds** | **Total** | **Red Data** | **Protected** | **Medicinal** |
|---|---|---|---|---|---|---|
| **Trees and shrubs** | 1 | 4 | 5 | 0 | 0 | 0 |
| **Grasses and sedges** | 23 | 0 | 23 | 0 | 0 | 0 |
| **Forbs** | 27 | 0 | 45 | 1 | 0 | 2 |
| **Total** | 36 | 6 | 42 | 1 | 0 | 2 |

Figure 13: Disturbed Grassland

| Disturbed Grassland summary | | | |
|---|---|---|---|
| **Status** | Primary and secondary disturbed and degraded grassland | | |
| **Soil** | Sandy loam | **Rockiness %** | 1-5 |
| **Conservation priority:** | Medium-Low | **Sensitivity:** | Medium-Low |
| **Species Richness:** | Medium | **Need for rehabilitation** | medium |
| **Dominant spp.** | *Eragrostis chloromelas, Eragrostis curvula, Cynodon dactylon, Hyparrhenia hirta* | | |

**Discussion**

The powerline can be supported.

### 5.2.5. Agriculture areas

Large part of the study site is currently used for production of maize or soybeans (Figure 14), and no indigenous plant species were noted on the ploughed land. Only a few weeds were noted.

Old fields occur in some areas and these are covered with secondary grassland with few plant species present, often dominated by *Eragrostis plana* and *Eragrostis chloromelas*. The tall-growing grass *Hyparrhenia hirta* is present forming typical isolated clumps.


Figure 14: Agriculture

The most prominent species include:

**Trees Shrubs and Dwarf shrubs**

None

**Grasses and Sedges**

| | | | |
|---|---|---|---|
| *Aristida congesta* | | *Hyparrhenia hirta* | d |
| *Cynodon dactylon* | | *Paspalum dilatatum* | |
| *Eragrostis chloromelas* | d | *Pogonarthria squarrosa* | |
| *Eragrostis plana* | d | | |

**Forbs**

| | | | |
|---|---|---|---|
| *Solanum panduriforme* | | *Verbena bonariensis* | W |

**Number of species**

| | Indigenous | Aliens / Weeds | Total | Red Data | Protected | Medicinal |
|---|---|---|---|---|---|---|
| **Trees and shrubs** | 0 | 0 | 0 | 0 | 0 | 0 |
| **Grasses and sedges** | 7 | 0 | 7 | 0 | 0 | 0 |
| **Forbs** | 1 | 1 | 2 | 0 | 0 | 0 |
| **Total** | 8 | 1 | 9 | 0 | 0 | 0 |

| **Agriculture areas summary** | | | |
|---|---|---|---|
| **Status** | Transformed | | |
| **Soil** | Sandy loam | **Rockiness %** | 0 |
| **Conservation priority:** | Low | **Sensitivity:** | Low |
| **Species Richness:** | Low | **Need for rehabilitation** | Low |
| **Dominant spp.** | *Eragrostis plana, Eragrostis chloromelas, Hyparrhenia hirta* | | |

**Discussion**

These areas are transformed and have no conservation value and low ecological sensitivity. Most of the planned mining infrastructure will fall within the agricultural field of the farm.

### 5.2.6. Transformed areas

The transformed areas include buildings, construction areas, mines and alien species plantations (Figure 15) where the natural vegetation has been destroyed. Only few weedy species, alien trees and planted ornamental species are found in these areas and the vegetation is not discussed further.

Figure 15: Transformed areas Left, Kendall power station, right Zeus substation

### 5.3 Species of Conservation Concern

A list of Species of Conservation Concern for the grids 2628BB, 2629 AC and 2629 CA was obtained from the database on the SANBI website (Table 5.2).

Threatened species are those that are facing high risk of extinction, indicated by the categories Critically Endangered (CE), Endangered (EN) and Vulnerable (VU). Species of Conservation Concern include the Threatened Species, but additionally have the categories Near Threatened (NT), Data Deficient (DD), Critically Rare (CR), Rare (R) and Declining (D). This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009).

**Table: Red data species listed from grids 2629 BD and 2629 DB by SANBI (POSA, 2016 website)**

| Family | Species | Status |
|---|---|---|
| Asphodelaceae | *Kniphofia typhoides* Codd | NT |
| Apocynaceae | *Stenostelma umbelluliferum* (Schltr.) S.P.Bester & Nicholas | NT |
| Asphodelaceae | *Trachyandra erythrorrhiza* (Conrath) Oberm. | NT |
| Amaryllidaceae | *Nerine gracilis* R.A.Dyer | VU |
| Apiaceae | *Alepidea peduncularis* A.Rich. | DDT |
| Asteraceae | *Callilepis leptophylla* Harv. | Declining |
| Amaryllidaceae | *Boophone disticha* (L.f.) Herb. | Declinin |

| | | |
|---|---|---|
| | | g |
| Amaryllidaceae | *Crinum bulbispermum* (Burm.f.) Milne-Redh. & Schweick. | Declining |

Eight plant species of conservation concern were previously recorded from the grids 2628BB, 2629 AC and 2629 CA, listed by SANBI. Two of these were recorded on the study site during the field survey, namely *Boophone disticha* and *Crinum bulbispermum* (Figure 16). It is however possible that all the above species are present in the general area, but less probable within the narrow servitude of the powerline. There is suitable habitat on the site for all these species. (An exception is *Nerine gracilis*, which is probably not present in the Eskom servitude). The Declining species (*Crinum bulbispermum* and *Boophone disticha*) has not yet reached a threshold of concern and therefore limited loss of habitat may be permitted. (Driver *et al.*, 2009).

Figure 16 The red data species *Boophone disticha* (left) and *Crinum bulbispermum* (right)

### 5.4 Protected species

No Nationally Protected tree (National Forests Act 1998) or NEMBA plant species (Government Notice No. 2007, National Environmental Management: Biodiversity Act, 2004) occur within the area.

No further plant provincially protected by the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998), were recorded during the survey.

### 5.5 Alien species

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants controlled and eradicated by means of an eradication and

monitoring program. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The amended Regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) identifies three categories of problem plants:

Category 1 (Declared weeds): plants may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish plant, maintain, propagate or sell/import any category 1 plant species;

Category 2 (Declared invaders): plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled; and

Category 3 (Declared invaders): plants are ornamentally used and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30 m of a 1:50 year flood line and must be prevented from spreading.

In addition, a second draft of the Alien and Invasive Species Regulations, as well as a new draft list of categories of invasive species in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) was published in the Government Gazette No. 32090, in April 2009. Any species designated under section 70 cannot be propagated, grown, bought or sold by the industry without a permit. Whereas CARA previously classified problem plants into two groups - declared weeds and plant invaders - the amended regulations make provision for four groups: declared weeds (Category 1 plants), plant invaders (Category 2 and Category 3 plants) and indicators of bush encroachment. The first three groups consist of undesirable alien plants and are covered by Regulation 15. Bush encroachers, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
Category 1b: Invasive species requiring compulsory control as part of an invasive species control program. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management program. No permits will be issued.
Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

In terms of the amendments to the regulations under the Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983) and Regulation 598, Government Gazette 37885, August 2014)(Alien and Invasive Species Regulations), landowners are legally responsible for the control of alien species on their properties.

Some alien woody plants were found on the site. Locally, especially along the spruit and in developed areas, alien invader trees are present. Species listed as declared invasive plants (Henderson 2001) that should be removed and controlled (Conservation of Agricultural Resources Act (Act 43 of 1983) include:

| | |
|---|---|
| *Eucalyptus* sp | Category 2 |
| *Acacia mearnsii / Acacia dealbata* | Category 2 |
| *Populus x canescens* | Category 2 |
| *Populus alba* | Category 2 |
| *Solanum mauritianum* | Category 1 |

The ever present *Tagetes minuta, Bidens bipinnata* and a few other weeds were recorded from the site.

### 5.6 Medicinal plants

Very limited important medicinal plants were recorded from the site. These plants are labelled “M” in the description of the plant communities.

### 5.7 Vegetation importance and Ecological sensitivity

The spruits and wetlands have High ecological sensitivity, The disturbed grassland type Medium-Low and the primary grassland types Medium-High ecological sensitivity. The transformed areas and agricultural areas have Low ecological sensitivity

**Table: Sensitivity scoring of vegetation that occurs within the study area.**

| Vegetation | Conservation Status of regional Vegetation unit | Listed Ecosystem | Legislated Protection | Plants species of conservation concern | Ecological Function | Conservation Importance | Total Score out of max of 18 |
|---|---|---|---|---|---|---|---|
| **Transformed areas, alien vegetation mapping units 5 & 6** | Not applicable No natural vegetation Score 0 | | 0 | 0 | 1 | 0 | **1 Low** |
| **Spruits and associated wetlands, mapping unit 1** | 3 | 3 | 3 | 2 | 3 | 3 | **17 Medium-High** |
| **Grassland, mapping units 2 & 3** | **3** | **2** | **1** | **2** | **2** | **2** | **12Medium-High** |
| **Disturbed Grassland, mapping unit 4** | **3** | **1** | **1** | **1** | **1** | **1** | **8 Medium-Low** |

# 6. IMPACT ASSESSMENT: IMPACTS ON VEGETATION AND FLORA

## 6.1 Methods

The methods and format of the impact tables used in this chapter are in accordance to the requirements of the 2014 Regulations.

» The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.

» The **probability (P)** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

» The **duration (D)**, wherein it will be indicated whether:

- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5;

» The **extent (E)**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

» The **magnitude (M)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» the **significance (S)**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;

- the significance rating is calculated by the following formula:

  **S (significance) = (D + E + M) x (P)**

» the **status**, which will be described as either positive, negative or neutral.

» the degree to which the impact can be reversed.

» the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

Impacts should be identified for the construction and operational phases of the proposed development. Proposed mitigation measures should be practical and feasible such that they can be realistically implemented by the applicant.

### 6.2 Impacts on the vegetation and flora of the site

The ecological sensitivity for each mapping unit is summarised in Table 5.1.

The ecological sensitivity of the Agricultural Areas and Transformed Areas (mapping units 5 and 6) is considered to be **Low** (see description of vegetation, Chapter 5). This is mainly due to the transformed status of the vegetation within these mapping units. The **significance of the impact** of the proposed development on this vegetation is therefore considered to be **Low,** and is not further analysed. From vegetation and flora point of view, the proposed powerlines on this area can unconditionally be supported.

However, the vegetation of Moist Grassland (mapping unit 2) and of Grassland on Dolerite (mapping unit 3) is primary with a **Medium-High** ecological sensitivity, while the vegetation of Disturbed Grassland has **Medium-Low ecological sensitivity.**

Impacts on vegetation are therefore discussed for the following mapping units:

- Spruits and associated Wetlands combined
- Moist Grassland and Grassland on Dolerite combined
- Disturbed Grassland

### 6.2.1 Spruits and associated Wetlands

**Table 6.1: Loss of indigenous vegetation or indigenous plant species due to clearing for construction of pylons and the powerline**

***Nature:*** Spruits and wetlands will be crossed by the powerlines. From a walk-down study it was indicated that the great majority pylons do not occur within spruits or wetlands, but a few were placed in or close to a wetland. Hoare recommended that all pylons that were too close to a wetland be moved slightly. This implies that the footprint areas of construction of the pylons are actually outside any spruit or wetland, and will therefore have very little impact. The distance between pylons is adequately long so spruits and wetland can easily be crossed without damaging any of them. Therefore it is envisaged that the powerline and pylons will have very little impact on spruits and wetlands.

| | **Without mitigation** | | **With mitigation** | |
|---|---|---|---|---|
| **CONSTRUCTION PHASE** | | | | |
| ***Probability*** | Very improbable | 1 | Very improbable | 1 |
| ***Duration*** | Short term | 2 | Short term | 2 |
| ***Extent*** | Regional | 5 | Regional | 5 |
| ***Magnitude*** | Minor | 2 | No effect | 0 |
| ***Significance*** | **Low (negligible)** | **9** | **Low (negligible)** | **7** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| **OPERATIONAL PHASE** | | | | |
| ***Probability*** | Very improbable | 1 | Very improbable | 1 |
| ***Duration*** | Permanent | 5 | Permanent | 5 |
| ***Extent*** | Regional | 5 | Regional | 5 |
| ***Magnitude*** | Low | 4 | Minor | 2 |
| ***Significance*** | **Low (negligible)** | **14** | **Low (negligible)** | **12** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| | | | | |
| ***Reversibility*** | Low | | Medium | |
| ***Irreplaceable loss of resources?*** | Low | | Low | |
| ***Can impacts be mitigated?*** | Yes | | | |

***Mitigation:***

- Limit disturbance close to spruit and wetland to a minimum.
- Rehabilitate disturbances close to spruits ;and wetland immediately
- Do not remove any spruit or wetland vegetation putting up the lines;
- Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas
- Remove and control all alien woody plant species that may appear during construction and operational phases
- Avoid erosion at spruits at all times

***Cumulative impacts:*** Expected that very little accumulative effects will occur at spruits and wetland. .

***Residual Risks:*** . None is anticipated provided that the mitigation measures are implemented correctly.

Notes:

- As the spruits and wetlands are actually avoided for pylon construction, no or very little impact on the vegetation of these systems is expected to occur
- Removal of alien woody species is of advantage to the environment.

**Table 6.2: Increase of alien invasive plant species within spruits and wetlands**

| | | | | |
|---|---|---|---|---|
| ***Nature:*** Spruits are major transport systems for seeds and other propagules of plants, particularly alien invasive plant species. Should disturbance occur in or close to spruits and wetlands, an increase in alien species will occur within these ecosystems | | | | |
| | **Without mitigation** | | **With mitigation** | |
| **CONSTRUCTION PHASE** | | | | |
| ***Probability*** | Probable | 3 | Improbable | 2 |
| ***Duration*** | Short term | 2 | Short-term | 2 |
| ***Extent*** | Regional | 5 | Regional | 5 |
| ***Magnitude*** | High | 5 | Low | 2 |
| ***Significance*** | **Moderate** | **36** | **Low** | **18** |
| ***Status (positive or negative)*** | Negative | | Positive | |
| **OPERATIONAL PHASE** | | | | |
| ***Probability*** | Improbable | 2 | Very Improbable | 1 |
| ***Duration*** | Permanent | 5 | Permanent | 5 |
| ***Extent*** | Regional | 5 | Regional | 5 |
| ***Magnitude*** | Low | 2 | Low | 1 |
| ***Significance*** | **Low** | **24** | **Low** | **11** |
| ***Status (positive or negative)*** | Negative | | Positive | |
| | | | | |
| ***Reversibility*** | Moderate | | High | |
| ***Irreplaceable loss of resources?*** | Moderate | | Low | |
| ***Can impacts be mitigated?*** | Yes | | | |
| ***Mitigation:***<br>• An alien invasive management programme must be incorporated into the Environmental Management Programme;<br>• Ongoing alien plant control must be undertaken;<br>• Areas which have been disturbed will be quickly colonised by invasive alien species. An ongoing management plan **must** be implemented for the clearing/eradication of alien species.<br>• Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. | | | | |
| ***Cumulative impacts:*** Moderate, should mitigation measure not be implemented. Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity, change ecosystem services and processes e.g. change nutrient cycling and productivity, and modify food webs. | | | | |

| |
|---|
| ***Residual Risks:*** Establishment and increase of woody alien species pose an ecological threat, especially along spruits. None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken. |

### 6.2.2 Moist Grassland and Grassland on Dolerite

**Table 6.3: Loss of indigenous vegetation due to clearing for construction pylons and the powerline**

| | | | | |
|---|---|---|---|---|
| ***Nature:*** The area of the footprint for every pylon will be cleared of vegetation. This may result in the loss of indigenous species, disturbance of plant species and the fragmentation of plant communities (though the areas to be cleared are small and isolated). The removal of vegetation will also expose soil increasing the risk of erosion.. | | | | |
| | **Without mitigation** | | **With mitigation** | |
| **CONSTRUCTION PHASE** | | | | |
| ***Probability*** | Definite | 5 | Definite | 5 |
| ***Duration*** | Short-term | 2 | Short-term | 2 |
| ***Extent*** | Limited to Sites | 1 | Limited to Sites | 1 |
| ***Magnitude*** | Low | 4 | Low | 3 |
| ***Significance*** | **Medium** | **35** | **Low** | **30** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| **OPERATIONAL PHASE** | | | | |
| ***Probability*** | Definite | 5 | Definite | 5 |
| ***Duration*** | Permanent | 5 | Permanent | 5 |
| ***Extent*** | Limited to Site | 1 | Limited to Site | 1 |
| ***Magnitude*** | Moderate | 3 | Low | 1 |
| ***Significance*** | **Medium** | **45** | **Medium** | **35** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| | | | | |
| ***Reversibility*** | Medium | | High | |
| ***Irreplaceable loss of resources?*** | Moderate | | Low | |
| ***Can impacts be mitigated?*** | Yes | | | |
| ***Mitigation:***<br>• The clearing of vegetation must be kept to a minimum and remain within the footprint of the pylon;<br>• Disturbed areas must be rehabilitated immediately after construction has been completed in that area by sowing appropriate indigenous grass species;<br>• During the construction phase workers must be limited to areas under construction and access to the undeveloped areas must be strictly controlled;<br>• Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas. | | | | |
| ***Cumulative impacts:*** Expected to reduce and fragment the natural grassland in the area to a limited extent. | | | | |
| ***Residual Risks:*** None anticipated provided that the mitigation measures are implemented correctly. | | | | |

Notes:

- It must be mentioned that we observe that grassland vegetation and indigenous plant species are actually protected in the Eskom servitude under the lines as this excludes other vegetation destructive developments
- Loss of protected, rare or red data plant species within the footprint areas of the pylons in this area is highly unlikely.

**Table 6.4: Increase of alien invasive plant species**

| ***Nature:*** Alien invasive plant species will encroach into disturbed areas. | | | | |
|---|---|---|---|---|
| | **Without mitigation** | | **With mitigation** | |
| **CONSTRUCTION PHASE** | | | | |
| ***Probability*** | Probable | 3 | Improbable | 2 |
| ***Duration*** | Short-term | 2 | Short-term | 2 |
| ***Extent*** | Limited to sites of pylons | 1 | Limited to Sites of pylons | 1 |
| ***Magnitude*** | Moderate | 5 | Low | 4 |
| ***Significance*** | **Low** | **24** | **Low** | **14** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| **OPERATIONAL PHASE** | | | | |
| ***Probability*** | Improbable | 2 | Very Improbable | 1 |
| ***Duration*** | Permanent | 5 | Permanent | 5 |
| ***Extent*** | Limited to sites of pylons | 1 | Limited to Sits of pylonse | 1 |
| ***Magnitude*** | Low | 2 | Low | 1 |
| ***Significance*** | **Low** | **16** | **Low** | **7** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| ***Reversibility*** | Moderate | | High | |
| ***Irreplaceable loss of resources?*** | Low | | Low | |
| ***Can impacts be mitigated?*** | Yes | | | |

***Mitigation:***

- An alien invasive management programme must be incorporated into the Environmental Management Programme;
- Ongoing alien plant control must be undertaken;
- Areas which have been disturbed will be quickly colonised by invasive alien species. An ongoing management plan **must** be implemented for the clearing/eradication of alien species.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.

***Cumulative impacts:*** Moderate, should mitigation measure not be implemented. Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity, change ecosystem services and processes e.g. change nutrient cycling and productivity, and modify food webs.

| |
|---|
| ***Residual Risks:*** None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken. |

### 6.2.3 Disturbed Grassland

**Table 6.5: Loss of indigenous vegetation due to clearing for construction of pylons and the powerline**

| | | | | |
|---|---|---|---|---|
| ***Nature:*** The area of the footprint for every pylon will be cleared of vegetation. This may result in the loss of indigenous species, disturbance of plant species and the fragmentation of plant communities (though the areas to be cleared are small and isolated). The removal of vegetation will also expose soil increasing the risk of erosion. The disturbed areas already contains several weedy species. The indigenous vegetation in not in a very good condition. | | | | |
| | **Without mitigation** | | **With mitigation** | |
| **CONSTRUCTION PHASE** | | | | |
| ***Probability*** | Definite | 5 | Definite | 5 |
| ***Duration*** | Short-term | 2 | Short-term | 2 |
| ***Extent*** | Limited to Sites of pylons | 1 | Limited to Sites of pylons | 1 |
| ***Magnitude*** | Low | 4 | Low | 3 |
| ***Significance*** | **Medium** | **35** | **Low** | **30** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| **OPERATIONAL PHASE** | | | | |
| ***Probability*** | Definite | 5 | Definite | 5 |
| ***Duration*** | Permanent | 5 | Permanent | 5 |
| ***Extent*** | Limited to Site of pylons | 1 | Limited to Site of pylons | 1 |
| ***Magnitude*** | Moderate | 3 | Low | 1 |
| ***Significance*** | **Medium** | **45** | **Medium** | **35** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| | | | | |
| ***Reversibility*** | Medium | | High | |
| ***Irreplaceable loss of resources?*** | Moderate | | Low | |
| ***Can impacts be mitigated?*** | Yes | | | |
| ***Mitigation:***<br>• The clearing of vegetation must be kept to a minimum and remain within the footprint of the pylon;<br>• Disturbed areas must be rehabilitated immediately after construction has been completed in that area by sowing appropriate indigenous grass species;<br>• During the construction phase workers must be limited to areas under construction and access to the undeveloped areas must be strictly controlled;<br>• Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas. | | | | |
| ***Cumulative impacts:*** Expected to reduce and fragment the natural (disturbed) grassland in the area to a limited extent. | | | | |

| |
|---|
| ***Residual Risks:*** None anticipated provided that the mitigation measures are implemented correctly. |

Notes:

- The disturbed grassland is not in a good condition and spread of weed species into the newly disturbed areas is likely – rehabilitation is therefore definitely necessary
- Loss of protected, rare or red data plant species within the footprint areas of the pylons in this area is highly unlikely.

**Table 6.6: Increase of alien invasive plant species**

| ***Nature:*** Alien invasive plant species will encroach into disturbed areas. | | | | |
|---|---|---|---|---|
| | **Without mitigation** | | **With mitigation** | |
| **CONSTRUCTION PHASE** | | | | |
| ***Probability*** | Highly Probable | 4 | Probable | 3 |
| ***Duration*** | Short-term | 2 | Short-term | 2 |
| ***Extent*** | Limited to sites of pylons | 1 | Limited to Sites of pylons | 1 |
| ***Magnitude*** | Moderate | 5 | Low | 4 |
| ***Significance*** | **Moderate** | **32** | **Low** | **21** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| **OPERATIONAL PHASE** | | | | |
| ***Probability*** | Highly Probable | 4 | Improbable | 1 |
| ***Duration*** | Permanent | 5 | Permanent | 5 |
| ***Extent*** | Limited to sites of pylons | 1 | Limited to Sits of pylonse | 1 |
| ***Magnitude*** | Low | 2 | Low | 1 |
| ***Significance*** | **Medium** | **32** | **Low** | **7** |
| ***Status (positive or negative)*** | Negative | | Negative | |
| ***Reversibility*** | Moderate | | High | |
| ***Irreplaceable loss of resources?*** | Low | | Low | |
| ***Can impacts be mitigated?*** | Yes | | | |

***Mitigation:***

- An alien invasive management programme must be incorporated into the Environmental Management Programme;
- Ongoing alien plant control must be undertaken;
- Areas which have been disturbed will be quickly colonised by invasive alien species. An ongoing management plan **must** be implemented for the clearing/eradication of alien species.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.

***Cumulative impacts:*** Moderate, should mitigation measure not be implemented. Alien invader plant species pose an ecological

| |
|---|
| threat as they alter habitat structure, lower biodiversity, change ecosystem services and processes e.g. change nutrient cycling and productivity, and modify food webs. |
| ***Residual Risks:*** None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken. |

## 7. GENERAL DISCUSSION AND CONCLUSION

Although both the Eastern Highveld Grassland Soweto Highveld Grassland are considered to be Endangered, and their ecosystems vulnerable, because about half of the area has been transformed by agriculture, mining and urban sprawl, these vegetation types are still widespread, and cannot be considered to be rare. However, grassland in general is rich in plant species, and several red data listed plant species may occur in these regions. The development of the powerline will be on agricultural land and natural to disturbed grassland. Vegetation will be removed on the footprint areas of the pylons. These areas are very small in relation to the vast surrounding grassland.

The significance of the impact of the proposed powerline on the natural indigenous grassland vegetation will be low to medium, as the only areas to be disturbed are the footprints of the pylons. The chances that protected, rare or red data plant species will be lost or affected are very small and highly improbable. It is usually found that natural grassland vegetation and therefore the plant species are well protected within an Eskom servitude, under the powerlines, as this area is excluded from other developments that can destroy the vegetation.

In disturbed grassland there is a higher risk of weed establishment on the areas disturbed for pylon construction, due to the weed species seedbank that already exists within the disturbed grassland.

As the span of the line between pylons is adequately long, the line will easily cross spruits and wetlands and pylons can be places far from the edges of spruits and wetlands, therefore spruits and wetland should not be affected. The spruits and wetlands (all watercourses) are protected ecosystems and may not be affected by the development, as the development is closer than 500 m from some of the spruits and tributaries, a water use licence will be needed. No waste or waste water or any

other pollutants may be deposited or released in any of the watercourses (see wetland report).

In conclusion, the impact of the proposed powerline on the vegetation of the area is considered to be quite low, especially should the proposed mitigation measures be implemented.

**Mitigation measures**

**Spruits and wetland**

- Limit disturbance close to spruit and wetland to a minimum.
- Rehabilitate disturbances close to spruits ;and wetland immediately
- Do not remove any spruit or wetland vegetation putting up the lines;
- Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas
- Remove and control all alien woody plant species that may appear during construction and operational phases
- Avoid erosion at spruits at all times

**Grassland**

- The clearing of vegetation must be kept to a minimum and remain within the footprint of the pylon;
- Disturbed areas must be rehabilitated immediately after construction has been completed in that area by sowing appropriate indigenous grass species;
- During the construction phase workers must be limited to areas under construction and access to the undeveloped areas must be strictly controlled;
- Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas.
- Control all waste dumping and avoid pollution, especially of watercourses at all times.

It is concluded that the impact on vegetation and flora, and in particular plant species of conservation concern will be small. Should the conservation authority of Mpumalanga regard it as feasible and acceptable to develop the powerline in the

area, it is suggested that, from a vegetation and flora point of view, the development can be supported.

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- - 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
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- Associate professor in Plant Ecology 1984-1988 at Potchefstroom University for CHE
- Professor in Plant Ecology 1988-2008 at University of Pretoria.
- 2009 – current Professor Extra-ordinary in the Dept of Plant Science, University of Pretoria
- • Founder and owner of the Professional Ecological Consultancy firms Ecotrust Environmental Services CC and Eco-Agent CC, 1988-present.

**Academic career:**

• Students:

- Completed post graduate students: M.Sc. 53; Ph.D. 14.
- Presently enrolled post-graduate students: M.Sc. 4; Ph.D. 2.

• Author of:

- 175 scientific papers in refereed journals
- >150 papers at national and international congresses
- >250 scientific (unpublished) reports on environment and natural resources
- 17 popular scientific papers.
- 39 contributions in books

• Editorial Committee of

- South African Journal of Botany,
- Journal Grassland Society of Southern Africa,

- Bulletin of the South African Institute of Ecologists.
- Journal of Applied Vegetation Science.( Sweden)
- Phytocoenologia (Germany)
-

• FRD evaluation category: C2 (=leader in South Africa in the field of Vegetation Science/Plant Ecology)

**Membership:**

• International Association of Vegetation Science.
• British Ecological Society
• International Society for Ecology (Intecol)
• Association for the Taxonomic study of the Flora of Tropical Africa (AETFAT).
• South African Association of Botanists (SAAB)

1988-1993 Elected to the **Council** of SAAB.
1989-1990 Elected as **Chairman** of the Northern Transvaal Branch
1990 Elected to the Executive Council as **Vice-President**
1990- Sub-editor Editorial Board of the Journal
1991-1992 Elected as **President** (2-year period)
1993 **Vice-President** and Outgoing President

• Wildlife Management Society of Southern Africa
• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
(=South African Academy for Science and Art).
• Wildlife Society of Southern Africa

1975 - 1988: Member
1975 - 1983: Committee member, Pietersburg Centre
1981 - 1982: **Chairman**, Pietersburg Centre

• Dendrological Society of Southern Africa

1984 - present: Member
1984 - 1988: Committee member, Western Transvaal Branch
1986 - 1988: **Chairman**, Western Transvaal Branch
1987 - 1989: Member, Central Committee (National level)
1990 - 2000: Examination Committee

• Succulent Society of South Africa

1987 - 2000

• Botanical Society of South Africa

2000 – present: Member

2001- 2008: Chairman, Pretoria Branch

2002 – 2006: Chairman, Northern Region Conservation Committee

2002- 2007: Member of Council

**Special committees**:

• Member of 10 special committees re ecology, botany, rangeland science in South Africa.

• Member of the International Code for Syntaxonomical Nomenclature 1993-present.

**Merit awards and research grants**:

1968 Post graduate merit bursary, CSIR, Pretoria.

1977-1979 Research Grant, Committee re Research Development, Dept. of Co-operation and Development, Pretoria.

1984-1989 Research Grant, Foundation for Research Development, CSIR, Pretoria.

1986-1987 Research Grant, Dept. of Agriculture and Water Supply, Potchefstroom.

1990-1997 Research Grant, Dept. of Environmental Affairs & Tourism, Pretoria.

1991-present Research Grant, National Research Foundation , Pretoria.

1991-1993 Research Grant, Water Research Commission.

1999-2003 Research Grant, Water Research Commission.

2006 South African Association of Botanists Silver Medal for outstanding contributions to South African Botany

**Abroad**:

1986 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom
Visits to Israel, Italy, Germany, United Kingdom, Portugal.

1987 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom.
Visits to Germany, Switzerland, Austria, The Netherlands, United Kingdom.

1990 Travel Grant, FRD.
Visit to Japan, Taiwan, Hong-Kong.

1991 Travel Grant, FRD.
Visits to Italy, Germany. Switzerland, Austria, France, The Netherlands, United Kingdom.

1993 Travel Grant, University of Pretoria.
Visits to the USA, Costa Rica, Czech Republic, Austria.

1994 Travel Grant FRD.
Visits to Switzerland, The Netherlands, Germany, Czech Republic.

1995 Travel Grant FRD, University of Pretoria
Visits to the USA
1996 Travel Grant, University of Pretoria
Visit to the UK.
1997 Travel Grant University of Pretoria, Visit Czech Republic, Bulgaria
1998 Travel Grant, University of Pretoria, Visit Czech Republic, Italy, Sweden
1999 Travel Grant, University of Pretoria, Visit Hungary, Spain, USA
2000 Travel Grant, University of Pretoria, Visit Poland, Italy, Greece.
2001 Travel Grant, NRF, Visit Brazil
2006 German Grant Invited lecture in Rinteln, Germany

**Consultant**

Founder and owner of Ecotrust Environmental Services CC and Eco-Agent CC

Since 1988 **>250** reports as consultant on environmental matters, including:

- Game Farm and Nature Reserve planning,
- Environmental Impact Assessments,
- Environmental Management Programme Reports,
- Vegetation Surveys,
- Wildlife Management,
- Veld Condition and Grazing Capacity Assessments,
- Red data analysis (plants and animals).

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