ECOAGENT
ECOLOGY & BIODIVERSITY CONSULTANTS

Construction of a 400 KV powerlines from Kusile Power Station to Lulamisa Substation (Bravo 3) DEA Ref No - 12/12/20/1095

May 2016

An assessment of vegetation and flora to inform the Construction of a 400 KV Line from Kusile Power Station to Lulamisa substation (Bravo 3)

DEA Ref No - 12/12/20/1094

by

GJ Bredenkamp DSc PrSciNat

Commissioned by

Limosella Consulting

EcoAgent CC
PO Box 23355
Monument Park
0181
Tel 012 4602525
Fax 012 460 2525
Cell 082 5767046

May 2016

TABLE OF CONTENTS

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 a 400 KV Line from Kusile Power Station to Lulamisa (Bravo 3). DEA Ref No - 12/12/20/1094” 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 a new 400 kV power line from Kusile to Lulamisa substation (near Diepsloot). The line will be approximately 120 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 will transect several vegetation types. Their conservation and status are summarised in the following table:

Vegetation type	**Conservation status**	**Threatened status**
Egoli Granite Grassland,	Endangered	Endangered
Carletonville Dolomite Grassland,	Vulnerable	Least Threatened
Rand Highveld Grassland,	Endangered	Mostly Vulnerable, Critically Endangered close to Pretoria
Andesite Mountain Bushveld,	Least Threatened	Critically Endangered
Marikana Thornveld	Endangered	Least Threatened
Gold Reef Mountain Bushveld	Least Threatened	Magaliesberg etc mostly Critically Endangered, quartzite ridges in study area Least Threatened
Eastern Highveld Grassland	Endangered	Vulnerable

The following 11 mapping units were identified during this study:

Mapping units / Plant Community	**Sensitivity**	**Mucina & Rutherford (2006)**
1. Spruit and Wetland vegetation	High	All vegetation types
2. Rand Highveld Grassland	Medium-High	Rand Highveld Grassland
3. *Hyparrhenia* Grassland on granite	Medium	Egoli Granite Grassland
4. Disturbed Grassland	Medium-Low	All vegetation types
5. Agriculture	Low	All vegetation types
6. Transformed Areas	Low	All vegetation types
7. Small Holdings transformed / disturbed grassland	Low	Mostly Egoli Granite Grassland Rand Highveld Grassland Andesite Mountain Bushveld Marikana Thornveld Rand Highveld grassland
8. Mixed Grassland on dolomite	Medium	Carletonville Dolomite Grassland
9. Mountain Bushveld on andesite	High	Andesite Mountain Bushveld
10. Bushveld in Tierpoort valley	Medium-High	Marikana Thornveld
11. Grassland on quartzite ridges	Medium-High	Gold Reef Mountain Bushveld

Most of the vegetation types are considered to be threatened, particularly Egoli Granite Grassland and Andesite Mountain Bushveld (Bronberg area). The grassland areas are threatened because so much of the area has been transformed by agriculture, mining and urban sprawl. Grassland in general is rich in plant species, and several red data listed plant species may occur in these regions. Vegetation will be removed on the footprint areas of the pylons, however, these pylon footprint areas are very small in relation to the vast surrounding grassland. Woody species, particularly taller growing tress will have to be removed, or at least cut down, to ensure that the powerlines are not damaged.

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.

The impact on woody vegetation is higher, as tall-growing trees will have to be removed.

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.

.

Should the conservation authority of Gauteng and 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. The current assessment evaluates the environmental impact of an alignment that stretches from the Kusile Power Station in Mpumalanga to the Lulamisa Substation located near Diepsloot in Gauteng. This project is known as Bravo 3.

EcoAgent CC was appointed by Limosella Consulting to do a vegetation assessment for the Bravo 3 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 18-23 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.

Scope of the study

The scope of the study is interpreted as follows:

- Assess, map and describe the vegetation within 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 and GDARD (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 April and 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 many areas along the powerline transect was not available though all vegetation types and plant communities could be assessed by visiting the accessible areas during the field survey

No alternative route options were available for evaluation during this assessment.

A further limitation was that limited time was available for surveying and reporting on the vegetation along a relatively long (approx 120 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 proposed to construct a new 400 kV power line from Kusile Power Station southwest of Balmoral in Mpumalanga to Lulamisa Substation in Gauteng (near Diepsloot). This line will be approximately 120 km in length and runs east-west over flat Highveld plains. The western section of the line runs through formal and informal residential areas at Diepsloot, Olievenhoutbosch, Blue Valley and Midtream. From there the line crosses primarily agricultural land, small holdings and some mining areas. Pockets of untransformed land are interspersed between the other land uses, particularly in the vicinity of Bronkhorstpruit towards the eastern extent of the line.

This component of the Bravo Integration Project is known as Bravo 3 (Figure 1). The other components (Bravo 4, Bravo 5 and Kyalami Strengthening) are discussed in separate reports.

3.2 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 (over the 120 km long area) in the region of 600-700 mm. Average daily maximum temperatures range from about 32°C in December to about 20°C in July, with daily minimum temperatures ranging from about 15°C in January to about 3°C in July. The mean annual potential evaporation (MAPE) is more than 2 600 mm (Land Type Survey Staff (1987).

3.3 Geology, Land types and Soil

The geology towards the western section of the proposed power lines, including the Lulamisa substation, is dominated by granite and gneiss of the Halfway House granite. The central part of the route overlies a section of Malmani dolomite of the Transvaal Sequence. The geology of the eastern section of the proposed power line is characterised by shale, sandstone or mudstone of the Witwatersrand Supergroup Pretoria Group and Rooiberg Group (Transvaal Supergroup), and in the far east Madzaringwe Formation (Karoo Supergroup), dominated by formations of the Dwyka group (DDPLG, 2002).

Land types in the area include the Ab, Ba, Bb and Ib.

3.4 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, especially in the Pretoria east and Bronkhortspruit areas, 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 a separate report. In general, the powerline crosses 6 Quaternary Catchments (A21C, A21B, A21A, A23A, B20D and B20F). A number of tributaries of large river systems also traverse the proposed lines. The main rivers possibly affected by the proposed line include the Rietvlei River, Bronkhorstspruit, Rietspruit, Blesbokspruit and the associated tributaries (Figure 2).

3.5 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).

3.6 Regional Vegetation Types

The regional vegetation classification (Mucina & Rutherford, 2006) indicated that 7 different vegetation units could potentially be influenced by the development (Figure 3).

The vegetation types (Mucina & Rutherford 2006) that are represented along the transect of the powerline with their conservation status according to (Mucina & Rutherford, 2006) and threatened status according to SANBI (2011):

Vegetation type	Conservation status	Threatened status
Egoli Granite Grassland,	Endangered	Endangered
Carletonville Dolomite Grassland,	Vulnerable	Least Threatened
Rand Highveld Grassland,	Endangered	Mostly Vulnerable, Critically Endangered close to Pretoria
Andesite Mountain Bushveld,	Least Threatened	Critically Endangered
Marikana Thornveld	Endangered	Least Threatened
Gold Reef Mountain Bushveld	Least Threatened	Magaliesberg etc mostly Critically Endangered, quartzite ridges in study area Least Threatened
Eastern Highveld Grassland	Endangered	Vulnerable

3.7 Mpumalanga Critical Biodiversity Areas and Gauteng Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. Critical Biodiversity Areas (CBAs) contain irreplaceable, important and protected areas (terms used in C-Plan 2) and are areas needed to reach the conservation targets of the Province. In addition 'Ecological Support Areas' (ESAs), mainly around riparian areas and other movement corridors were also classified to ensure sustainability in the long term. Landscape features associated with ESAs is essential for the maintenance and generation of biodiversity in sensitive areas and requires sensitive management where incorporated into C-Plan 3. The majority of the proposed lines in Gauteng are located on areas classified as 'Ecological Support Areas' and 'Important Areas' as well as several sections that is not currently classified (Figure 4).

Critical Biodiversity Areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision making. CBA's are therefore areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses (Desmet et al, 2009).

In addition, the assessment also made provision for Ecological Support Areas (ESA's), which are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in

supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas (Desmet et al, 2009).

The line runs along a section of the border of the Diepsloot Nature Reserve and crosses the Rietvlei Nature Reserve. The Gauteng Conservation Plan (CPlan v 3.3, GDARD 2011) and the Mpumalanga Biodiversity Sector Plan (Lotter *et al*, 2015) show the line traversing primarily areas with intermediate to low sensitivity although areas classified as Important/Highly Significant, Ecological Support Areas and Important and Necessary are relevant (Figure 6).

3.8 Conservation Status

Conservation status as indicated by the National Biodiversity Assessment (SANBI, 2011) shows that areas in the west are Endangered and Critically Endangered (with little Least Concern) wile the eastern area is mainly classified as Vulnerable (Figure 5).

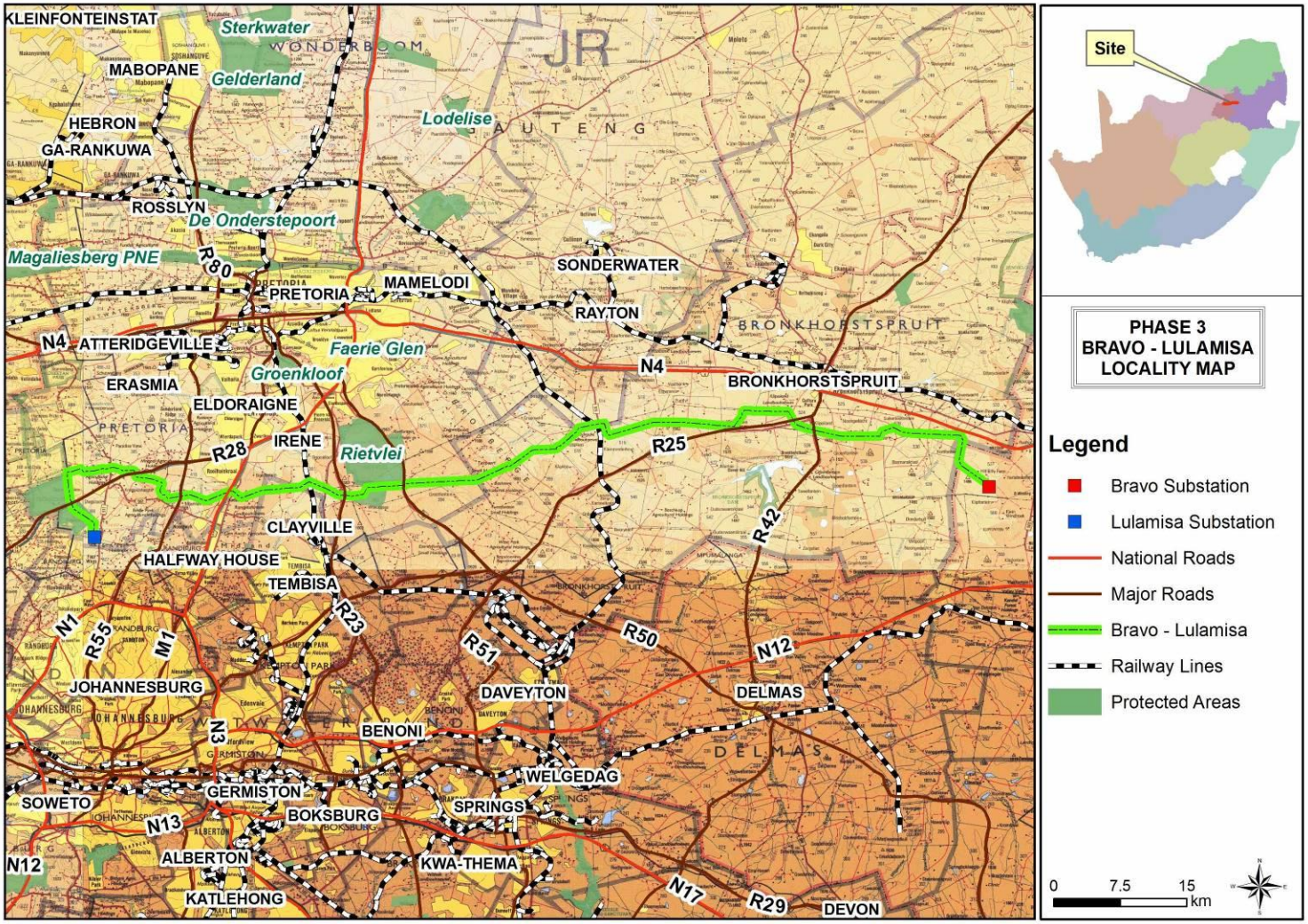

Figure 1: The locality of the study site

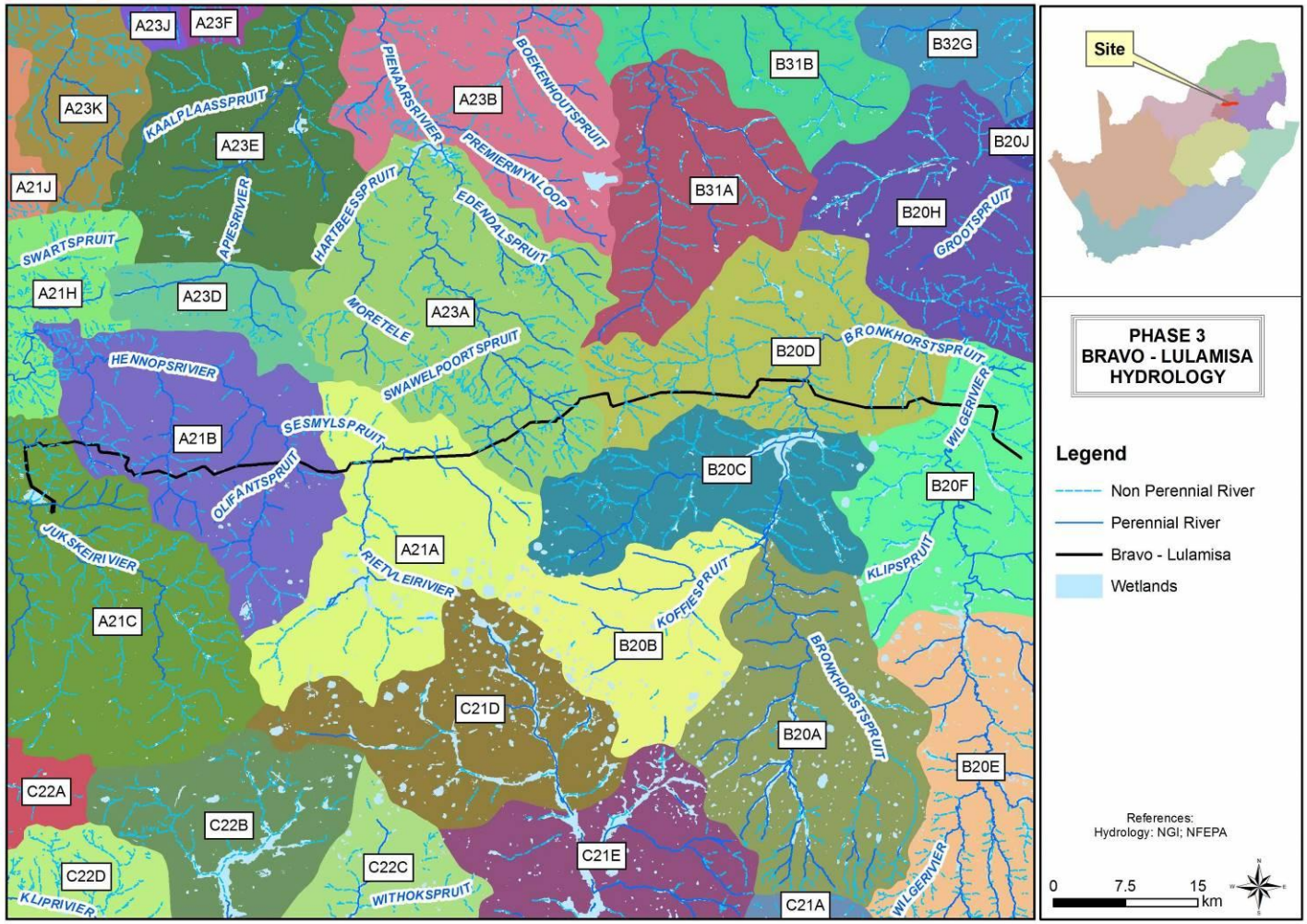

Figure 2: Hydrological data for the proposed powerline. Note that drainage is mainly northwards.

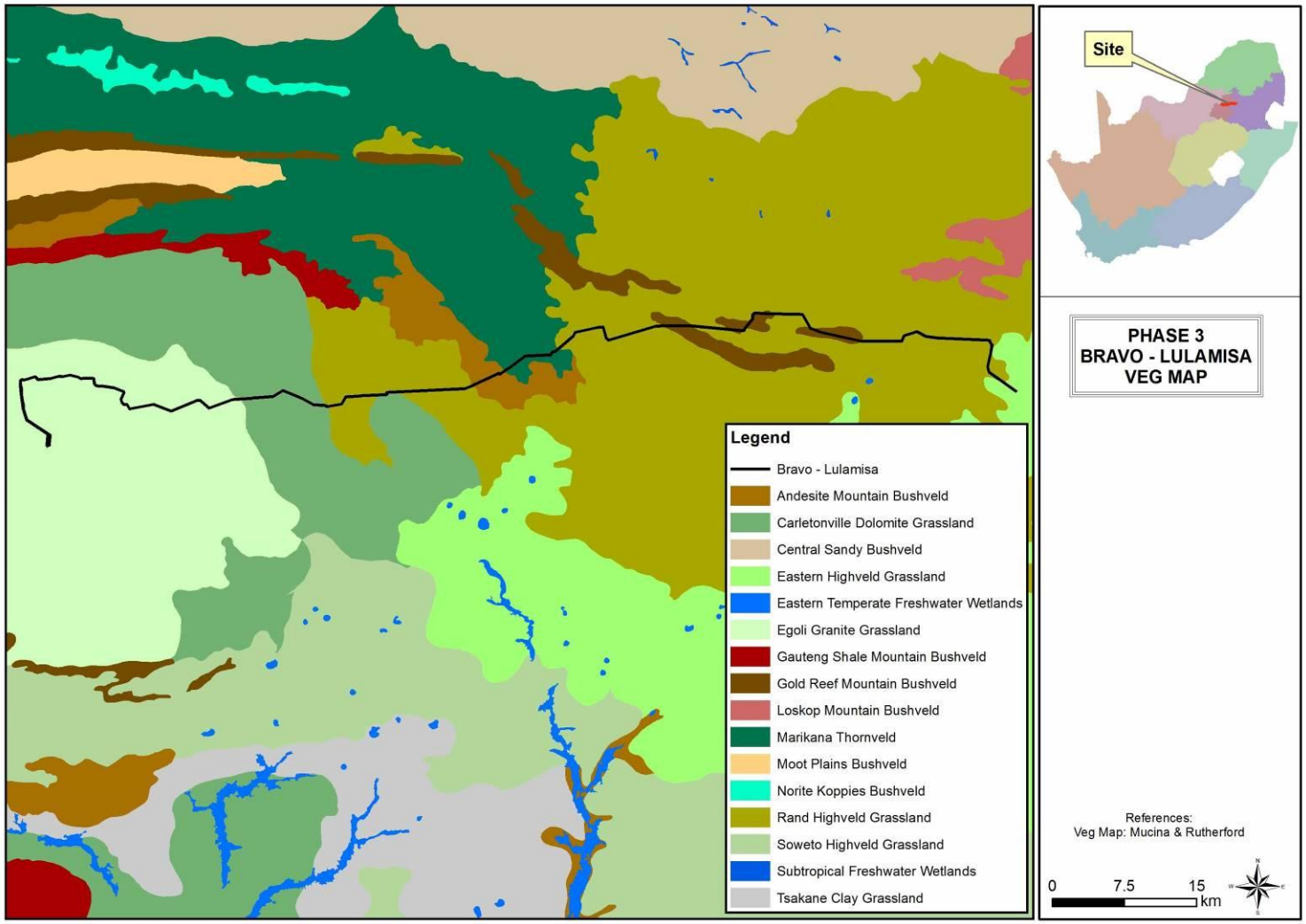

Figure 3: Regional vegetation (Mucina & Rutherford 2006)

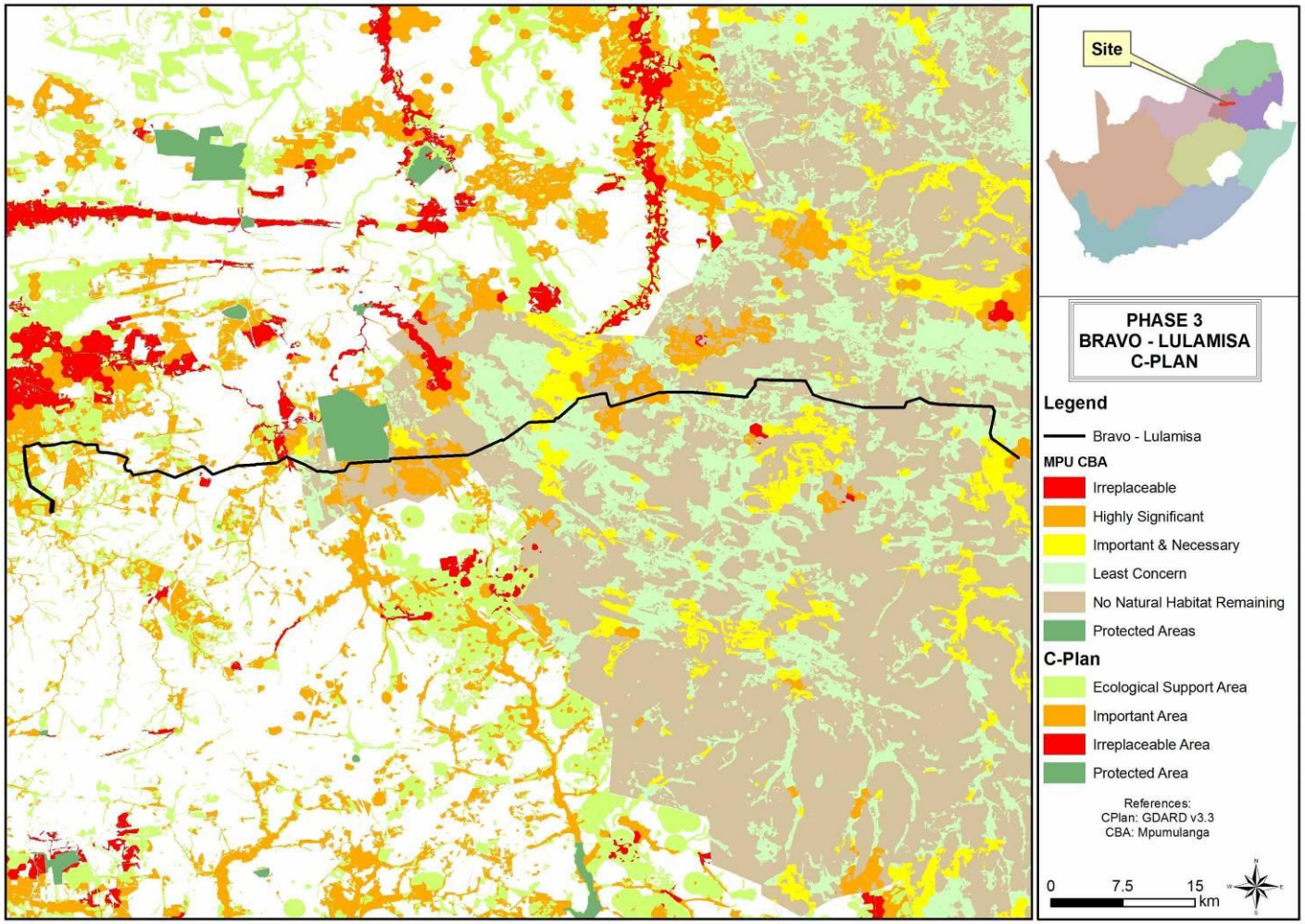

Figure 4: Critical Biodiversity Areas along the proposed powerline transect

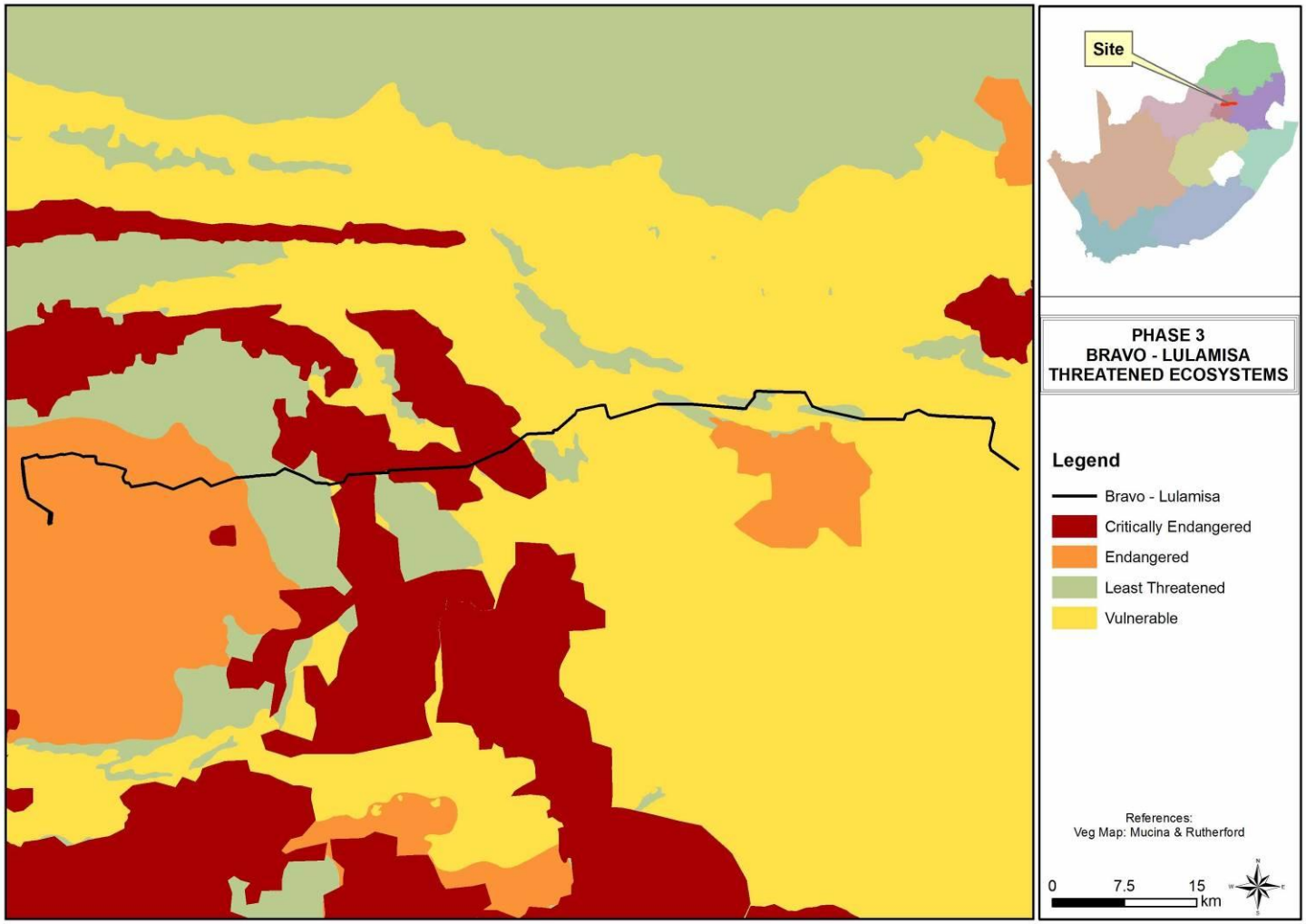

Figure 5: Threatened Ecosystems along the proposed powerline transect Reference verkeerd op kaart moet SANBI 2011 wees

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 18-23 April 2016 by Prof GJ Bredenkamp, accompanied by Dr IL Rautenbach (zoologist). The proposed powerline stretches from the Kusile Power Station (Figure 6) south of Balmoral, Mpumalanga to the Lulamisa Substation (Figure 7), at Diepsloot, Gauteng.

Figure 6: The Kusile Power Station

Figure 7: The Lulamisa Substation

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), and SANBI 2011).

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.

- 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	14-18	7-13	0-6

Sensitivity	High	Medium	Low

A score of Medium-High (score 10-13) or Medium Low (score 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-High 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

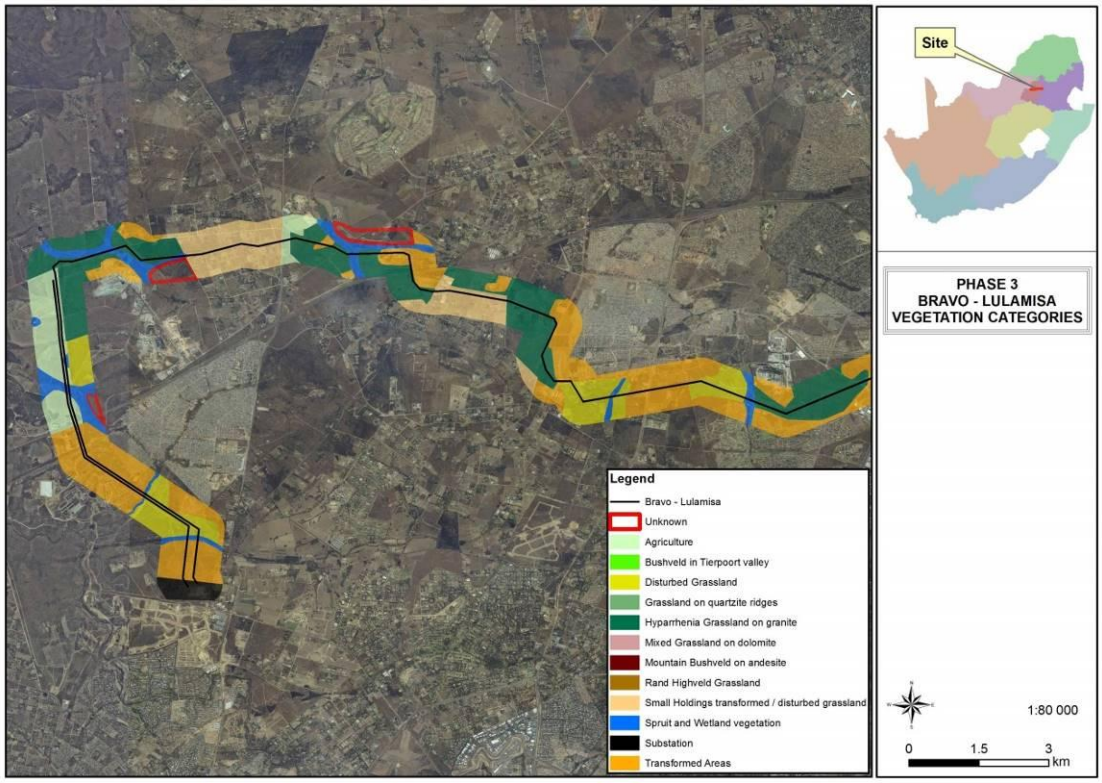

Figure 8. (1) Vegetation map of the study site with the position of the powerline

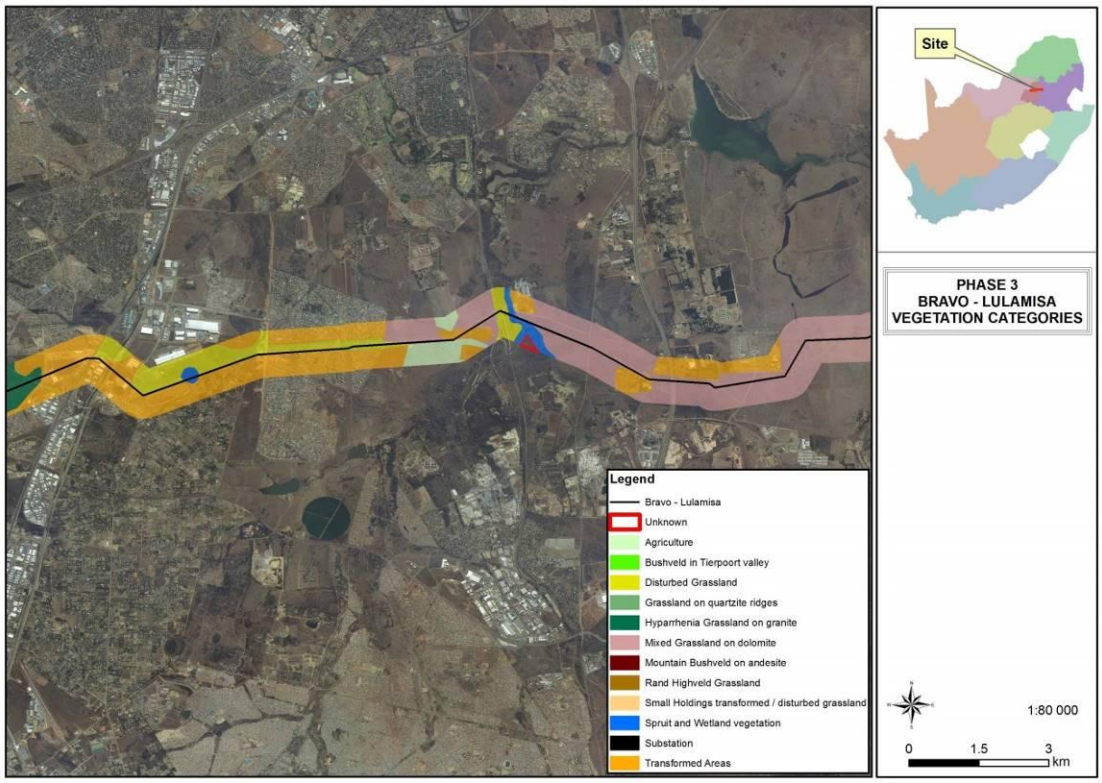

Figure 8 continued (2): Vegetation map of the study site with the position of the powerline

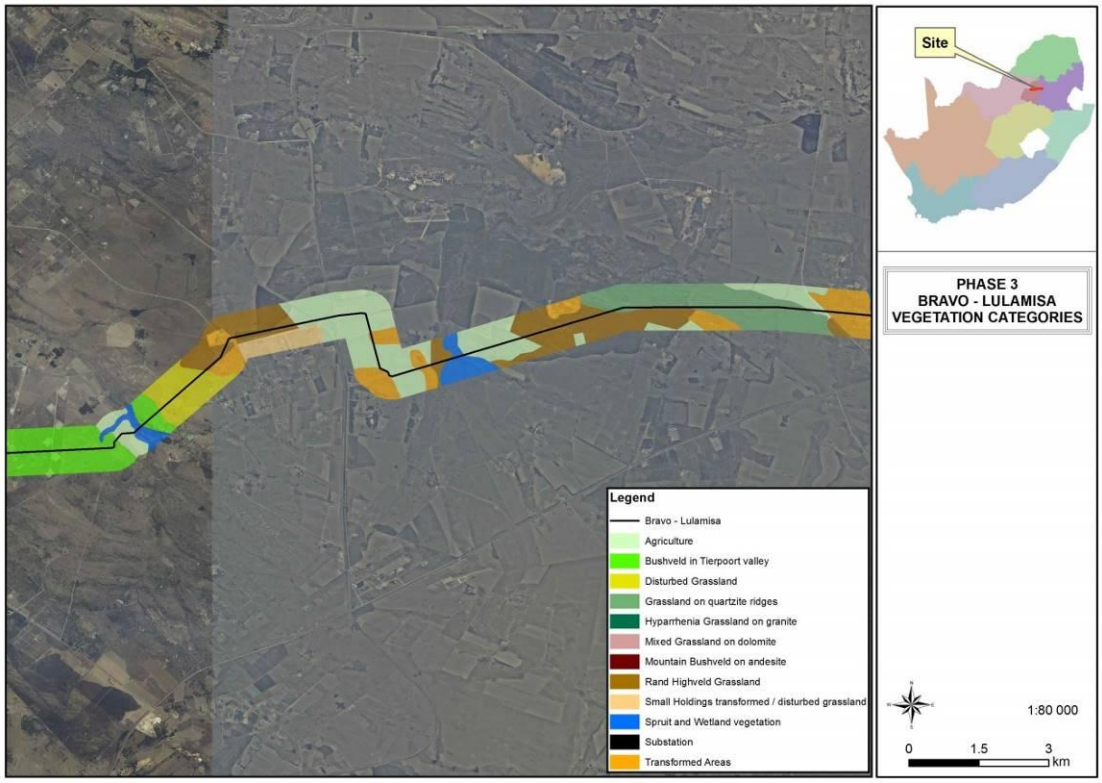

Figure 8 continued (3): Vegetation map of the study site with the position of the powerline

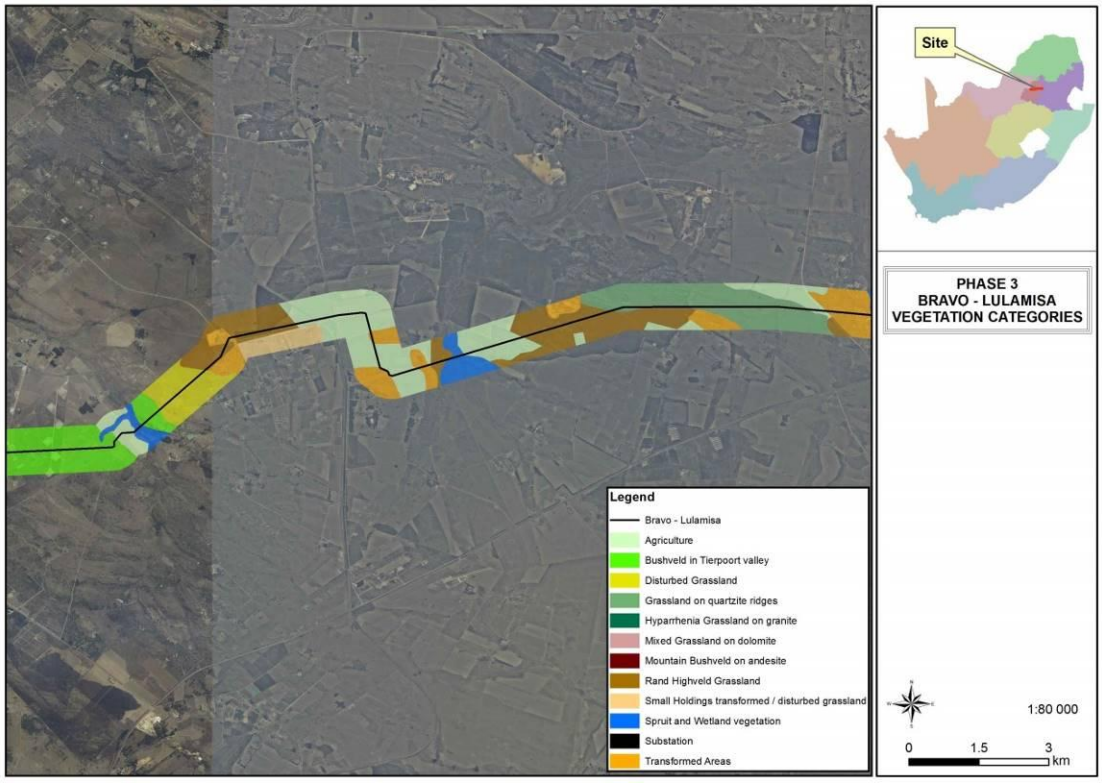

Figure 8 continued (4): Vegetation map of the study site with the position of the powerline

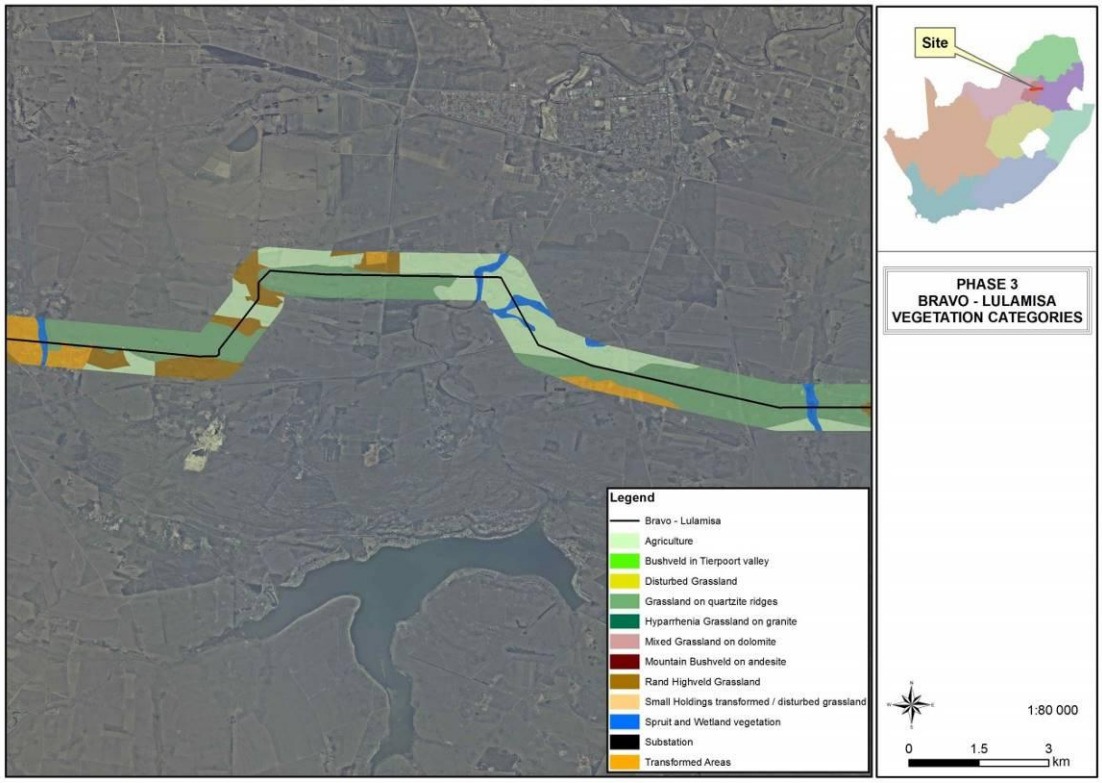

Figure 8 continued (5): Vegetation map of the study site with the position of the powerline

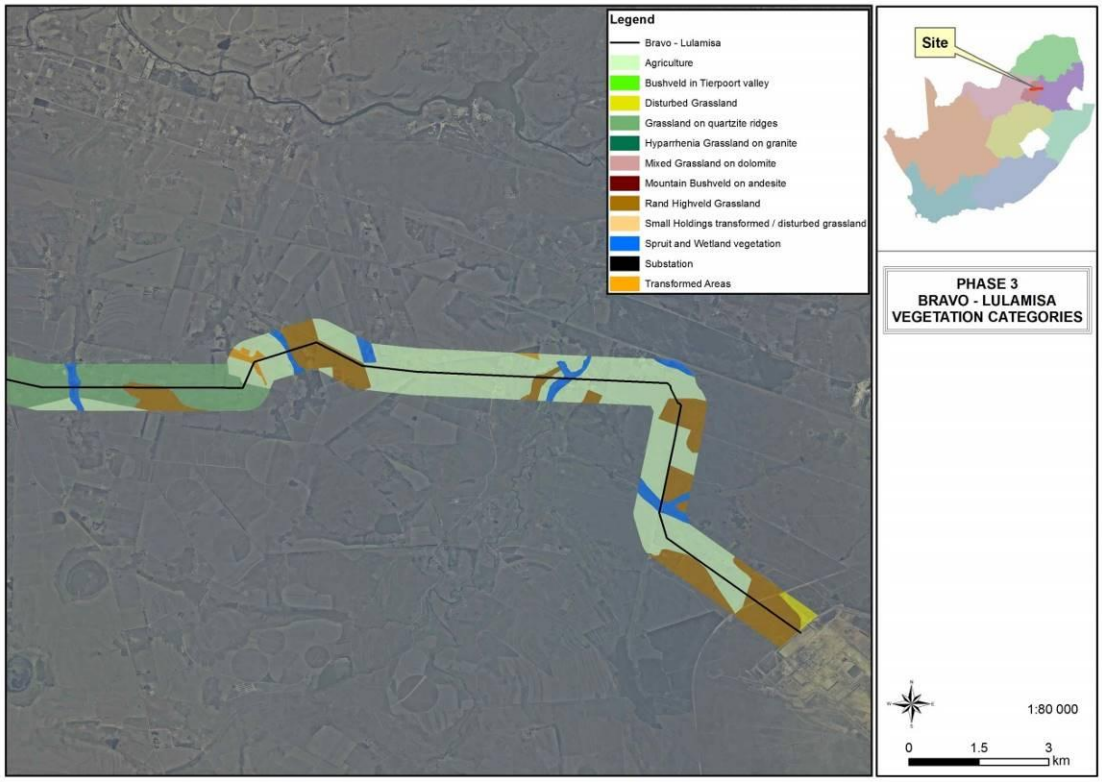

Figure 8 continued (6): Vegetation map of the study site with the position of the powerline

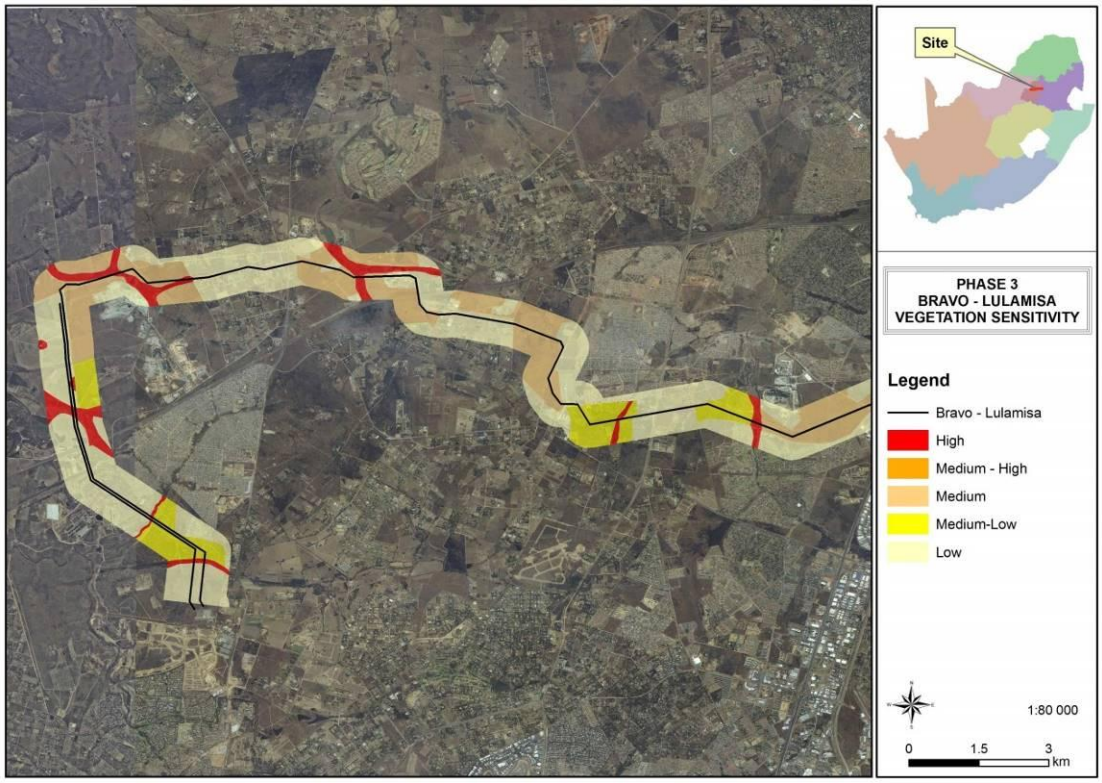

Figure 9 (1): Sensitivity map of the study site with the position of the powerline

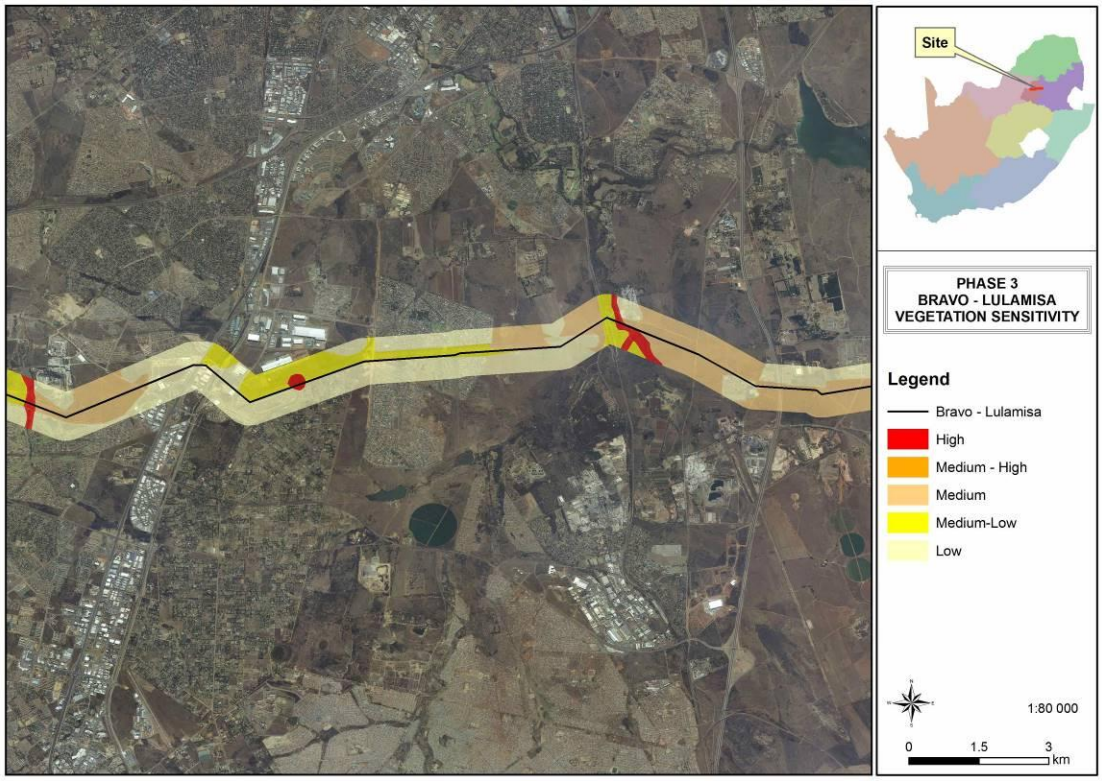

Figure 9 continued (2): Sensitivity map of the study site with the position of the powerline

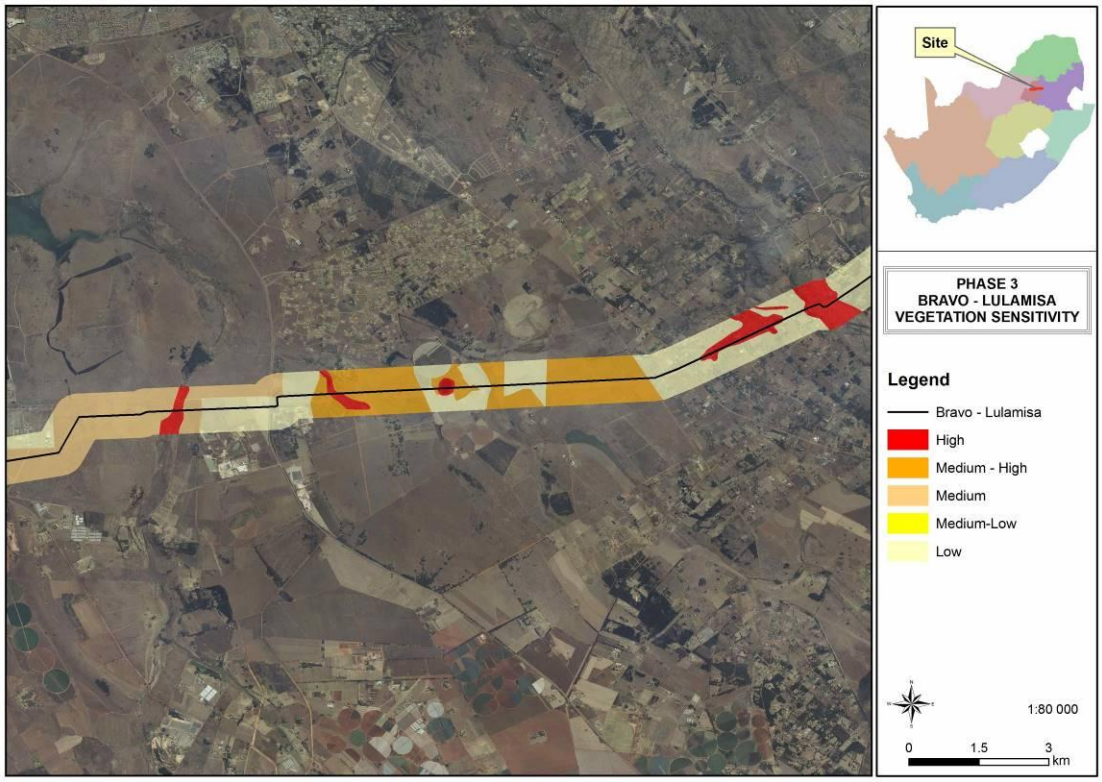

Figure 9 continued (3): Sensitivity map of the study site with the position of the powerline

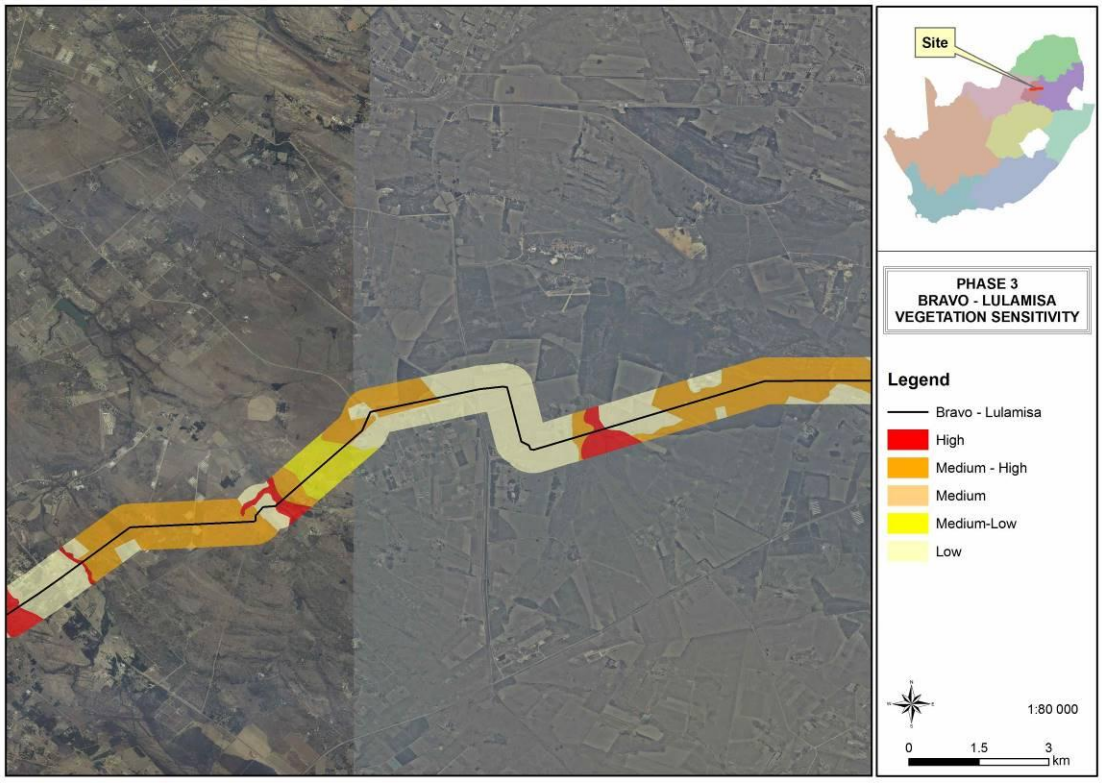

Figure 9 continued (4): Sensitivity map of the study site with the position of the powerline

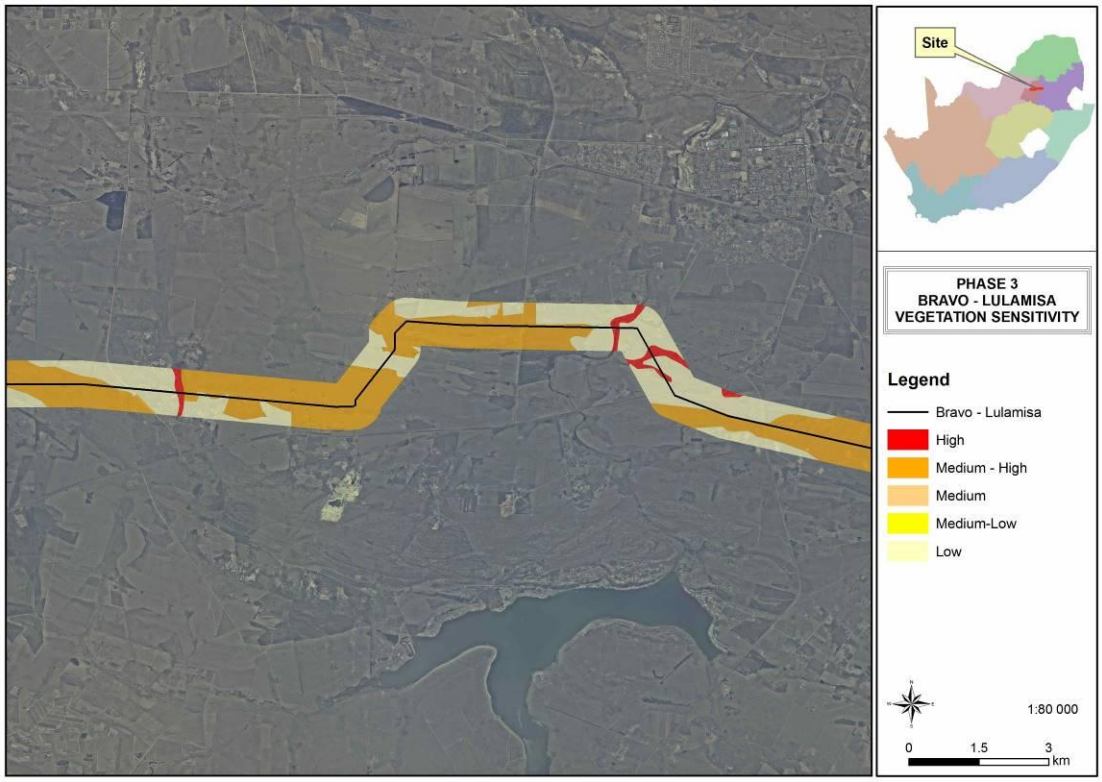

Figure 9 continued (5): Sensitivity map of the study site with the position of the powerline

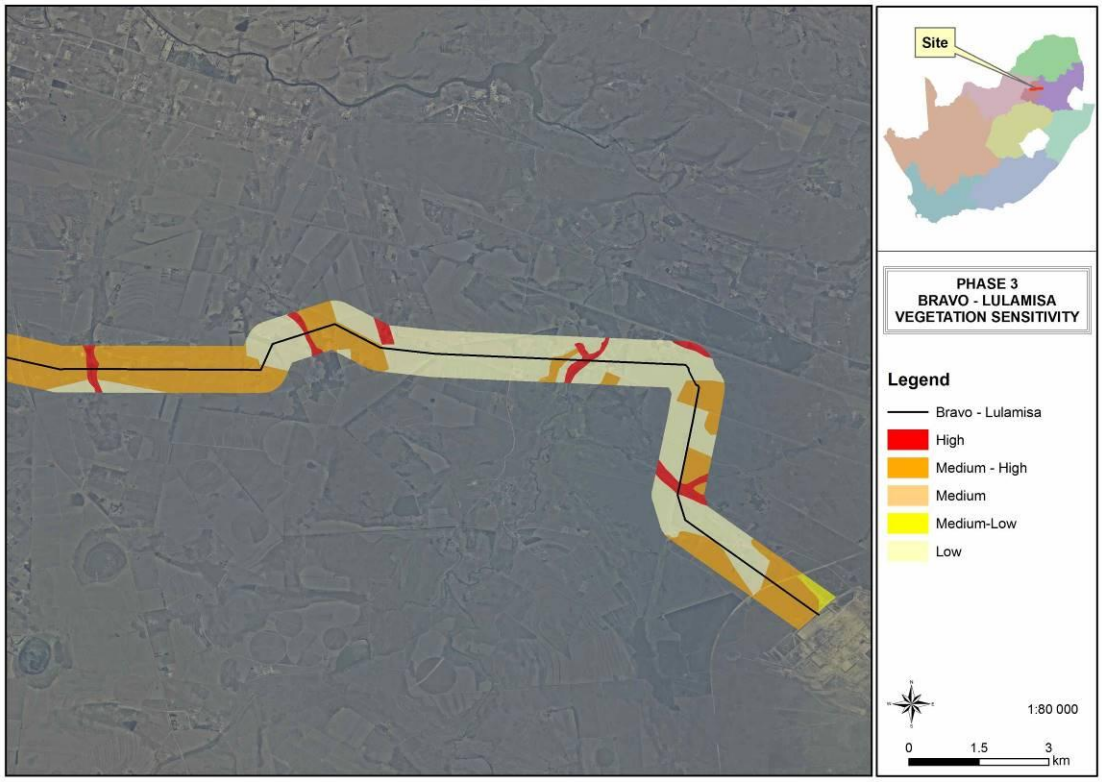

Figure 9 continued (6): Sensitivity map of the study site with the position of the powerline

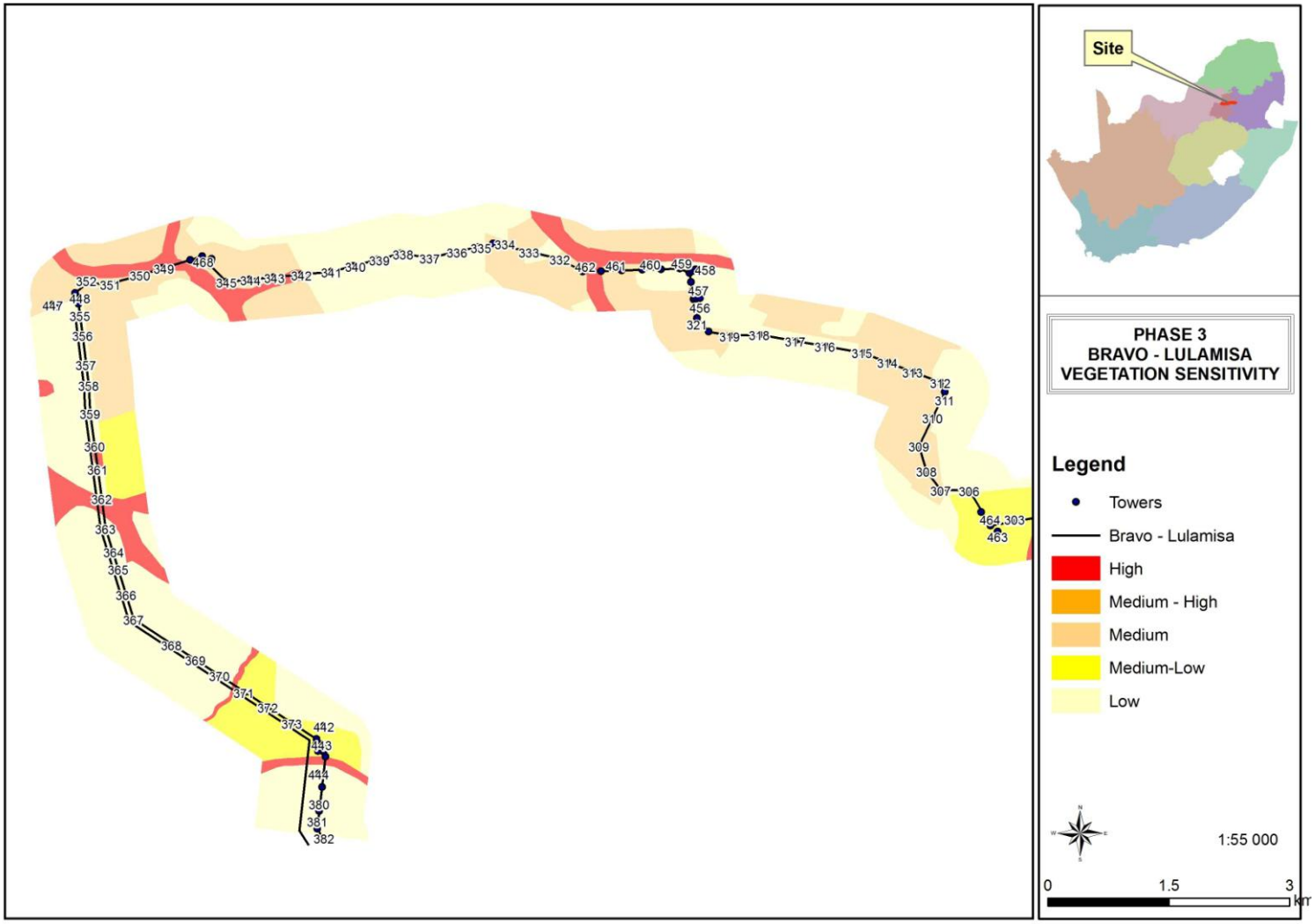

Figure 10 (1): Tower positions relative to the vegetation sensitivity categories

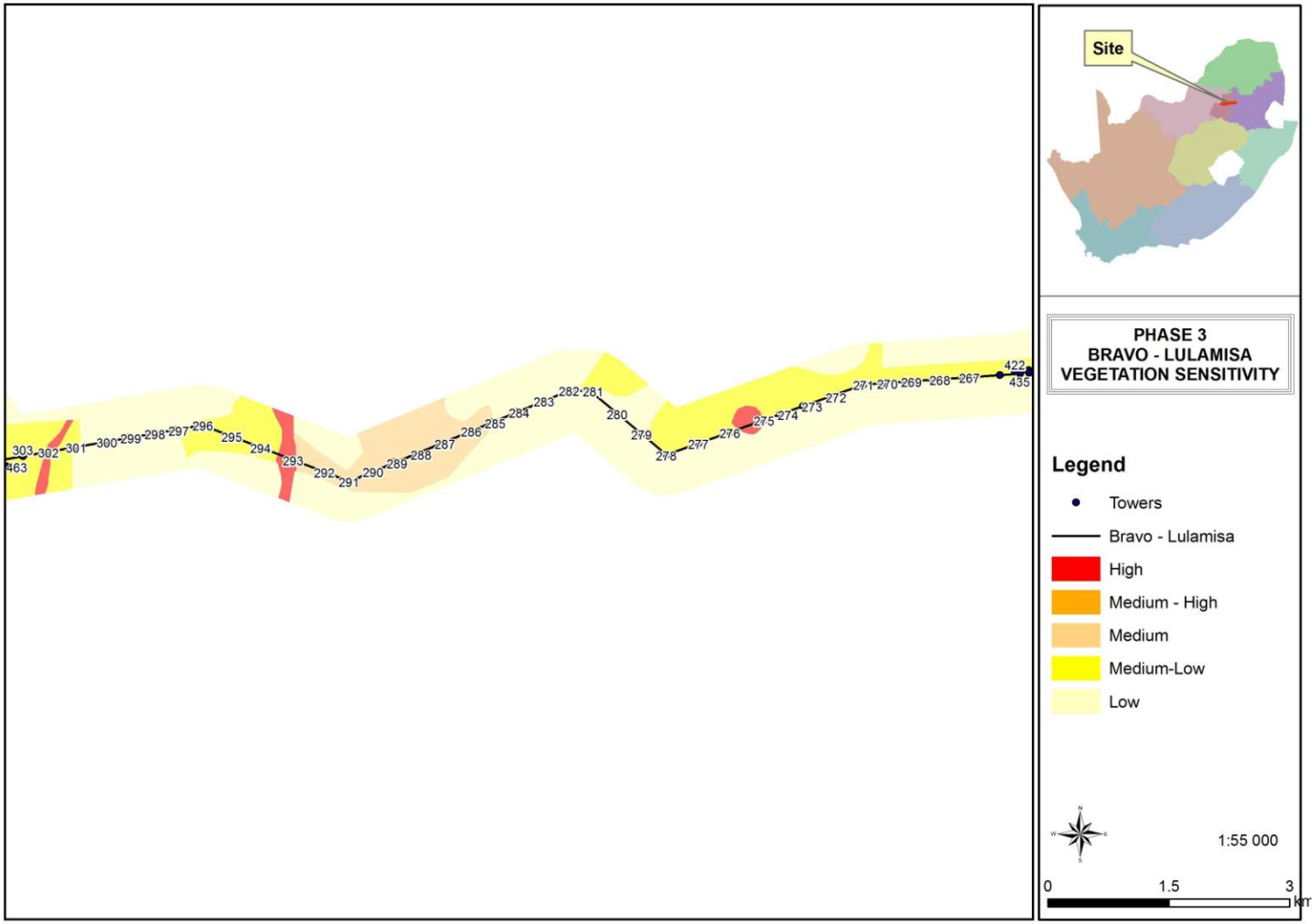

Figure 11 continued (2): Tower positions relative to the vegetation sensitivity categories

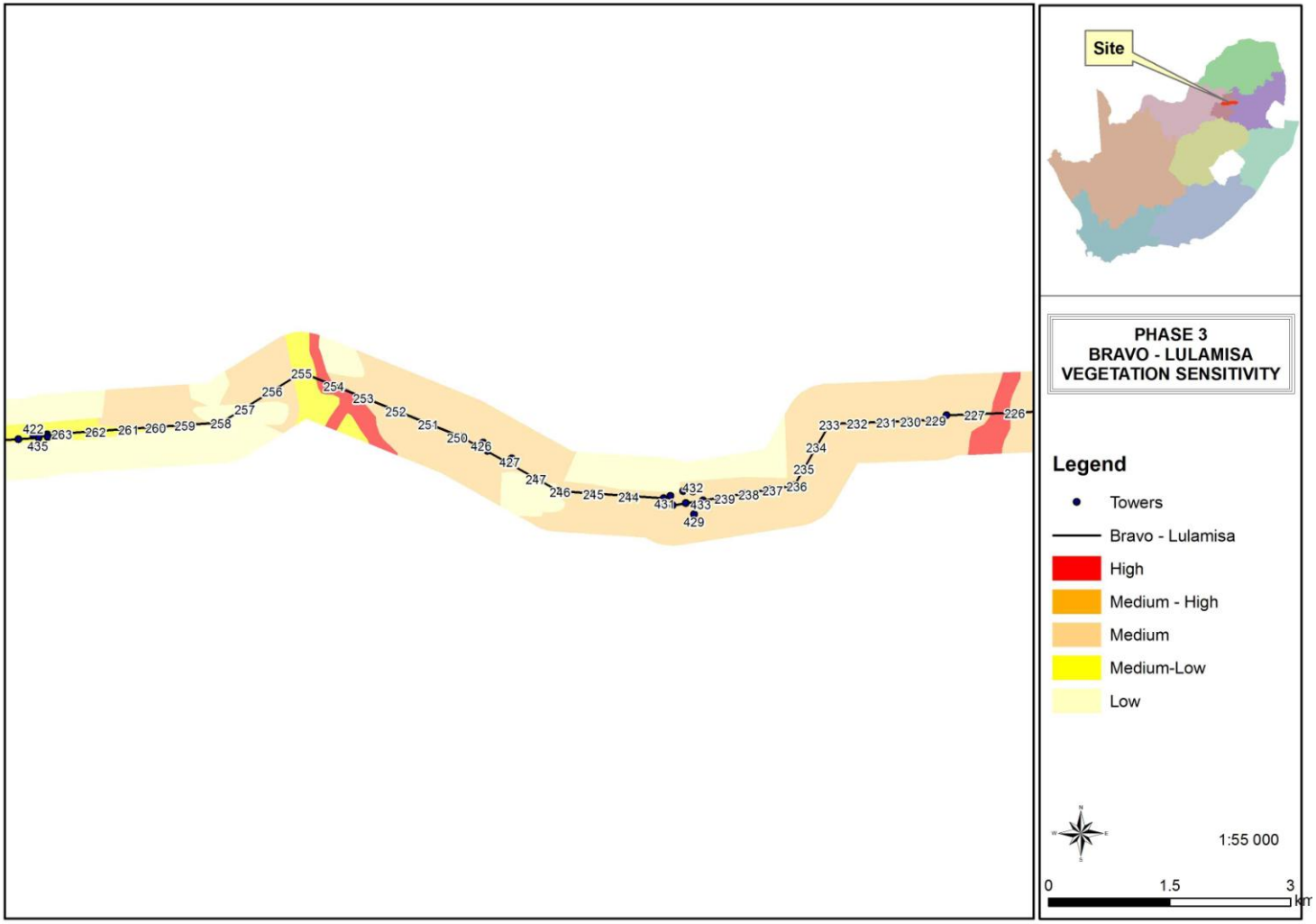

Figure 12 continued (3): Tower positions relative to the vegetation sensitivity categories

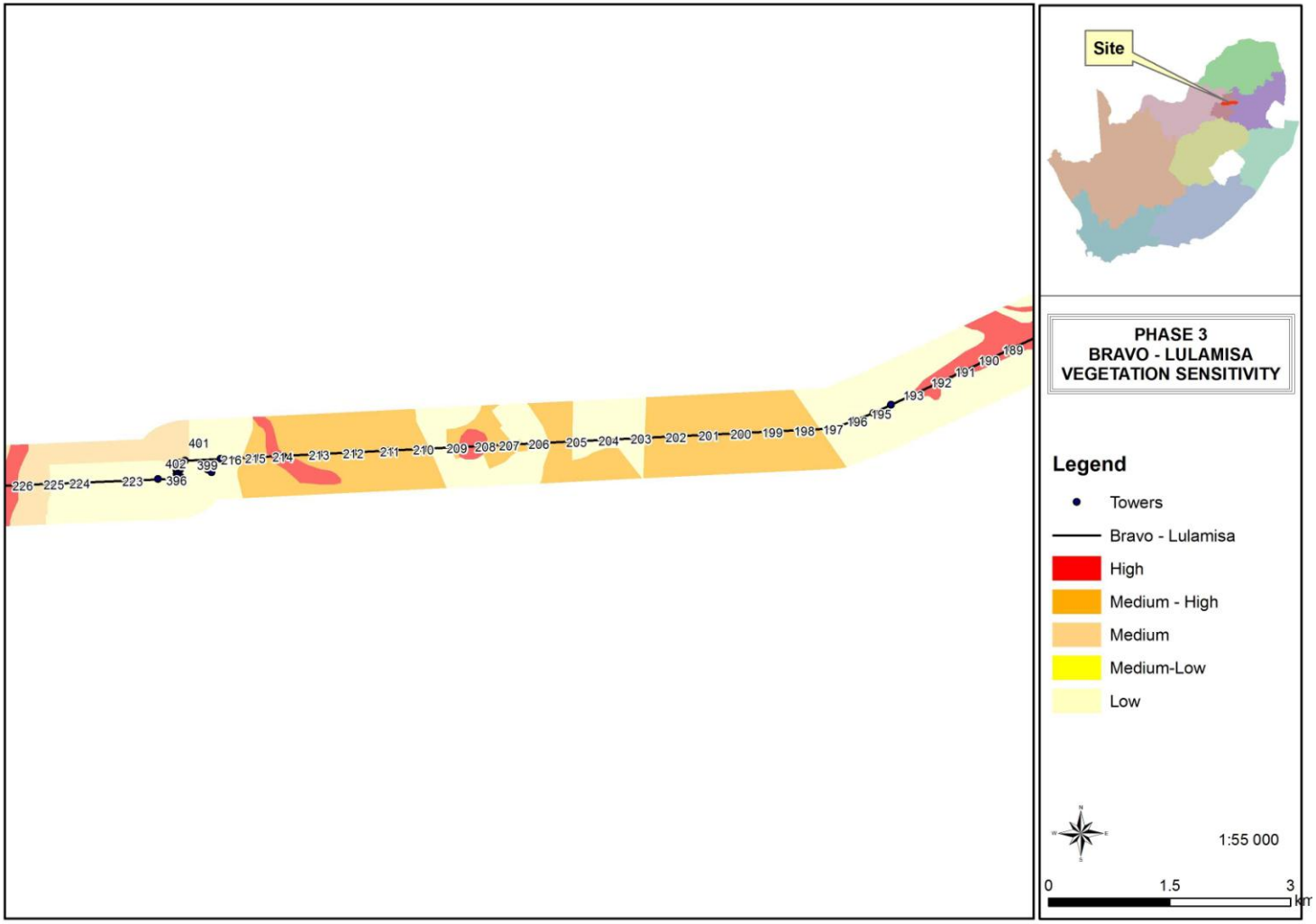

Figure 13 continued (4): Tower positions relative to the vegetation sensitivity categories

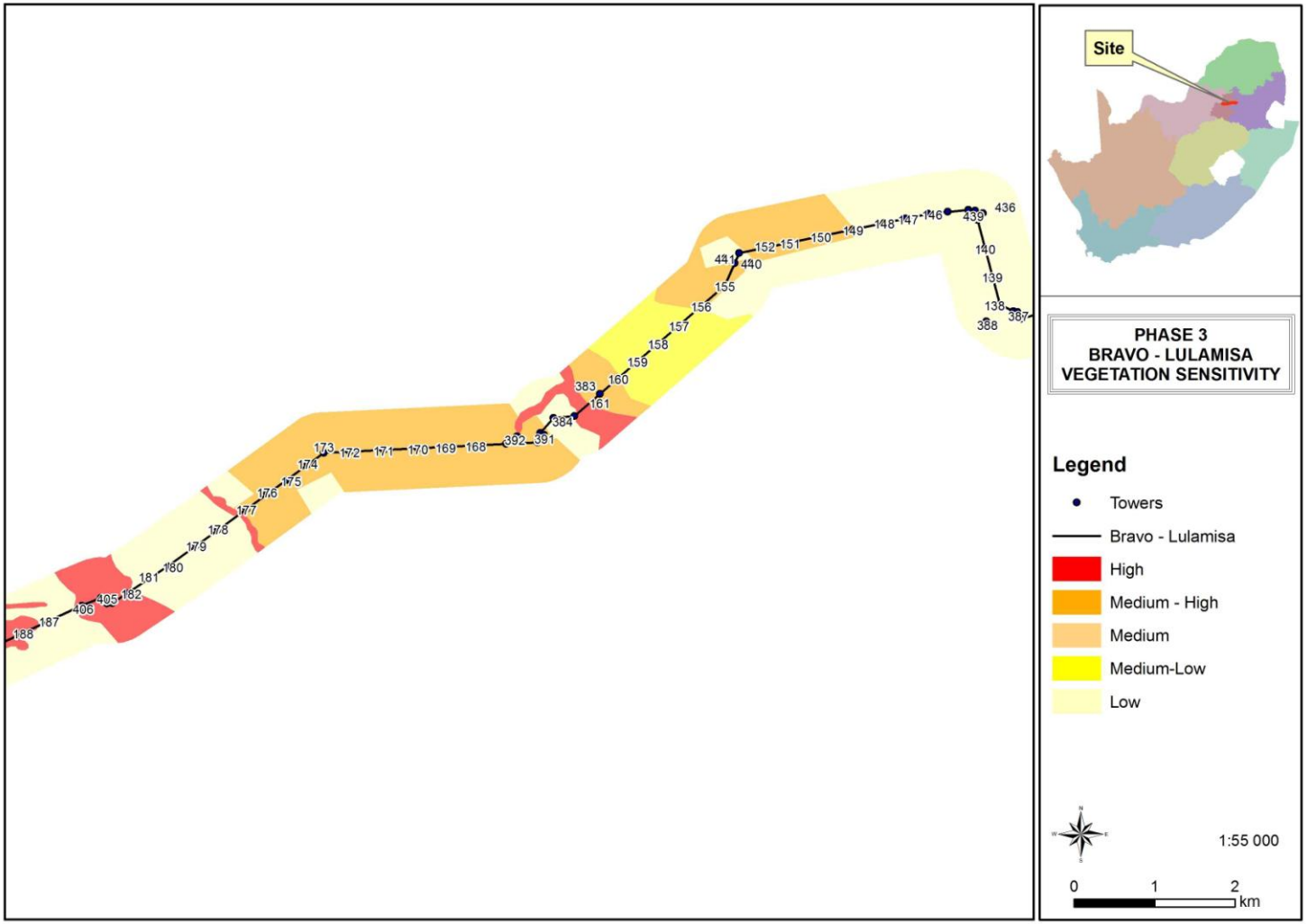

Figure 14 continued (5): Tower positions relative to the vegetation sensitivity categories

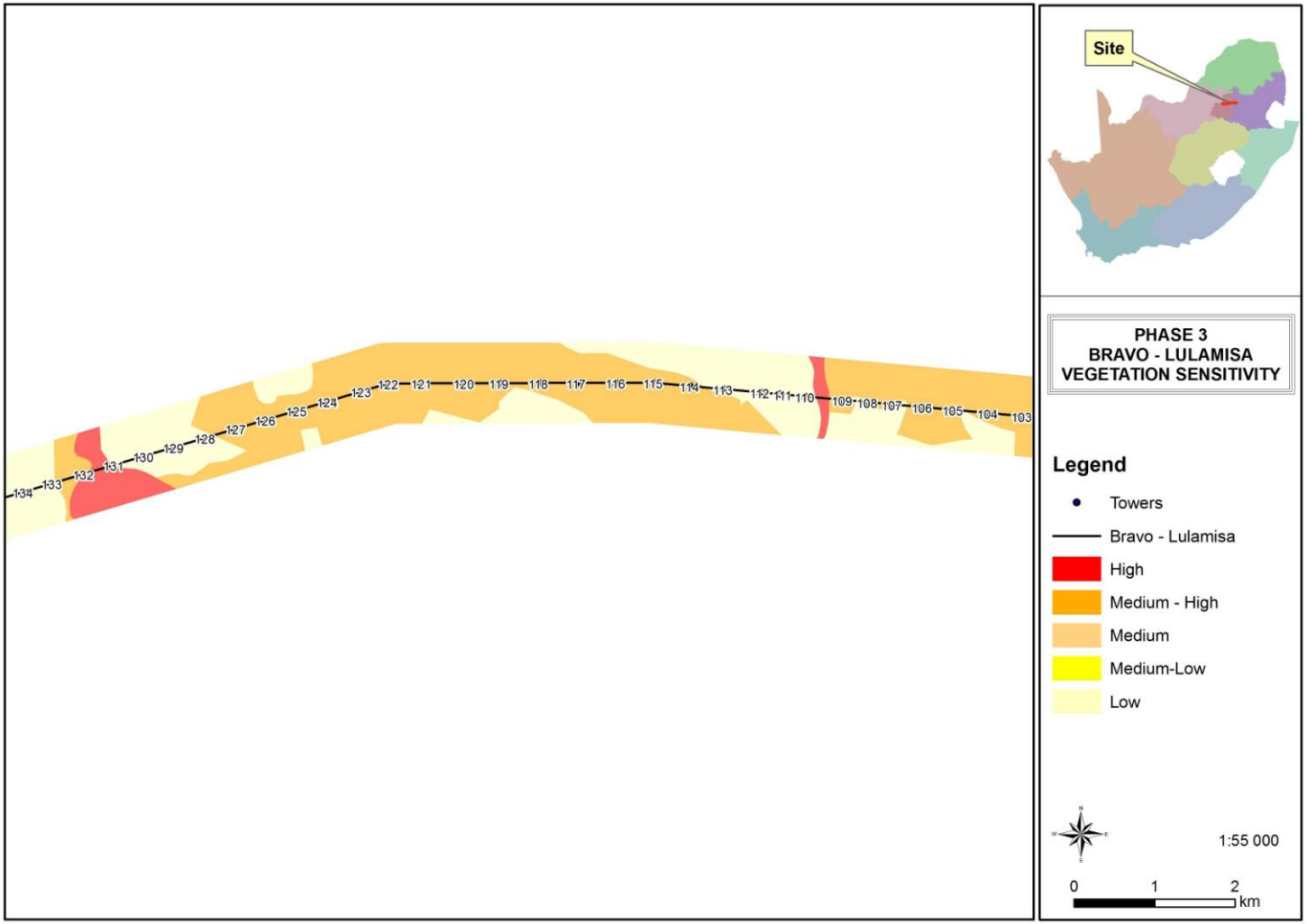

Figure 15 continued (6): Tower positions relative to the vegetation sensitivity categories

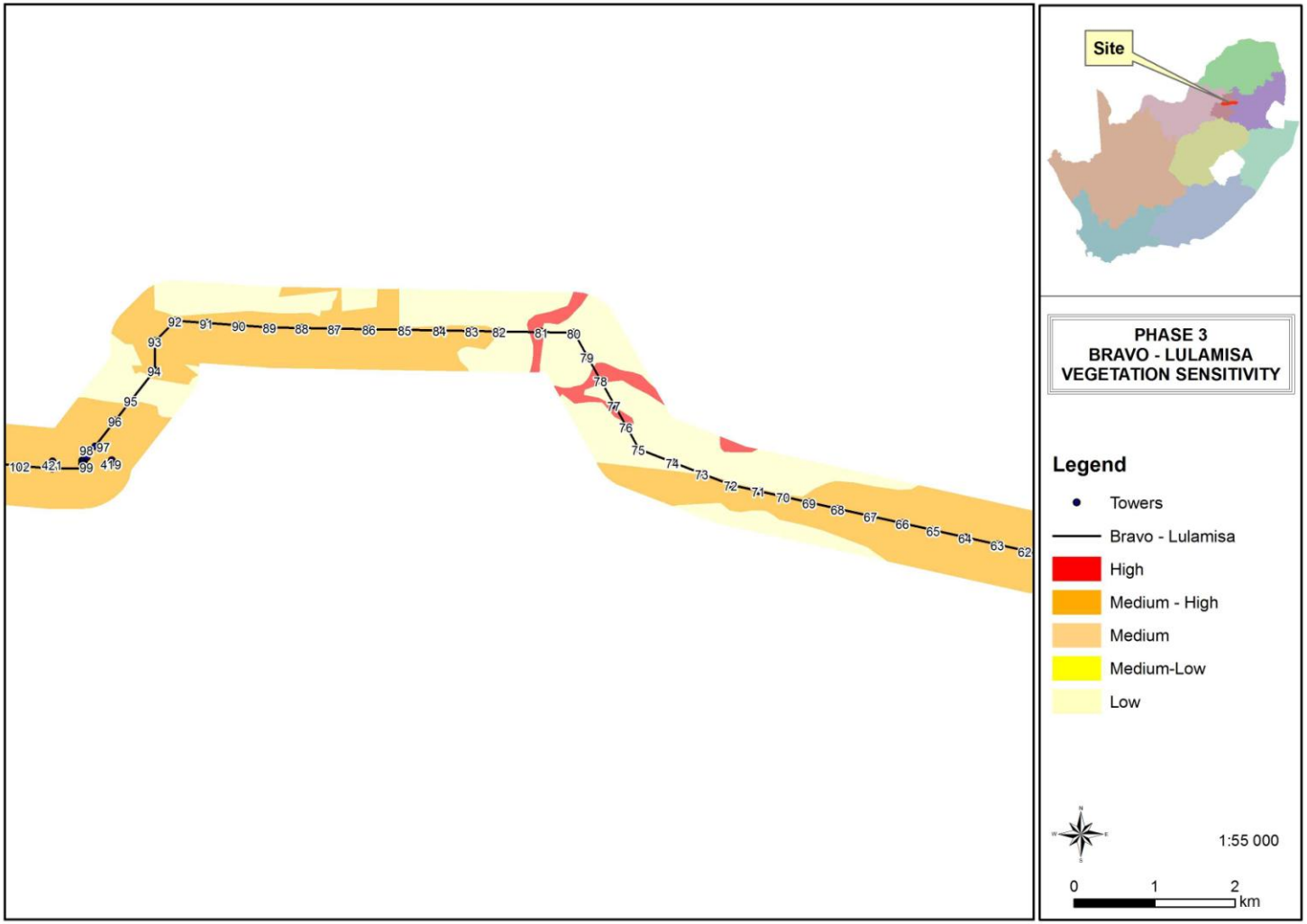

Figure 16 continued (7): Tower positions relative to the vegetation sensitivity categories

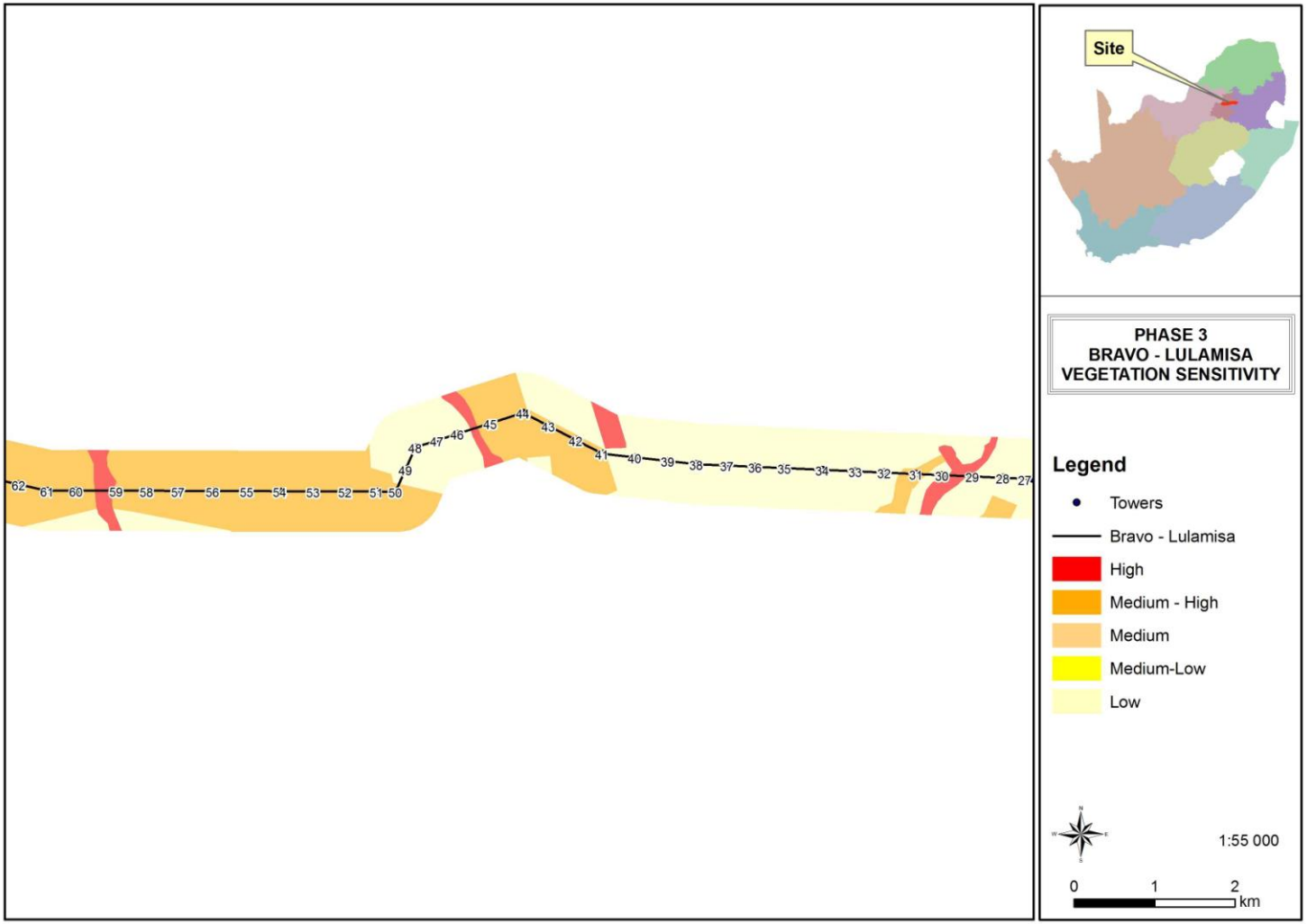

Figure 17 continued (8): Tower positions relative to the vegetation sensitivity categories

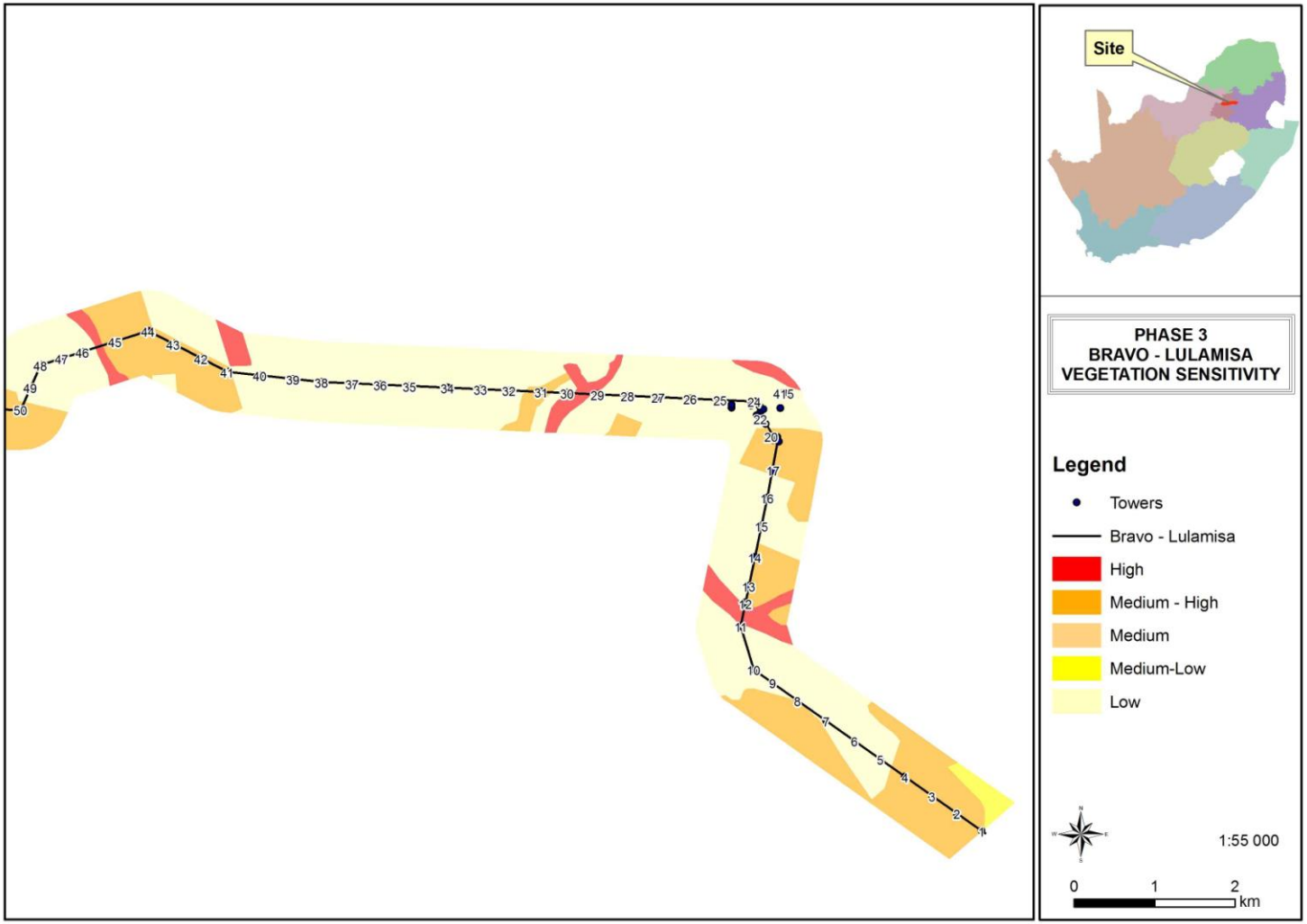

Figure 18 continued (9): Tower positions relative to the vegetation sensitivity categories

5. RESULTS: VEGETATION AND FLORA

5.1 Classification of the vegetation

The regional vegetation classification (Mucina & Rutherford, 2006) indicated that 7 different vegetation types could potentially be influenced by the powerline development (Figure 19).

A summary of these vegetation types is given below:

Vegetation Type	Description (Mucina & Rutherford, 2006)
Egoli Granite Grassland	Egoli Granite Grassland is characterised by a high species richness with a patchy dominance of various grass species and a large variety of forbs. Egoli Granite Grassland is extremely poorly conserved, with only 0.02% (26ha) of the vegetation type currently protected. Therefore the current protection status of this grassland is completely inadequate in order to meet South Africa's international obligations in terms of the Convention on Biological Diversity (Raimondo *et al*. 2015). Egoli Granite Grasslands are threatened by habitat fragmentation and transformation and its conservation status is considered to be **Endangered.** Therefore every effort needs to be made to minimise destructive effects of development in this region on the remaining patches of this vegetation type.
Carletonville Dolomite Grassland	Carletonville Dolomite Grassland is associated with slightly undulating plains dissected by prominent rocky chert ridges. The area is dominated by many grass species that forms a complex mosaic pattern. The vegetation type is **Vulnerable** with a small extent conserved in statutory. Erosion is very low (84%) to low (15%)
Rand Highveld Grassland	Rand Highveld Grassland comprises species rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. This vegetation unit is poorly conserved with much of its area transformed by cultivation, plantations, urbanisation or dam-building and mining. Where disturbances occurred, the invasive exotic tree *Acacia mearnsii* (Black Wattle) can become dominant and displace the natural vegetation. Due to the extensive usage of the areas once covered by Rand Highveld Grassland vegetation types, the remaining portions are of high conservation value and sensitivity and are .thus classified as **endangered** vegetation types
Andesite Mountain Bushveld	Andesite Mountain Bushveld is characterised by dense, medium-tall thorny bushveld with a well-developed grass layer on hill slopes and some valleys with undulating landscapes. About 7% of the area is statutorily conserved and 15% already transformed by urban areas and cultivation. The conservation status is **Least Threatened**.

Marikana Thornveld	Only a small area on the east of Pretoria is covered with this vegetation type that occurs westwards through Brits, Marikana and Rustenburg. It is considered to be **Endangered**, as <1% is statutorily conserved and 48% transformed by urbanisation, cultivation and mining.
Gold Reef Mountain Bushveld	This mountain bushveld consists of rocky quartzite ridges, and along the powerline transect the Bronberg is of great conservation importance. Smaller rocky outcrops to the east, near Bronkhorstspruit. As 22% if the area is statutorily conserved and only 15% transformed, the conservation status is **Least Threatened.**
Eastern Highveld Grassland	Eastern Highveld Grassland comprises short dense grassland and small, scattered rocky outcrops are characterised by wiry, sour grasses and some woody species. This vegetation unit is poorly conserved with much of its area transformed by cultivation, grazing, and mining. Where disturbances occurred, the invasive exotic tree *Acacia mearnsii* (Black Wattle) can become dominant and displace the natural vegetation. Due to the extensive usage of the areas once covered by Eastern Highveld Grassland vegetation types, the remaining portions are of high conservation value and sensitivity and are thus classified as **Endangered** vegetation type

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

Table 5.1: Mapping units

Mapping units / Plant Community	**Sensitivity**	**Mucina & Rutherford (2006)**
1. Spruit and Wetland vegetation	High	All vegetation types
2. Rand Highveld Grassland	Medium-High	Rand Highveld Grassland
3. *Hyparrhenia* Grassland on granite	Medium	Egoli Granite Grassland
4. Disturbed Grassland	Medium-Low	All vegetation types
5. Agriculture	Low	All vegetation types
6. Transformed Areas	Low	All vegetation types
7. Small Holdings transformed / disturbed grassland	Low	Mostly Egoli Granite Grassland Rand Highveld Grassland Andesite Mountain Bushveld Marikana Thornveld Rand Highveld grassland
8. Mixed Grassland on dolomite	Medium	Carletonville Dolomite Grassland
9. Mountain Bushveld on andesite	High	Andesite Mountain Bushveld
10. Bushveld in Tierpoort valley	Medium-High	Marikana Thornveld
11. Grassland on quartzite ridges	Medium-High	Gold Reef Mountain Bushveld

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 4). All these spruits and tributaries result in the mosaic of Grassland, Moist Grasslands and Wetlands. Wetland conditions are 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, especially in the eastern parts of the transect.

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 (i.e. often changes with intermittent flooding and drier periods), weedy and temporary, due to regular flooding. 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.

Grass species include *Cynodon dactylon, Eragrostis plana, Eragrostis curvula* and *Hyparrhenia* on drier spots and *Paspalum dilatatum, Paspalum urvillei, Imperata cylindrica* at the moister spots. Sedge species are from the genera *Cyperus, Fuirena* and *Kyllinga. Arundo donax* may be locally present.

The usual weed species such as *Verbena bonariensis, Conyza bonariensis, Plantago lanceolata, Ricinus communis, Datura stramonium, Amaranthus hybridus, Tagetes minuta, Bidens pilosa, Bidens bipinnata, Xanthium strumarium* and the exotic grass *Pennisetum clandestinum* are often found within this system.

The vegetation of spruit systems is mostly highly disturbed and degraded in the western part of the study area, particularly where they occur in the almost continuous residential and industrial areas from the Lulamisa substation eastwards to the R21 highway.

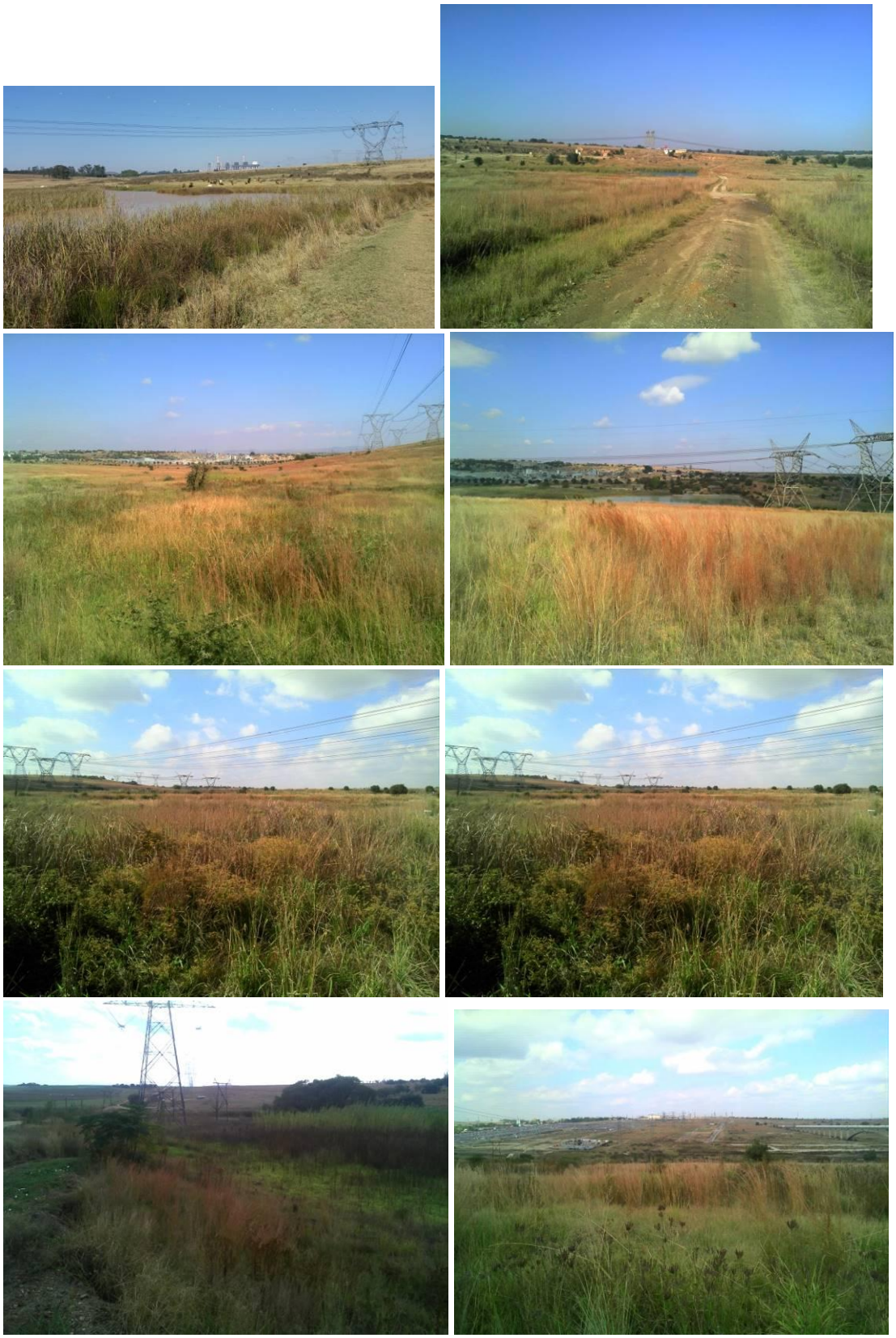

Figure 19: A collage showing different wetlands and spruits along the transect of the proposed Kusile-Lulamisa powerline.

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	High	**Need for rehabilitation**	Low
Dominant spp.	*Cyperus* sp, *Imperata cylindrica*, *Typha capensis*		

The following plant species were recorded from the spruit and wetland systems found along the proposed powerline transect:

Trees and shrubs, dwarf shrubs

Combretum erythrophyllum		*Pyracantha angustifolia*	A
Eucalyptus sp	A	*Searsia pyroides*	
Morus nigra	A	*Salix babylonica*	A
Populus alba	A	*Solanum mauritianum*	A
Populus x canescens	A	*Stoebe vulgaris*	

Grasses and sedges

Agrostis lachnantha		*Hyparrhenia dregeana*	d
Andropogon eucomus		*Hyparrhenia hirta*	d
Carex sp		*Imperata cylindrica*	
Cymbopogon caesius		*Juncus effusus*	
Cynodon dactylon		*Leersia hexandra*	
Cyperus congestus		*Leptochloa fusca*	
Cyperus laevigatus		*Paspalum dilatatum*	
Cyperus longus		*Paspalum distichum*	
Cyperus spp		*Paspalum scrobiculatum*	
Eleocharis sp		*Pennisetum clandestinum*	A
Eragrostis chloromelas		*Phragmites australis*	
Eragrostis curvula	d	*Schoenoplectus corymbosus*	
Eragrostis gummiflua		*Setaria sphacelata*	
Eragrostis plana	D	*Sporobolus africanus*	
Hemarthria altissima		*Themeda triandra*	
Heteropogon contortus		*Typha capensis*	

Forbs

Berkheya radula		*Crinum bulbispermum*	RD
Bidens bipinnata	W	*Crotalaria sp*	
Centella asiatica	M	*Equisetum ramosissimum*	
Cirsium vulgare	W	*Fuirena pubescens*	
Conyza podocephala		*Gomphocarpus fruticosus*	W
Cosmos pinnata	W	*Haplocarpha lyrata*	

Helichrysum nudifolium		*Ranunculus multifidus*	
Lobelia sp		*Rumex crispus*	W
Lotononis sp		*Schkuhria pinnata*	WM
Monopsis decipiens		*Senecio inaequalis*	
Nemesia fruticans		*Senecio inornatus*	
Oenothera rosea		*Solanum panduriforme*	
Oenothera tetraptera		*Tagetes minuta*	W
Persicaria lapathifolia		*Verbena bonariensis*	W
Persicaria serrulata		*Wahlenbergia caledonica*	
Plantago lanceolata	W		

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	3	7	10	0	0	0
Grasses and sedges	32	1	33	0	0	0
Forbs	22	9	31	1	0	2
Total	57	17	74	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 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, considered as having high conservation value and high sensitivity. Of some concern is the presence of a red data plant species (*Crinum bulbispermum*) observed at limited localities. This species is classified as Declining indicating that it is approaching thresholds for listing as threatened, but there are still adequate subpopulations in existence. There is need to minimise loss of habitat (Driver *et al*, 2009), but the proposed powerline should not be a threat to this species. The powerlines will easily span across the river and spruits, and will not affect the vegetation of the banks or wetlands negatively. Care should, however, 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.

5.2.2. Rand Highveld Grassland

This grassland occurs from Kusile (south of Balmoral), westwards to the M6 (Lynwood Rd / Graham Rd). A few relatively small quartzite ridges are present within this vegetation type (The vegetation on these quartzite ridges is discussed under 5.2.11).

This grassland vegetation is typical Rand Highveld Grassland. This area is excellent for agriculture and large parts have been ploughed for cultivation of maize, soybeans and other crops (see paragraph 5.2.5). Natural, not-ploughed areas are found scattered in isolated patches. Although most of the grassland of this mapping unit is mostly primary, some areas are disturbed and overgrazed (Figure 20).

The most prominent species are the grasses *Eragrostis curvula, Eragrostis chloromelas, Cynodon dactylon* and *Hyparrhenia hirta. Themeda triandra* is prominent on veld in good condition. The alien trees *Acacia mearnsii, Acacia dealbata* and *Eucalyptus* sp are often present, as individual trees or in groups or plantations. The two *Acacia* species are invasive.

The natural grassland is often located in the broad and shallow valley bottoms, with a narrow seasonal drainage lines. These areas are not suitable for agriculture and were consequently not ploughed.

Figure 20: Typical Rand Highveld Grassland.

Rand Highveld Grassland summary			
Status	Grazed grassland		
Soil	Light brown loam	**Rockiness**	0-5%
Conservation value:	Medium-High	**Ecological sensitivity**	Medium-High
Species richness	High	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis curvula, Eragrostis chloromelas, Hyparrhenia hirta, Eragrostis plana, Themeda triandra*		

The following plant species were recorded in this plant community:

Trees, Shrubs and Dwarf shrubs

Acacia dealbata	A	*Eucalyptus* sp	A
Acacia mearnsii	A	*Stoebe vulgaris*	

Grasses and sedges

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

Forbs

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

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	1	3	4	0	0	0
Grasses and sedges	16	0	16	0	0	0
Forbs	30	4	34	1	0	2
Total	47	7	54	1	0	2

Discussion

This grassland is currently used for grazing for cattle, and is mostly shortly grazed and locally trampled. Large areas within the Rand Highveld Grassland have been transformed for cultivation, and therefore this vegetation type is considered to be Vulnerable (SANBI, 2011). The impact of the proposed powerline is however quite small and its development can be supported.

5.2.3. *Hyparrhenia hirta* Grassland on granite

This grassland is restricted to the western-most part of the proposed powerline, within the Egoli Granite Grassland. The line stretches from the Lulamisa substation westwards to the R21 highway. This grassland vegetation type is regarded as Endangered, due to the multiple urban (residential and industrial) developments in this area. (Figure 8). Along the transect of the proposed powerline the vegetation is mostly highly disturbed, though limited patches are in a relatively good condition.

The terrain consists of slightly undulating plains. The grassland is mostly dominated by the tall-growing anthropogenic grass, *Hyparrhenia hirta.* Other common species are *Eragrostis curvula* and *Cynodon dactylon.* Herbaceous forbs are found scattered in this vegetation. (Figure 21).

Figure 21: Grassland on granite with *Hyparrhenia hirta* prominent.

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Acacia dealbata	A	*Pinus* sp	A
Acacia mearnsii	A	*Searsia lancea*	
Asparagus laricinus		*Searsia pyroides*	
Ehretia rigida		*Senegalia caffra*	
Elephantorrhiza elephantina	M	*Stoebe vulgaris*	
Eucalyptus sp	A	*Vachellia karroo*	M
Gymnosporia buxifolia			

Grasses and Sedges

Aristida congesta		*Eragrostis gummiflua*	
Aristida diffusa		*Eragrostis plana*	
Brachiaria serrata		*Heteropogon contortus*	
Bulbostylis hispidula		*Hyparrhenia hirta*	D
Cymbopogon caesius		*Melinis repens*	
Cymbopogon pospischilii		*Pogonarthria squarrosa*	
Cynodon dactylon	d	*Setaria sphacelata*	
Digitaria eriantha		*Sporobolus africanus*	
Eragrostis chloromelas	d	*Themeda triandra*	
Eragrostis curvula	d	*Trichoneura grandiglumis*	

Forbs

Aloe davyana		*Hypoxis rigidula*	
Anthospermum hispidulum		*Hypoxis* sp	
Becium obovatum		*Indigofera zeyheri*	
Chaetacanthus burchellii		*Ipomoea crassipes*	
Berkheya setifera		*Justicia anagalloides*	
Berkheya sp		*Kohautia amatymbica*	
Chamaecrista mimosoides		*Lactuca inermis*	
Commelina africana		*Nidorella hottentotica*	
Conyza podocephala		*Pentarrhinum insipidum*	
Eriosema cordatum		*Plantago lanceolata*	
Felicia muricata		*Pseudognaphalium luteoalbum*	
Gazania krebsiana		*Rhynchosia totta*	
Geigeria burkei		*Schkuhria pinnata*	MW
Gomphocarpus fruticosus		*Senecio erubescens*	
Helichrysum nudifolium		*Senecio inaequalis*	
Helichrysum rugulosum		*Sida alba*	
Hermannia betonicifolia		*Sida dregei*	
Hermannia depressa		*Tagetes minuta*	W
Hilliardiella oligocephala		*Tephrosia capensis*	
Hypoxis hemerocallidea	RD	*Verbena bonariensis*	W

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	9	4	13	0	0	2
Grasses and sedges	20	0	20	0	0	0
Forbs	37	3	40	1	0	1
Total	66	7	73	1	0	3

Grassland on granite summary			
Status	Disturbed and degraded grassland		
Soil	Shallow sandy loam	**Rockiness %**	0-15
Conservation priority:	Medium-High	**Sensitivity:**	High
Species Richness:	Very High	**Need for rehabilitation**	Medium
Dominant spp.	*Eragrostis curvula, Eragrostis chloromelas, Hyparrhenia hirta, Cynodon dactylon*		

Discussion

The species richness in this area is very high, but most areas are highly disturbed and degraded, and here the species richness is quite low. Egoli Granite Grassland is Endangered, due to the immense developments between Johannesburg and Pretoria, However, along the proposed powerline this grassland is mostly highly disturbed. As the powerline will have little impacts on the grassland, the development of the powerline can be supported.

5.2.4. Disturbed Grassland

Highly disturbed patches of grassland occur throughout the study area. (Figure 8). In many cases these areas have been ploughed for cultivation, and are now weed dominated veld or secondary grassland. The most prominent species are the grasses *Eragrostis curvula, Eragrostis chloromelas, Cynodon dactylon* and *Hyparrhenia hirta.* (Figure 22). The weeds *Tagetes minuta* and *Bidens bipinnata* are mostly prominent.

The following plant species occur in this vegetation:

Trees and shrubs

Acacia dealbata	A	*Eucalyptus* sp	A
Acacia mearnsii	A	*Stoebe vulgaris*	

Grasses

Aristida aequiglumis		*Heteropogon contortus*	
Aristida congesta		*Hyparrhenia hirta*	D
Cynodon dactylon	D	*Melinis repens*	
Eragrostis chloromelas	d	*Paspalum dilatatum*	
Eragrostis curvula	D	*Pogonarthria squarrosa*	
Eragrostis gummiflua		*Sporobolus africanus*	
Eragrostis plana	d		

Forbs

Anthospermum hispidulum		*Helichrysum nudifolium*	
Bidens bipinnata	W	*Helichrysum rugulosum*	
Cosmos pinnata	W	*Senecio erubescens*	
Guilleminea densa	W	*Senecio inaequilatera*	W
Schkuhria pinnata	WM	*Tagetes minuta*	W

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	1	3	4	0	0	0
Grasses and sedges	13	0	13	0	0	0
Forbs	3	7	10	0	0	1
Total	17	10	27	0	0	1

Figure 22: Disturbed grassland with Kusile power station in the background

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

Discussion

This vegetation is highly degraded with no or little conservation value. 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 23), 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 *Cynodon dactylon, Eragrostis curvula* and

Eragrostis chloromelas. The tall-growing grass *Hyparrhenia hirta* is present forming typical isolated clumps.

Figure 23: 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

Bidens bipinnata	W	*Tagetes minuta*	W
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, Eragrostis curvula, Cynodon dactylon*		

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, where the natural vegetation has been destroyed, include dense built-up residential areas and industrial areas in e.g. Diepsloot, Olievenhoutbosch, Blue Valley Golf Estate, Randjesfontein, (Samrand industrial area) and Midstream Estates. Large plantations of alien plant species are also included in transformed areas. Only weedy species, alien trees and planted ornamental plant species are found in these areas and the vegetation is not discussed further.

5.2.7. Small Holdings

Some agricultural holdings are crossed (or at least bypassed) by the proposed powerline, e.g. Laezonia agricultural holdings, Timsrand agricultural Holdings, Knoppieslaagte, Tierpoort and Bashewa agricultural holdings. The vegetation of these areas are quite varied, including well-developed gardens with vast lawn and severa planted exotic and indigenous ornamental plant species, but also include partly developed or undeveloped holdings covered with disturbed grassland. Here the vegetation is mostly dominated by species such as *Hyparrhenia hirta, Eragrostis curvula, Cynodon dactylon* and often several weedy species. No attempt was made to describe the gardens but holdings at several localities were surveyed. Access was often a problem in these areas.

The following plant species occur in this vegetation:

Trees and shrubs

Acacia mearnsii	A	*Searsia pyroides*	
Eucalyptus sp	A	*Senegalia caffra*	
Gymnosporia buxifolia		*Stoebe vulgaris*	
Searsia lancea		*Vachellia karroo*	

Grasses

Aristida congesta		*Hyparrhenia hirta*	D
Cynodon dactylon	D	*Melinis repens*	
Eragrostis chloromelas	d	*Paspalum dilatatum*	
Eragrostis curvula	D	*Pennisetum clandestinum*	A
Eragrostis gummiflua		*Pogonarthria squarrosa*	
Eragrostis plana	d	*Sporobolus africanus*	
Heteropogon contortus			

Forbs

Bidens bipinnata	W	*Helichrysum nudifolium*	
Cosmos pinnata	W	*Helichrysum rugulosum*	
Guilleminea densa	W	*Senecio inaequilatera*	W
Schkuhria pinnata	WM	*Tagetes minuta*	W

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	6	2	8	0	0	0
Grasses and sedges	12	1	13	0	0	0
Forbs	2	6	8	0	0	1
Total	20	9	29	0	0	1

Small holdings summary			
Status	Primary and secondary disturbed and degraded grasslandor developed gardens		
Soil	Sandy loam	**Rockiness %**	1-5
Conservation priority:	Low	**Sensitivity:**	Low
Species Richness:	Low	**Need for rehabilitation**	Medium
Dominant spp.	*Eragrostis curvula, Cynodon dactylon, Hyparrhenia hirta*		

Discussion

This vegetation is often degraded with no or little conservation value. The powerline can be supported (however resistance was observed at some property owners).

5.2.8. Grassland on Dolomite

The proposed powerline transect crosses an area underlain by dolomite and chert from just west of the R21 highway to the R50 road. The vegetation is mostly wuite disturbed (Figure 24). The powerline also crosses a part of the Rietvlei Nature Reserve. Within the Reserve this grassland is in a good condition. Due to rocky, shallow soils these areas are mostly not used for cultivation. The grassland has the typical plant species composition of rocky shallow soils.

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Acacia mearnsii	A	*Eucalyptus* sp	A
Asparagus laricinus		*Gymnosporia buxifolia*	
Asparagus suaveolens		*Pinus* sp	A
Ehretia rigida		*Searsia lancea*	
Elephantorrhiza elephantina	M	*Searsia pyroides*	

Senegalia caffra		*Vachellia karroo*	M
Stoebe vulgaris		*Vachellia tortilis*	

Grasses and Sedges

Andropogon schirensis		*Hyparrhenia hirta*	D
Aristida congesta		*Loudetia simplex*	
Aristida diffusa		*Melinis nerviglume*	
Brachiaria serrata		*Melinis repens*	
Bulbostylis burchellii		*Panicum natalense*	
Cymbopogon caesius		*Pogonarthria squarrosa*	
Cymbopogon pospischilii		*Schizachyrium sanguineum*	
Cynodon dactylon	d	*Setaria sphacelata*	
Digitaria eriantha		*Themeda triandra*	
Diheteropogon amplectens		*Trachypogon spicatus*	
Eragrostis chloromelas	d	*Trichoneura grandiglumis*	
Eragrostis curvula	d	*Urelytrum agropyroides*	
Heteropogon contortus			

Forbs

Aloe davyana		*Indigofera zeyheri*	
Anthospermum hispidulum		*Ipomoea crassipes*	
Becium obovatum		*Justicia anagalloides*	
Chaetacanthus burchellii		*Kohautia amatymbica*	
Commelina africana		*Nidorella hottentotica*	
Eriosema cordatum		*Pentarrhinum insipidum*	
Felicia muricata		*Pseudognaphalium luteoalbum*	
Gazania krebsiana		*Rhynchosia minima*	
Geigeria burkei		*Rhynchosia totta*	
Gomphocarpus fruticosus		*Schkuhria pinnata*	MW
Helichrysum miconiifolium		*Senecio inaequalis*	
Helichrysum nudifolium		*Sida dregei*	
Helichrysum rugulosum		*Tagetes minuta*	W
Hermannia lancifolia		*Tephrosia capensis*	
Hermannia depressa		*Thesium utile*	
Hilliardiella oligocephala		*Verbena bonariensis*	W
Hypoxis rigidula			

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	11	3	14	0	0	2
Grasses and sedges	23	0	23	0	0	0
Forbs	30	3	33	0	0	1
Total	64	6	70	0	0	3

Figure 24: Grassland on dolomite

Grassland on dolerite summary			
Status	Disturbed and degraded grassland		
Soil	Shallow sandy loam	**Rockiness %**	0-20
Conservation priority:	Medium-High	**Sensitivity:**	Medium-High
Species Richness:	Very High	**Need for rehabilitation**	Low
Dominant spp.	*Loudetia simplex, Diheteropogon amplectens, Schizachyrium sanguineum*		

Discussion

The species richness in this area is very rich, but most areas, except Rietvlei Nature Reserve are disturbed and degraded. Carletonville Dolomite Grassland is Vulnerable (SANBI 2011), due to the development, however according to Mucina and Rutherford (2006) the area is Least Threatened. However, along the proposed powerline this grassland is mostly highly disturbed, except in Rietvlei Nature Reserve where the vegetation is in good condition. As the powerline will have little impacts on the grassland, the development of the powerline can be supported.

5.2.9. Mixed Mountain Bushveld on andesite

This ecosystem does form part of the hills and ridges of Gauteng and is therefore subject to the “Hills and Ridges” policy of GDARD.

This area of the Bronberg is furthermore known for the presence of red data plant and animal species. However, an existing Eskom powerline crosses the ridge here and the Eskom servitude has been cleared. However, due to the sensitivity of this area, which is classified by SANBI (2011) as Critically Endangered, the vegetation survey and subsequently the vegetation map included 500 m on both sided of the powerline. This is a mixed mountain shrubveld with many plant species (Figure 8).

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Acacia mearnsii	A	*Mundulea sericea*	
Afrocanthium gilfillanii		*Ochna pretoriensis*	
Combretum molle		*Ochna pulchra*	
Croton gratissimus		*Olea europaea ssp. africana*	
Ancylobothrys capensis		*Rothmannia capensis*	
Burkea africana		*Sarcostemma viminale*	
Cryptolepis oblongifolia		*Searsia lancea*	
Diospyros lycioides		*Searsia magalismontana*	
Elephantorrhiza burkei		*Searsia zeyheri*	
Englerophytum magalismontanum		*Strychnos pungens*	
Euclea crispa	M	*Terminalia sericea*	
Gymnosporia tenuispina		*Vangueria infausta*	
Lannea discolor		*Vangueria parvifolia*	
Lantana camara	A	*Ziziphus mucronata*	M
Lopholaena coriifolia			

Grasses and sedges

Aristida congesta	*Brachiaria deflexa*
Aristida transvaalensis	*Brachiaria serrata*

Bulbostylis hispidula
Cymbopogon caesius
Cymbopogon pospischilii
Cynodon dactylon
Digitaria eriantha
Diheteropogon amplectens
Eragrostis curvula
Eragrostis racemosa
Heteropogon contortus
Hyparrhenia hirta
Loudetia simplex
Melinis nerviglumis
Melinis repens
Panicum maximum
Panicum natalensis
Perotis patens
Pogonarthria squarrosa
Schizachyrium sanguineum
Setaria lindenbergiana
Setaria sphacelata
Themeda triandra
Trachypogon spicatus
Tristachya leucothrix d
Tristachya rehmannii
Urelytrum agropyroides

Forbs

Ceratotheca triloba W
Cheilanthes viridis
Cleome angustifolia
Cleome monophylla
Commelina africana
Elephantorrhiza elephantina
Fimbristylis hispidula
Gladiolus species
Helichrysum kraussii
Hibiscus cannabinus
Indigofera comosa
Kalanchoe paniculata
Leonotis ocymifolia
Oldenlandia herbacea
Parinari capensis
Pellaea calomelanos
Plectranthus sp
Psammotropha myriantha
Rhynchosia nitens
Selaginella dregei
Tagetes minuta W
Tragia sp
Ursinia nana
Xenostegia tridentata
Xerophyta retinervis

Number of species recorded:

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	27	2	29	0	0	2
Grasses	27	0	27	0	0	0
Forbs	23	2	25	0	0	0
Total	77	4	81	0	0	2

Mixed Mountain Bushveld on andesite summary

Status	Species rich rare mountain bushveld on ridge		
Soil	Shallow loam	**Rockiness %**	0-20
Conservation priority:	High	**Sensitivity:**	High
Species Richness:	Very High	**Need for rehabilitation**	Low
Dominant spp.	*Diospyros lycioides, Euclea crispa, Loudetia simplex, Diheteropogon amplectens, Schizachyrium sanguineum*		

Discussion

This area is situated on a ridge. No red data plant species were recorded, though there is suitable habitat for *Ceropegia decidua* subsp *pretoriensis.* Some alien woody species are present but the vegetation is generally in a good condition with very high plant species richness. The current powerline is in an Eskom servitude where the vegetation is partially cleared. It is not foreseen that an additional powerline will affect the vegetation much, but as this is such a sensitive ecosystem, clearing of vegetation should be kept to a minimum.

5.2.10. Bushveld in the Tierpoort area

East of the M6 Road, (Lynnwood Rd) is a shallow valley covered with woody vegetation (Figure 25). The soil is rocky and shallow. This vegetation occurs on the small holdings located immediately north of the Bronberg and particularly north of the M6 Road, and also occurs further east on farmland. A consequence is that this vegetation is variously disturbed, caused by the different management practices applied by the many landowners.

Generally though, the vegetation is a mixed thornveld, with *Senegalia caffra* mostly present (Figure 16). Other conspicuous woody plant species include *Searsia zeyheri, Gymnosporia buxifolia, Ziziphus mucronata, Euclea crispa* and *Olea europaea* subsp *africana.* The grass cover is utilised, often trampled or even replaced by agriculture or gardens. Prominent grass species found in the more natural areas include *Hyparrhenia hirta, Eragrostis curvula, Digitaria diagonalis* and *Themeda triandra.*

Conspicuous forbs that were noted include *Aloe davyana, Boophone disticha* and *Athrixia elata.*

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Afrocanthium gilfillanii		*Opuntia ficus-indica*	A
Clematis brachiata		*Rothmannia capensis*	
Combretum molle		*Sarcostemma viminale*	
Diospyros lycioides		*Searsia lancea*	
Elephantorrhiza elephantina		*Searsia pyroides*	
Euclea crispa	dM	*Searsia zeyheri*	
Gymnosporia tenuispina		*Senegalia caffra*	d
Lantana camara	A	*Strychnos pungens*	
Mundulea sericea		*Vangueria infausta*	
Olea europaea ssp. africana	d	*Ziziphus mucronata*	dM

Grasses and sedges

Aristida congesta		*Eragrostis racemosa*	
Brachiaria serrata		*Heteropogon contortus*	
Bulbostylis hispidula		*Hyparrhenia hirta*	d
Cymbopogon caesius		*Melinis repens*	
Cymbopogon pospischilii		*Panicum maximum*	
Cynodon dactylon		*Perotis patens*	
Digitaria diagonalis		*Pogonarthria squarrosa*	
Digitaria eriantha		*Setaria sphacelata*	
Diheteropogon amplectens		*Themeda triandra*	d
Eragrostis curvula	d		

Forbs

Aloe davyana		*Lantana rugosa*	
Athrixia elata		*Leonotis ocymifolia*	
Boophone disticha	RD	*Lippia javanica*	
Commelina africana		*Oldenlandia herbacea*	
Fimbristylis hispidula		*Parinari capensis*	
Gazania krebsiana		*Pentanisia angustifolia*	
Helichrysum rigidula		*Tagetes minuta*	W
Hibiscus aethiopicus		*Xenostegia tridentata*	
Hypoxis rigidula			
Kalanchoe paniculata			

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	19	1	20	0	0	2
Grasses and sedges	19	0	19	0	0	0
Forbs	17	1	18	1	0	0
Total	55	2	57	1	0	2

Figure 25: Mixed Bushveld in the Tierpoort valley

Bushveld in the Tierpoort area summary			
Status	Disturbed and semi-developed area		
Soil	Shallow to deep sandy loam	**Rockiness %**	0-100
Conservation priority:	Medium-High	**Sensitivity:**	Medium-Low
Species Richness:	High	**Need for rehabilitation**	Low
Dominant spp.	*Senegalia caffra, Euclea crispa, Ziziphus mucronata*		

Discussion

The transect of the powerline is located along an existing Eskom powerline, and it runs over small holdings and farmland. For the extra lines, some trees will have to be removed for the construction phase and tall-growing woody vegetation will have to be controlled to avoid damage to the electricity systems, during the operational phase. In general no threatened or rare woody plant species were noted along the transect.

Herbaceous vegetation will not be damaged much by the pylons and the chance that some threatened herbaceous plant species will be in the way of the pylons, is very small.

5.2.11. Grassland on quartzite ridges

Limited rocky quartzite ridges are found In the Bronkhorstspruit area. The proposed powerline will cross these ridges. The ridges are very rocky with quartzite boulders and sheets, and with scattered woody vegetation (Figure 26). Access to these ridges was very limited, and the vegetation was sampled at a few plots only. The dominant plant species is the grass *Aristida transvaalensis.* Woody species include *Senegalia caffra, Celtis africana, Ziziphus mucronata* and *Searsia pyroides.*

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Diospyros lycioides		*Searsia lancea*	
Elephantorrhiza elephantina		*Searsia pyroides*	
Euclea crispa	dM	*Senegalia caffra*	d
Gymnosporia buxifolia		*Ziziphus mucronata*	dM
Mundulea sericea			

Grasses and sedges

Aristida congesta		*Loudetia simplex*	d
Aristida transvaalensis	D	*Melinis nerviglumis*	
Brachiaria serrata		*Melinis repens*	
Bulbostylis hispidula		*Panicum natalensis*	
Cymbopogon caesius		*Perotis patens*	
Cymbopogon pospischilii		*Pogonarthria squarrosa*	
Cynodon dactylon		*Schizachyrium sanguineum*	d
Digitaria eriantha		*Setaria sphacelata*	
Diheteropogon amplectens	d	*Themeda triandra*	
Eragrostis curvula		*Trachypogon spicatus*	
Eragrostis racemosa		*Tristachya leucothrix*	d
Heteropogon contortus		*Tristachya rehmannii*	
Hyparrhenia hirta			

Forbs

Aloe davyana		*Hibiscus aethiopicus*	
Athrixia elata		*Hypoxis rigidula*	
Boophone disticha	RD	*Kalanchoe paniculata*	
Commelina africana		*Lantana rugosa*	
Fimbristylis hispidula		*Leonotis ocymifolia*	
Gazania krebsiana		*Lippia javanica*	
Helichrysum rigidula		*Parinari capensis*	

Pentanisia angustifolia *Xenostegia tridentata*
Tagetes minuta W

Number of species recorded:

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	9	0	9	0	0	2
Grasses and sedges	25	0	25	0	0	0
Forbs	16	1	17	0	0	0
Total	50	1	51	0	0	2



Figure 26: Quartzite ridges grassland

Grassland on quartzite ridge summary			
Status	rocky grassland		
Soil	Shallow sandy loam	**Rockiness %**	10-50
Conservation priority:	Medium-High	**Sensitivity:**	Medium-High
Species Richness:	High	**Need for rehabilitation**	Low
Dominant spp.	*Loudetia simplex, Diheteropogon amplectens, Schizachyrium sanguineum*		

Discussion

The proposed powerline crosses the very rocky ridges in this area, along existing powerlines. No red data plant species was recorded along the transect. The proposed powerline can be supported because it is within the servitude of existing powerlines. The

chance that threatened plant species will be in the way of pylons is small, though construction of pylons in this rocky area will cause bigger environmental damage than in not-rocky areas. This damage must be rehabilitated in a suitable way. On the other hand it can be stated that the vegetation under the powerlines is protected from other more vegetation destructive developments.

5.3 Species of Conservation Concern

A list of Species of Conservation Concern for the grids grids 1528 CC, CD, DC and DD BD was obtained from the database on the SANBI website. 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 1528 CC, CD, DC and DD BD by SANBI (POSA, 2016 website)

Family	Species	Threat status	Available habitat
Euphorbiaceae	*Acalypha caperonioides* Baill. var. *caperonioides*	DDT	Limited not found
Poaceae	*Agrostis eriantha* Hack. var. *planifolia* Gooss. & Papendorf	DDT	Limited to wet areas, not found
Apiaceae	*Alepidea peduncularis* A.Rich.	DDT	Grassland, not found
Amaryllidaceae	*Boophone disticha* (L.f.) Herb.	Declining	Yes, not found
Hyacinthaceae	*Bowiea volubilis* Harv. ex Hook.f. subsp. *volubilis*	VU	Yes, Bushveld, Tierpoort area, not found
Orchidaceae	*Brachycorythis conica* (Summerh.) Summerh. subsp. *transvaalensis* Summerh.	EN	Limited to the dolomite grassland in Irene area, not found
Asteraceae	*Callilepis leptophylla* Harv.	Declining	Grassland, not found
Apocynaceae	*Ceropegia decidua* E.A.Bruce subsp. *pretoriensis* R.A.Dyer	VU	Yes Bronberg area, not found
Capparaceae	*Cleome conrathii* Burtt Davy	NT	No
Amaryllidaceae	*Crinum bulbispermum* (Burm.f.) Milne-Redh. & Schweick.	Declining	Wetland areas, not found but possibly present
Amaryllidaceae	*Crinum macowanii* Baker	Declining	Wetland areas, not found but possibly present
Acanthaceae	*Dicliptera magaliesbergensis* K.Balkwill	VU	Yes, Bronberg area, not found
Hyacinthaceae	*Drimia elata* Jacq.	DDT	No
Hyacinthaceae	*Drimia sanguinea* (Schinz) Jessop	NT	No
Zamiaceae	*Encephalartos laevifolius* Stapf & Burtt Davy	CR	No
Zamiaceae	*Encephalartos lanatus* Stapf & Burtt Davy	NT	No
Zamiaceae	*Encephalartos longifolius* (Jacq.) Lehm.	NT	No
Scrophulariaceae	*Freylinia tropica* S.Moore	Rare	No
Mesembryanthemaceae	*Frithia humilis* Burgoyne	EN	Limited but geology not suitable
Gunneraceae	*Gunnera perpensa* L.	Declining	Very limited, to wet areas not found

Orchidaceae	*Habenaria barbertoni* Kraenzl. & Schltr.	NT	No
Orchidaceae	*Habenaria bicolor* Conrath & Kraenzl.	NT	Limited
Orchidaceae	*Habenaria kraenzliniana* Schltr.	NT	No
Orchidaceae	*Habenaria mossii* (G.Will.) J.C.Manning	EN	No
Orchidaceae	*Holothrix randii* Rendle	NT	No
Hypoxidaceae	*Hypoxis hemerocallidea* Fisch., C.A.Mey. & Avé-Lall.	Declining	Yes, present
Aquifoliaceae	*Ilex mitis* (L.) Radlk. var. mitis	Declining	No
Fabaceae	*Indigofera hybrida* N.E.Br.	VU	?
Proteaceae	*Leucadendron daphnoides* (Thunb.) Meisn.	EN	No
Mesembryanthemaceae	*Lithops lesliei* (N.E.Br.) N.E.Br. subsp. *lesliei*	NT	No
Fabaceae	*Melolobium subspicatum* Conrath	VU	No
Apocynaceae	*Miraglossum laeve* Kupicha	Threatened	?
Myrothamnaceae	*Myrothamnus flabellifolius* Welw.	DDT	Yes quartzite ridges, but not recorded
Fabaceae	*Pearsonia bracteata* (Benth.) Polhill	NT	?
Anacardiaceae	*Searsia gracillima* (Engl.) Moffett var. *gracillima*	NT	No
Apocynaceae	*Stenostelma umbelluliferum* (Schltr.) S.P.Bester & Nicholas	NT	No
Alliaceae	*Tulbaghia pretoriensis* Vosa & Condy	DDT	Limited? Not found

Several plant species of conservation concern were previously recorded from the grids 2628BB, 2629 AC and 2629 CA, listed by SANBI. This is because the powerline is long and crosses several vegetation types and habitats. *Leucadendron* and *Encaphalartos* sp were probable noted from gardens, as these species do not occur in this area, *Encephalartos lanatus* occurs in the Middelburg area but not within the study area transect. Species that were recorded include *Boophone disticha* and *Hypoxis hemerocallidea*. It is however possible that more of 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 many of these species. The Declining species (*Hypoxis hemerocallidea* and *Boophone disticha*) has not yet reached a threshold of concern and therefore limited loss of habitat may be permitted. (Driver *et al.*, 2009).

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 result of the sensitivity assessment indicates that the Rocky plateau and Rocky Outcrops (mapping units 1&2), are considered to be sensitive (GDARD minimum requirements, GDARD hills and ridges policy). The alien *Eucalyptus* bush is classified as being of low sensitivity. The riparian area and ridge vegetation also scored high.

Table: 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 & 7	Not applicable No natural vegetation Score 0		0	0	1	0	**1 Low**
Spruits and associated wetlands, mapping units 1	3	3	3	2	3	3	**17 High**
Grassland, mapping units 2, 8 & 11	**3**	**3**	**1**	**2**	**2**	**2**	**13 Medium-High**
Disturbed grassland, mapping unit 4	**2**	**1**	**1**	**2**	**2**	**1**	**9 Medium-Low**
Egoli Granite Grassland, mapping unit 3	**3**	**3**	**3**	**2**	**2**	**2**	**15 High**
Mountain Bushveld on andesite (Bronberg) Mapping unit 9	**3**	**3**	**3**	**2**	**2**	**2**	**15 High**
Bushveld areas, mapping unit 10	**2**	**1**	**1**	**2**	**2**	**1**	**9 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. It is assumed that the distance between pylons will be adequately long that 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: • 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: 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 Rand Highveld Grassland, *Hyparrhenia hirta* Grassland on granite, Mixed Grassland on Dolomite, Grassland on Quartzite

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:

- 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.
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: • 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.
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.

6.2.4 Mountain Bushveld on Andesite, Bushveld in Tierpoort Valley

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, while woody vegetation will be cleared all along the line. This may result in the loss of indigenous plant species, especially woody species, disturbance of plant species and the fragmentation of plant communities. 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	Regional (all along the line)	3	Regional (all along the line)	3
Magnitude	Moderate	6	Moderate	5
Significance	**Medium**	**55**	**Medium**	**50**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Permanent	5	Permanent	5
Extent	Regional (all along the line)	3	Regional (all along the line)	3
Magnitude	Moderate	3	Low	2
Significance	**Medium**	**55**	**Medium**	**50**
Status (positive or negative)	Negative		Negative	
Reversibility	Medium		High	
Irreplaceable loss of resources?	Moderate		Low	
Can impacts be mitigated?	Yes			

Mitigation:

- 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;

• Woody plants should only be cut shorter if absolutely necessary • 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 medium extent.
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly.

Notes:

- Loss of protected, rare or red data herbaceous plant species within the footprint areas of the pylons in this area is highly unlikely.
- Loss of woody plant species within the servitude is likely

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.

7. GENERAL DISCUSSION AND CONCLUSION

Most of the vegetation types are considered to be threatened, particularly Egoli Granite Grassland and Andesite Mountain Bushveld (Bronberg area). The grassland areas are threatened because so much of the area has been transformed by agriculture, mining and urban sprawl. Grassland in general is rich in plant species, and several red data listed plant species may occur in these regions. Vegetation will be removed on the footprint areas of the pylons. However, these pylon footprint areas are very small in relation to the vast surrounding grassland. Woody species, particularly taller growing tress will have to be removed, or at least cut down, to ensure that the powerlines are not damaged.

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.

The impact on woody vegetation is higher, as tall-growing trees will have to be removed.

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.

Bushveld

- 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;
- Woody plants should only be cut shorter if absolutely necessary

Rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas.

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 and Gauteng 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.**

8. REFERENCES

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. Memoirs of the Botanical Survey of South Africa. 57: 1–146.

Bredenkamp, G.J. & Brown, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. Urban Greenfile Nov-Dec 2001: 38-39.

Bromilov, C. 2010. Probleemplante en Indringerkruide van Suid Afrika. Briza, Pretoria.

Coetzee, J.P., Bredenkamp, G.J., Van Rooyen, N. & Theron, G.K. 1994. An overview of the physical environment and vegetation units of the Ba and Ib land types of the Pretoria-Witbank-Heidelberg area. *South African Journal of Botany* 60(1): 49-60.

Coetzee, J.P., Bredenkamp, G.J. & Van Rooyen, N. 1995. The phytosociology of the grasslands of the Ba and Ib land types in the Pretoria-Witbank-Heidelberg area. *South African Journal of Botany* 61(3): 123-133.

Cymbian 2009. Biophysical Specialist Study Report for the Bravo 3 Power Line Route Alternatives. Cymbian Enviro-Socio Consulting Services. Drafted for Zitholele Consulting

Department of Environmental Affairs and Tourism. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

Driver, M., Raimondo, D., Maze, K., Pfab, M.F. and Helme, N.A. 2009. Applications of the Red List for conservation practitioners. In: D. Raimondo, L. Von Staden, W. Foden, J.E. Victor, N.A. Helme, R.C. Turner, D.A. Kamundi and P.A. Manyama (eds). Red List of South African Plants. Strelitzia 25:41-52. South African National Biodiversity Institute, Pretoria.

Gauteng Department of Agriculture and Rural Development, 2014a. Technical report for the Gauteng Conservation Plan (Gauteng C-Plan V3.3). Biodiversity Management Directorate, Department of Agriculture and Rural development, Johannesburg, Gauteng.

Gauteng Department of Agriculture and Rural Development, 2014b. Requirements for biodiversity assessments Version 3. Biodiversity Management Directorate, Department of Agriculture and Rural development, Johannesburg, Gauteng.

Government Notice Regulation 544, 545 and 546 of 18 June 2010 (NEMA).

Government Notice Regulation 982, 983, 984 and 985 of 4 December 2014 (NEMA).

Henderson, L. 2001. Alien weeds and invasive plants. ATC, Pretoria.

Hoare, D, 2013. Walkdown Survey Report: Specialist ecological study on the potential impacts of the proposed Kendal-Zeus powerline in Mpumalanga Province. David Hoare Consulting CC, Pretoria.

Low, A.E. & Rebelo, A.G. (eds). 1998. *Vegetation of South Africa, Lesotho and Swaziland*. A companion to the Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

Land Type Survey Staff (1987). Land Types of the Maps 2526 Rustenburg, 2528 Pretoria. Memoirs of the Agricultural Natural Resources of South Africa No. 8

Mpumalanga Tourism and Parks Board. 2006. Requirements for assessing and mitigating environmental impacts of development applications.

Mucina, L. & Rutherford, M.C. 2006. *The vegetation of South Africa, Lesotho and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Mucina, L., Bredenkamp, G.J., Hoare, D.B. & McDonald, D.J. 2000. A National vegetation database for South Africa. South Africa Journal of Science 96:497-498.

Mueller-Dombois, D. & Ellenberg, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

National Biodiversity Assessment 2011. South African National Biodiversity Institute, Pretoria.

Raimondo, D. (ed.). 2015. South Africa's strategy for plant conservation. South African National Biodiversity Institute and Botanical Society of Sout Africa, Pretoria.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). 2009. Red list of South African plants 2009. Strelitzia 25:1-668.

SANBI & DEAT. 2009. Threatened Ecosystems in South Africa: Descriptions and Maps. DRAFT for Comment. South African National Biodiversity Institute, Pretoria, South Africa.

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)

The Environmental Conservation Act, 1989 (Act No. 73 of 1989)

The National Environment Management Act, 1998 (Act No. 107 of 1998)

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004), and Regulation 598, Government Gazette 37885, August 2014, (Alien and Invasive Species Regulations).

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

The National Forests Act, 2006 (Act 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062 , Cape Town, 8 Sept 2006.

The Natural Scientific Professions Act (Act 27 of 2003)

Westhoff, V. & Van der Maarel, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.

ABRIDGED CURRICULUM VITAE: GEORGE JOHANNES BREDENKAMP

Born: 10 February 1946 in Johannesburg, South Africa.
Citizenship: South African
Marital status: Married, 1 son, 2 daughters

Present work address
Department of Botany, University of Pretoria, Pretoria, 0002, South Africa
Tel:(27)(12)420-3121 Fax: (27)(12)362 5099
E-Mail: gbredenk@postino.up.ac.za
or
EcoAgent CC
PO Box 25533, Monument Park, 0105, South Africa
Tel and Fax: (27)(12) 346 3180
Cell 082 5767046
E-Mail: george@ecoagent.co.za

Qualifications:
1963 Matriculation Certificate, Kemptonpark High School
1967 B.Sc. University of Pretoria, Botany and Zoology as majors,
1968 B.Sc. Hons. (cum laude) University of Pretoria, Botany.
1969 T.H.E.D. (cum laude) Pretoria Teachers Training College.
1975 M.Sc. University of Pretoria, Plant Ecology .
1982 D.Sc. (Ph.D.) University of Pretoria, Plant Ecology.

Theses: (M.Sc. and D.Sc.) on plant community ecology and wildlife management in nature reserves in South African grassland and savanna.

Professional titles:
• MSAIE South African Institute of Ecologists and Environmental Scientists
- 1989-1990 Council member
• MGSSA Grassland Society of Southern Africa
- 1986 Elected as Sub-editor for the Journal
- 1986-1989 Serve on the Editorial Board of the Journal
- - 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
- 1993 Elected as professional member

• PrSciNat. South African Council for Natural Scientific Professions **Registration Number 400086/83**
- 1993-1997 **Chairman** of the Professional Advisory Committee: Botanical Sciences
- 1993-1997: **Council** Member
- 1992-1994: Publicity Committee
- 1994-1997: Professional Registration Committee

Professional career:

- Teacher in Biology 1970-1973 in Transvaal Schools
- Lecturer and senior lecturer in Botany 1974-1983 at University of the North
- 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).

www.ecoagent.co.za

Tel/Fax 012 460 2525 • george@ecoagent.co.za