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CONSTRUCTION OF A 400 KV BY-PASS LINE, APPROXIMATELY 10 KM IN LENGTH, ON THE BRAVO – VULCAN (WITBANK) LINE TO BY-PASS DUVHA (Bravo 5). DEA Ref No - 12/12/20/1097

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by

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Commissioned by

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May 2016

TABLE OF CONTENTS

TABLE OF FIGURES

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 “Construction of a 400 kv by-pass line, approximately 10 km in length, on the Bravo – Vulcan (Witbank) line to by-pass Duvha (Bravo 5). DEA ref no - 12/12/20/1097” 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 by-pass powerline of about 10 km at the Duvha Power Station. EcoAgent CC, was appointed by Limosella Consulting to do a vegetation assessment of the transect of this powerline.

According to the most recent vegetation map of South Africa the powerline transect is located within the Eastern Highveld Grassland and Rand Highveld Grassland. Although these two vegetation types are not rare and occur quite widespread, they are considered to be Endangered as about half is transformed, mainly by agriculture, mining and urban sprawl. Grassland in general is considered to be rich in plant species and is regarded as an ecologically sensitive ecosystem. The vegetation on the study site, surrounding the Duvha Substation is, however, totally disturbed and degraded.

Six plant communities (ecosystems, mapping units) were identified on the site. The vegetation and plant species composition of these mapping units are discussed. These mapping units can be grouped into three groups, disturbed wetland, disturbed grassland and totally transformed areas. Spruits and wetlands normally have High ecological sensitivity, though in this case the wetlands are so transformed that they are regarded to have a Low ecological sensitivity (also see Limosella wetland report) all the other grassland types on the site are also so disturbed, that, from a vegetation and flora perspective, they have no conservation value and low ecological sensitivity.

The impact assessment indicated that the impact on the grassland vegetation will be low, while the impact on the wetlands will be negligible.

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Should the conservation authority of Mpumalanga regard it as feasible and acceptable to develop the proposed by-pass 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. One of these projects is known as Bravo 5, which entails a by-pass powerline of about 10 km at the Duvha Power Station.

EcoAgent CC was appointed by Limosella Consulting to do a vegetation assessment for the Bravo 5 component of the larger Bravo Integration Project.

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

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

The assignment is interpreted as follows:

- Assess, map and describe the vegetation within the corridor of the proposed new by-pass powerline;
- Assess the flora in terms of NEMA, NEMBA and other relevant legislation (see summary below), as well as relevant minimum requirements of MTPA (though the field survey was conducted during the late autumn / early winter season, May 2016);

- Indicate possible impacts of the proposed development on the vegetation and flora;
- Suggest mitigation measures in order to limit the impact of the proposed development.

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

Assumptions and Limitations

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

A further limitation was that limited time was available for surveying and reporting on the vegetation for the Bravo Integration Project.

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 transects of the proposed by-pass 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

The Duvha by-pass is located at the Duvha Power Station southwest of Emalahleni, Mpumalanga Province. (Figure 1).

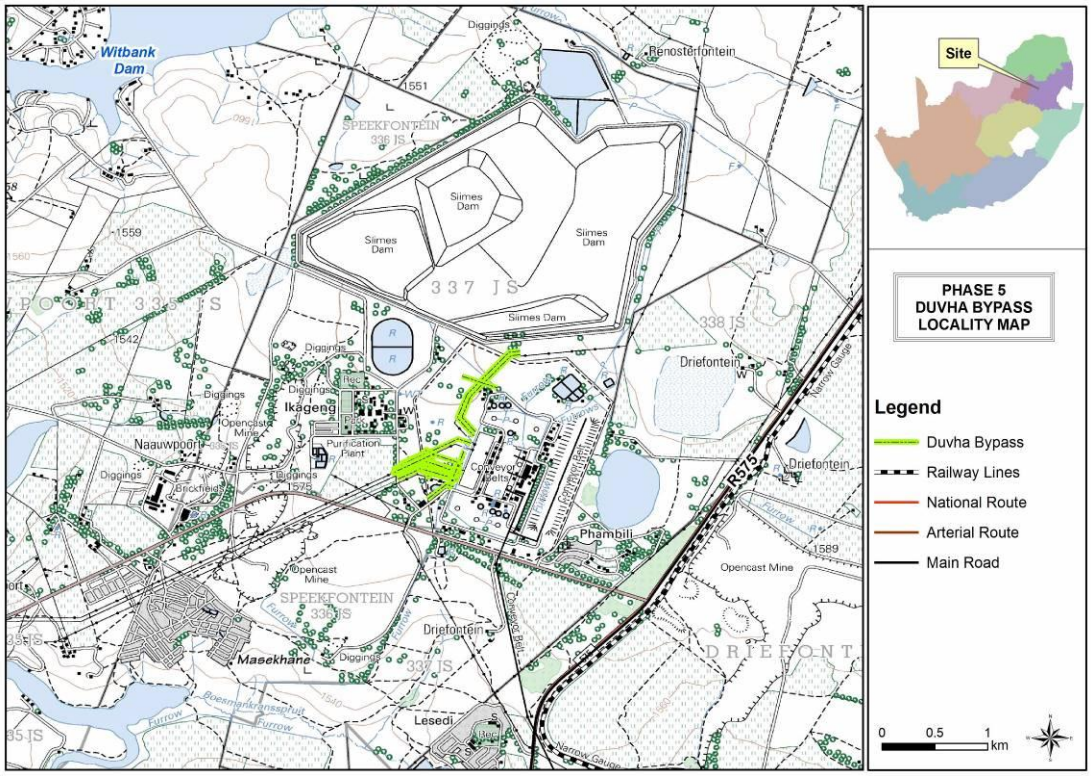

Figure 1: The locality of the study site

3.2 Physical Environment

Regional Climate

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

Geology, land type and soil

The geology of the study area is characterised by arenite (shale, sandstone or mudstone) of the Madzaringwe Formation (Karoo Supergroup) (Figure 2). The Ba land type occurs here in the southern portion of the site. Arenite weathers to form the main agricultural red and brown soils. In the northen part the soils are shallow and represents the Fa land type.

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. Altitude is about 1570 metres above mean sea level (mamsl) (Cymbian, 2009).

Duvha Powerstation is located in Catchment B11G. In this catchment, the precipitation rate is lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.32. Consequently, watercourses in this area are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

Land-use

The Land-Use at the power station was previously cultivated fields (maize) and grazed grasslands. Now the area is urbanised (EMhalahleni) and the specific site is now a large power station..

Vegetation Types

The Bravo 5 infrastructure is located on the grassland biome. The vegetation types located on the study site are classified as Eastern Highveld Grassland and Rand Highveld Grassland (Figure 5).

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

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.

Both these vegetation types are impacted where disturbances occurred, by the invasive exotic tree *Acacia mearnsii* (Black Wattle) that can become dominant and displace the natural vegetation. Due to the extensive usage of the areas once covered by Eastern Highveld Grassland and Rand Highveld Grassland vegetation types, the remaining portions are of high conservation value and sensitivity, and both are listed as Endangered (Mucina & Rutherford, 2006) and as Vulnerable by the National Biodiversity Assessment (SANBI, 2011).

Critical Biodiversity Areas and Conservation Status

The Mpumalanga Biodiversity Conservation Plan: Critical Biodiversity Areas (Terrestrial) Map shows that most of the site is located where No Natural Habitat Remained. In the northern part of the site sensitivity range from Highly Significant to Important (Figure 6), but all these areas have been totally transformed by the Eskom operation of the Duvha Power Station.

Conservation status as indicated by the National Biodiversity Assessment (SANBI, 2011) shows the entire area is classified as Vulnerable.

Figure 2: Geology.

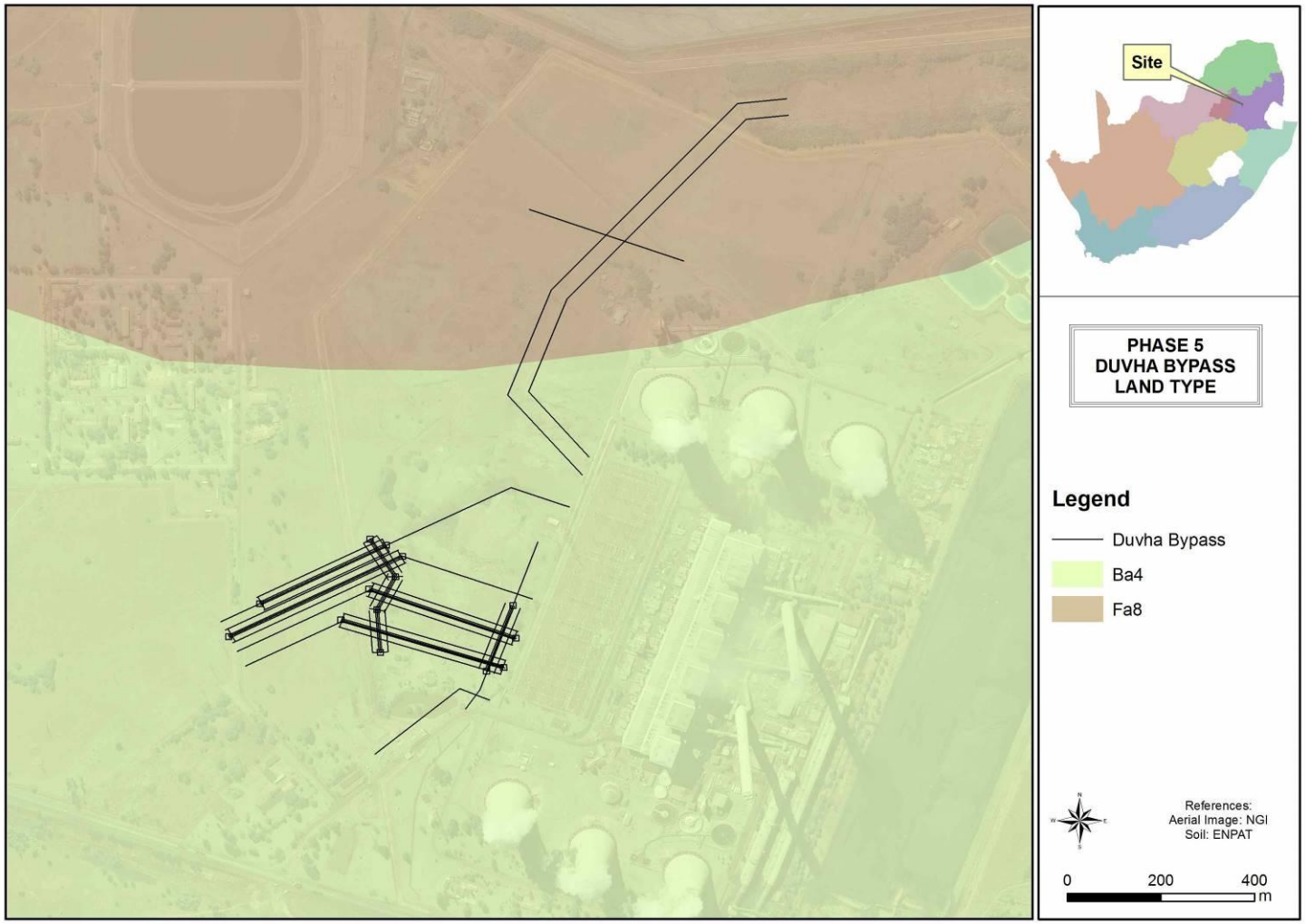

Figure 3: Land types.

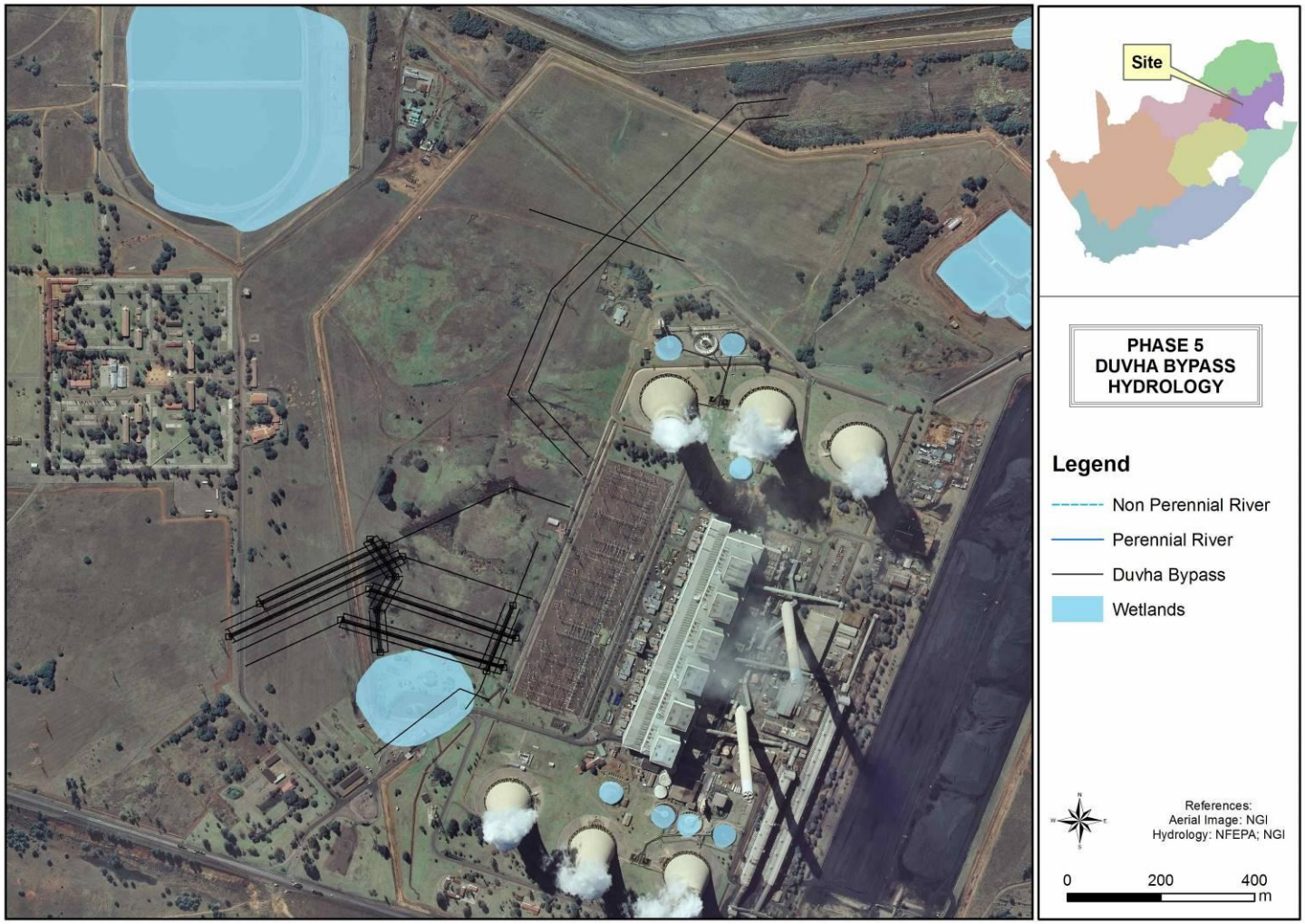

Figure 4: A hydrology map of the site and water features in the proximity of the powerline route.

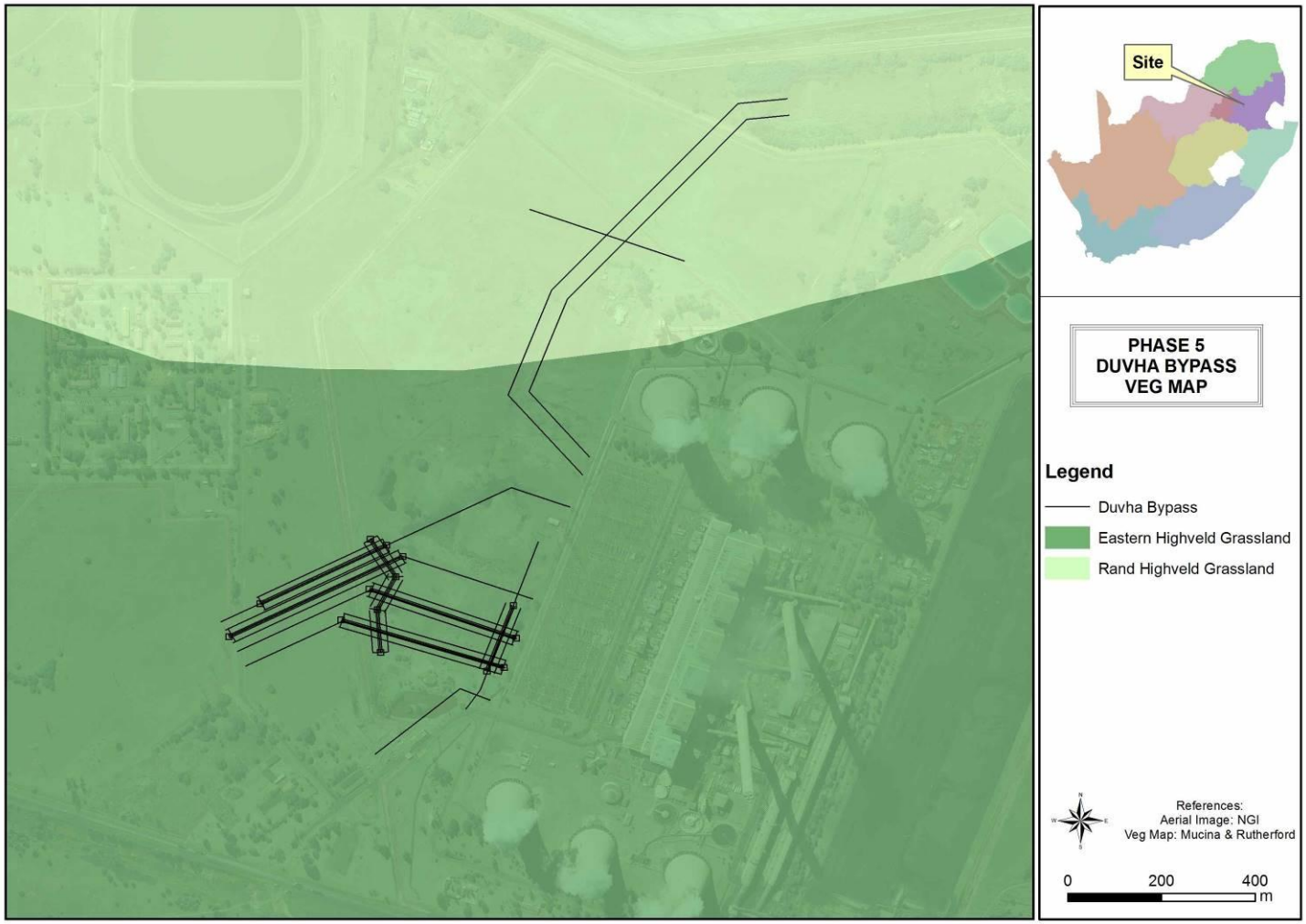

Figure 5: Regional vegetation (Mucina & Rutherford 2006)

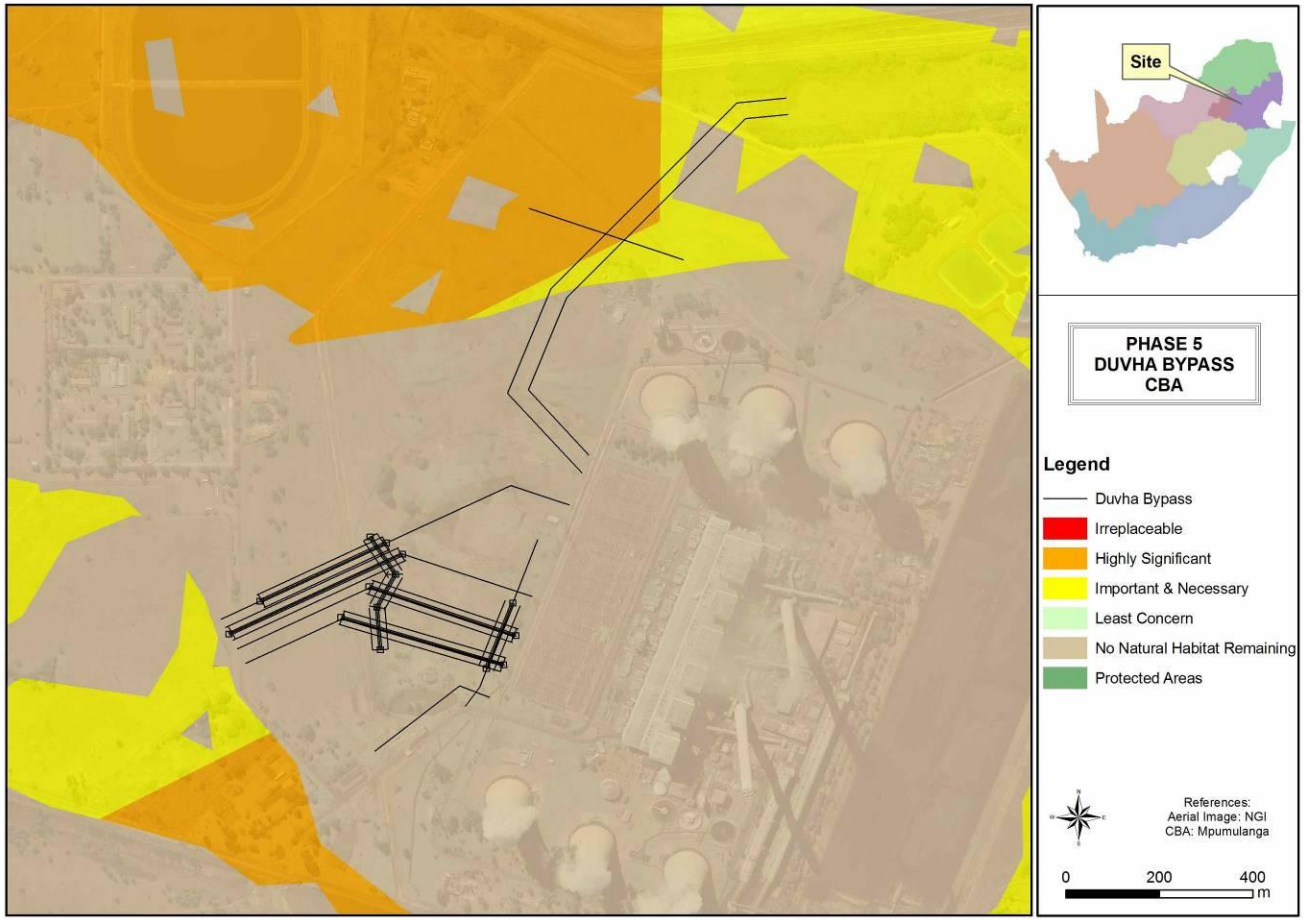

Figure 6: The Mpumalanga Critical Biodiversity Areas

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 23 May 2016 by Prof GJ Bredenkamp, accompanied by Dr IL Rautenbach (mammalogist).

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

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

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

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

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

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

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

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

Conservation Value

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

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

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

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

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

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

Ecological Sensitivity

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

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

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

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

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

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

The sensitivity scores are as follows:

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

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

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

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

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

Plant Species Status

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

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

Plant Species Richness

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

Categories of plant species richness are as follows:

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

Figure 7: A Google image of the site to indicate that the total area has been transformed.

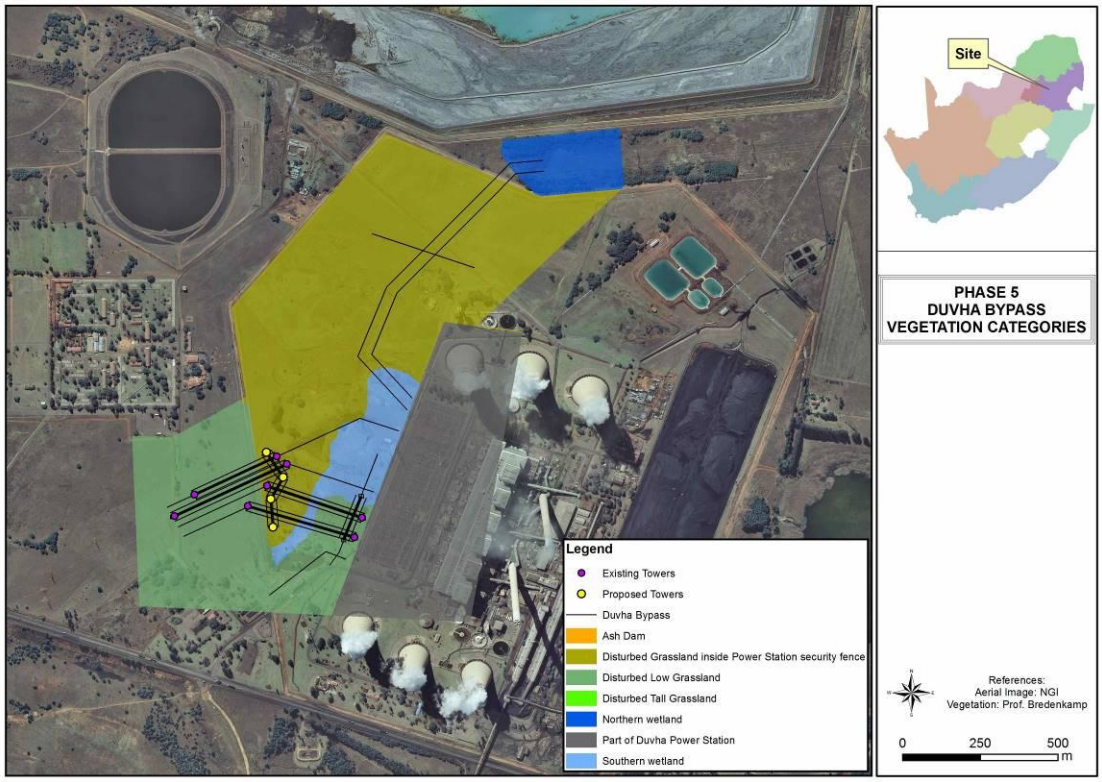

Figure 8: Vegetation map of the study site with the position of the powerline and pylons

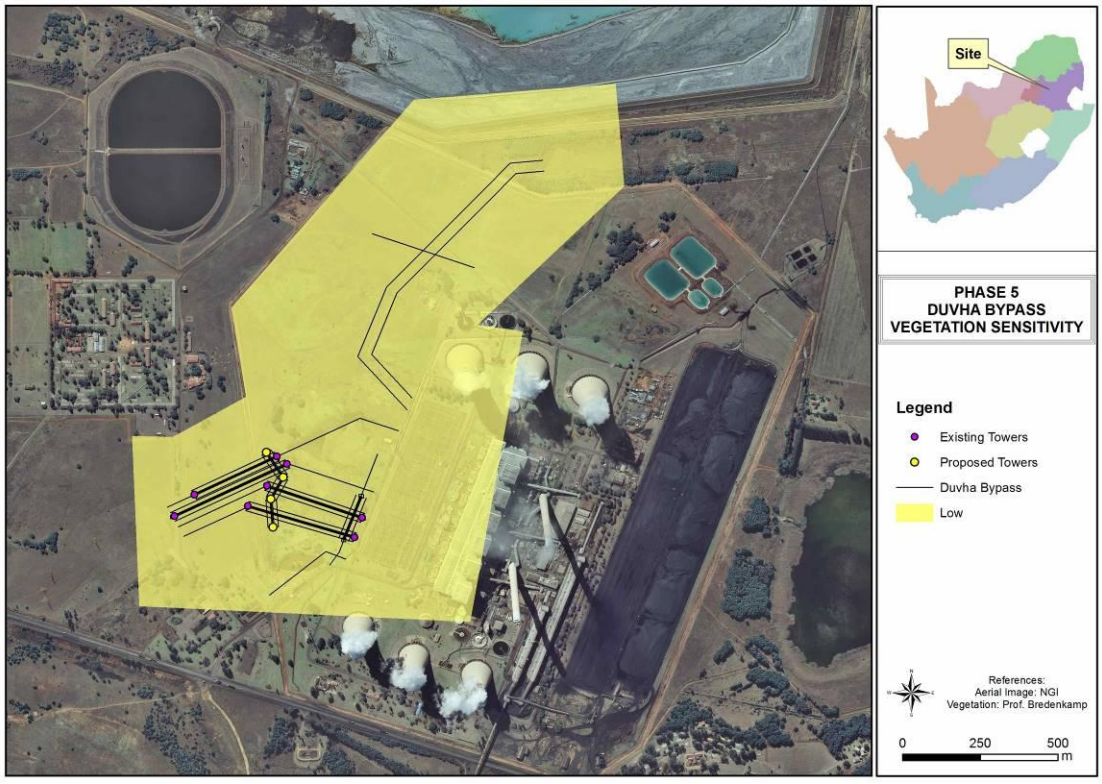

Figure 9: Sensitivity map of the study site with the position of the powerline and pylons

5. RESULTS: VEGETATION AND FLORA

5.1 Classification of the vegetation

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

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

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

The **Eastern Highveld Grassland** is associated with arenite, mostly shale and this area is coal-bearing (Figure 2). The A land type is typical of this area (Figure 3), with clay-loam soils highly suitable for agriculture, with the result that large areas have been ploughed for cultivation of crops. Therefore, as far as Critical Biodiversity Area goes, the site at the Duvha Power Station is mainly transformed, i.e. No Natural Habitat Remaining (Figure 6).

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

Six mapping units were identified:

Table: Mapping units

Mapping units / Plant Community	Sensitivity
1. Wetland 1a Northern wetland 1b Southern wetland	Low
2. Disturbed Tall Grassland	Low
3. Disturbed Low Grassland	Low
4. Disturbed Grassland inside Power Station security fence	Low
5. Part of Duvha Power Station	Low
6. Ash Dam	Low

5.2 Description of the plant communities

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

5.2.1 Wetland vegetation

Two wet areas were identified on the site.

1a. Northern artificial wetland area

The first is a highly disturbed, transformed low lying area situated between the power station and the ash dam, in the northern part of the study site. The western, northern and southern parts, surrounding the wetland area, were filled for levelling the ground for the power station and also by construction of the ash dam. Although it seems that the low-lying area was probably wet, this area is now rather an artificial wetland, created by seepage from adjacent higher-lying areas.

Two new powerlines will follow two existing lines over this area (Figure 8).

Few species occur in this wetland area. On the southern side the wetland is fringed by a zone of *Acacia mearnsii* and a seam of *Cortaderia selloana* (Figure 10). The wet area is dominated by *Phragmites australis.* Other plant species include the weeds *Tagetes minuta, Bidens bipinnata, Amaranthus hybridus* and *Pennisetum clandestinum.*

Figure 10: The northern wetland. Note the fringe of *Cortaderia selloana* and *Acacia mearnsii.* Also note the two existing powerlines.

1b. Artificial wet area on the southwestern part of the site

A dam and seepage wet area occurs directly west of the power station, basically under existing lines. From the seepage wetland water drains into a dam/pond south of the seepage wetland (Figure 11). This dam is currently used for aesthetic purposes. The vegetation of the seepage wetland is characterised by low species richness with only a few wetland species. The dominant plant species recorded in the wetland included *Typha capensis, Persicaria lapathifolia, Juncus rigidus, Phragmites australis* as well as some exotic species. The area is grazed by game kept within the relatively small fenced power station area.

Wetlands summary			
Status	Seepage artificial wetlands		
Soil	Mottled clay	**Rockiness**	0-5%
Conservation value:	Low to Medium	**Ecological sensitivity**	Low
Species richness	Low	**Need for rehabilitation**	Low
Dominant spp.	*Phragmites australis*, *Typha capensis*		

Figure 11: The seepage area of the southern wetland (Photo from Limosella wetland report)

The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Acacia mearnsii	A

Grasses and sedges

Cortaderia selloana	A	*Phragmites australis*	
Cyperus laevigatus		*Schoenoplectus corymbosus*	
Cyperus longus		*Setaria sphacelata*	
Juncus rigidus		*Typha capensis*	

Forbs

Bidens bipinnata	W	*Plantago lanceolata*	W
Cosmos pinnata	W	*Rumex crispus*	W
Gomphocarpus fruticosus	W	*Senecio inornatus*	
Oenothera rosea	W	*Tagetes minuta*	W
Persicaria lapathifolia		*Verbena bonariensis*	W

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	0	1	1	0	0	0
Grasses and sedges	7	1	8	0	0	0
Forbs	2	8	10	0	0	0
Total	9	10	19	0	0	0

Conclusion

Rivers, spruits and wetlands are regarded as ecologically sensitive. However from the vegetation and flora point of view, in this case the artificial wetland's sensitivity is regarded as low. The powerlines will easily span across the wetland, and will not affect the vegetation of the banks or wetland negatively. (See wetland report for more information).

5.2.2. Disturbed Tall Grassland

A small patch of disturbed tall grassland occurs in the northern part of the site (Figure 8). This grassland is dominated by the tall-growing *Hyparrhenia hirta* (Figure 12). From the plant species composition it is derived that this grassland represents Rand Highveld Grassland (Figure 5).

Figure 12: Typical Disturbed Tall Grassland.

Disturbed Tall Grassland summary			
Status	Highly disturbed		
Soil	Brown shallow loam	**Rockiness**	1-5%
Conservation value:	Low	**Ecological sensitivity**	Low
Species richness	High	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis curvula, Eragrostis chloromelas, Eragrostis plana, Heteropogon contortus*		

The following plant species were recorded in this plant community:

Trees, Shrubs and Dwarf shrubs

Acacia mearnsii	A	*Stoebe vulgaris*	

Grasses and sedges

Andropogon schirensis		*Hyparrhenia hirta*	D
Aristida congesta		*Melinis repens*	
Aristida junciformis		*Monocymbium ceresiiforme*	
Brachiaria serrata		*Panicum natalensis*	
Cynodon dactylon		*Perotis patens*	
Eragrostis chloromelas	d	*Pogonarthria squarrosa*	
Eragrostis curvula	d	*Sporobolus africanus*	
Eragrostis gummiflua		*Tristachya leucothrix*	
Eragrostis racemosa		*Urelytrum agropyroides*	
Heteropogon contortus	d		

Forbs

Anthospermum hispidulum		*Pollichia campestris*	
Dicoma anomala		*Pygmaeothamnus zeyheri*	
Helichrysum miconiifolium		*Senecio coronatus*	
Helichrysum rugulosum	d	*Tagetes minuta*	W
Hypoxis rigidula		*Verbena bonariensis*	W

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	1	1	2	0	0	0
Grasses and sedges	19	0	19	0	0	0
Forbs	8	2	10	0	0	0
Total	28	3	31	0	0	0

Discussion

This grassland has medium species richness. This small patch of grassland is too small and too isolated and too disturbed to be of any conservation value. Development of the powerline on this vegetation may be support.

5.2.3. Disturbed Low Grassland

This grassland occurs west of the fences power station area (Figure 8). The grass is regularly mowed, so is always short (Figure 13). The soil is deep and sandy. It appears that the area may have been ploughed in the past, Several trees, mostly exotic, were planted as ornamentals. The most common plant species are *Eragrostis curvula* and *Cynodon dactylon.*

Figure 13: Short, mowed grassland outside the fenced area

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Cupressus sp	A	*Pinus* sp	A
Eucalyptus sp	A	*Populus nigra*	A
Gleditschia triacanthos	A	*Searsia lancea*	

Grasses and Sedges

Bulbostylis hispidula		*Eragrostis curvula*	d
Chloris pycnothrix		*Melinis repens*	
Cynodon dactylon		*Perotis patens*	
Eragrostis chloromelas	d	*Pogonarthria squarrosa*	

Forbs

Gomphrena celosioides	W	*Tagetes minuta*	W
Senecio inaequalis	W		

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	1	5	6	0	0	0
Grasses and sedges	8	0	8	0	0	0
Forbs	0	3	3	0	0	1
Total	9	8	17	0	0	1

Disturbed Low Grassland summary			
Status	Disturbed / transformed grassland		
Soil	Sandy soil	**Rockiness %**	0
Conservation priority:	Low	**Sensitivity:**	Low
Species Richness:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis curvula, Cynodon dactylon*		

Discussion

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

5.2.4. Disturbed Grassland inside power station security fence

The grassland inside the security fence of the power station is disturbed, short and managed. Currently it is grazed by game (zebra). The eastern part is lower-lying is and can be regarded as an artificial wetland (see paragraph 5.2.1 above). Some exotic trees were planted in this area. The grassland is very similar to the disturbed grassland outside the fence, but is even more disturbed.

The most prominent species include:

Trees Shrubs and Dwarf shrubs

Cupressus sp	A	*Pinus* sp	A
Eucalyptus sp	A	*Populus nigra*	A
Gleditschia triacanthos	A	*Searsia lancea*	

Grasses and Sedges

Chloris pycnothrix		*Eragrostis curvula*	d
Cynodon dactylon		*Melinis repens*	
Eragrostis chloromelas	d	*Perotis patens*	

Forbs

Gomphrena celosioides	W

Number of species

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	1	5	6	0	0	0
Grasses and sedges	6	0	6	0	0	0
Forbs	0	1	1	0	0	1
Total	7	6	13	0	0	1

Disturbed Grassland inside the power station security fencesummary			
Status	Disturbed / transformed grassland		
Soil	Sandy soil	**Rockiness %**	0
Conservation priority:	Low	**Sensitivity:**	Low
Species Richness:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis curvula, Cynodon dactylon*		

Discussion

The vegetation of this area is of no conservation value and has low sensitivity. The development of the powerline can be supported.

5.2.5. Part of Duvha Power Station

This mapping unit shows part of the Duvha power station and has no vegetation

5.2.6 Ash Dam

This mapping unit shows part of the Duvha power station ash dam and has no vegetation

5.3 Species of Conservation Concern

A list of Species of Conservation Concern for the grids 2529CC 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).

No species of conservation concern (Raimondo et al. 2009) were listed in the database and no species were recorded from the specific site.

The following species of conservation concern were previously recorded from the Grid 2529CC (SANBI, POSA website):

Species	Status
Aspidoglossum validum Kupicha	Threatened
Callilepis leptophylla Harv.	Declining
Frithia humilis Burgoyne	EN

These species do not occur on the site, as there is no suitable habitat or the vegetation is too transformed.

However, the POSA list is based on herbarium specimens housed in the National Herbarium of SANBI, therefore many plant species that do occur in the area are not listed. The grassland habitat at this site is suitable for *Hypoxis hemerocallidea* and *Boophone disticha*, but they were too not found on the site.

It is concluded that no species of conservation concern currently occur on the site.

5.4 Protected species

No Nationally protected tree species or provincially protected plant species were found on the site.

No TOPS protected plant species are present on the site (The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004)).

5.5 Medicinal Plants

No important medicinal plants were found on the site.

5.6 Alien Plants

The invasive alien woody plants found on the site include *Eucalyptus* sp, *Acacia meansii, Solanum mauritianum, Melia azedarach*.

The general condition of the vegetation at the proposed site is degraded and transformed. The species richness is low, and many weed species are present. Even the indigenous forb species are regarded as pioneers or weeds. The area of this plant community represents transformed vegetation with low sensitivity, and has no threatened species of conservation concern. Rubble was dumped over a large portion of the site.

As far as vegetation is concerned, the dismantling of the relevant sections of the current power lines and the construction of any of Options 1 or 2 new power lines can be supported in this area.

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

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

Spruits and wetlands normally have High ecological sensitivity, though in this case the wetlands are so transformed that they are regarded to have a Low ecological sensitivity (also see Limosella wetland report) all the other grassland types on the site are also so disturbed, that, from a vegetation and flora perspective, they have no conservation value and low ecological sensitivity.

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

Vegetation	Conservation Status of regional Vegetation unit	Listed Ecosystem	Legislated Protection	Plants species of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18
Transformed areas, alien vegetation mapping units 5 & 6	Not applicable No natural vegetation Score 0		0	0	0	0	**0 Low**
Spruits and associated wetlands, mapping unit 1	2	2	1	0	1	0	**6 Low**
Disturbed Grassland, mapping units 2, 3 & 4	**3**	**0**	**0**	**0**	**1**	**0**	**4 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. The distance between pylons is adequately long so spruits and wetland can easily be crossed without damaging any of them. Therefore it is envisaged that the powerline and pylons will have very little impact on spruits and wetlands.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Very improbable	1	Very improbable	1
Duration	Short term	2	Short term	2
Extent	Local	1	Local	1
Magnitude	Minor	2	No effect	0
Significance	**Low (negligible)**	**5**	**Low (negligible)**	**3**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Very improbable	1	Very improbable	1
Duration	Permanent	5	Permanent	5
Extent	Local	1	Local	1
Magnitude	Low	4	Minor	2
Significance	**Low (negligible)**	**10**	**Low (negligible)**	**8**
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.

6.2.2 Disturbed Grassland types on the site

Table 6.2: 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, but the grassland are all already severely disturbed. 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	Local	1	Local	1
Magnitude	Low	2	Low	1
Significance	**Low**	**25**	**Low**	**20**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Permanent	5	Permanent	5
Extent	Local	1	Local	1
Magnitude	Low	2	Low	1
Significance	**Medium**	**40**	**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 6.3: 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

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

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

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

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

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

Mitigation measures

Spruits and wetland

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

Grassland

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

It is concluded that the impact on vegetation and flora, and in particular plant species of conservation concern will be small. Should the conservation authority of Mpumalanga regard it as feasible and acceptable to develop the powerline in the area, it is suggested that, from a vegetation and flora point of view, the development can be supported.

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- >250 scientific (unpublished) reports on environment and natural resources
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• Wildlife Management Society of Southern Africa
• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
(=South African Academy for Science and Art).
• Wildlife Society of Southern Africa

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

• Dendrological Society of Southern Africa

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

• Succulent Society of South Africa

1987 - 2000

• Botanical Society of South Africa

2000 – present: Member

2001- 2008: Chairman, Pretoria Branch

2002 – 2006: Chairman, Northern Region Conservation Committee

2002- 2007: Member of Council

Special committees:

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

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

Merit awards and research grants:

1968 Post graduate merit bursary, CSIR, Pretoria.

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

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

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

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

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

1991-1993 Research Grant, Water Research Commission.

1999-2003 Research Grant, Water Research Commission.

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

Abroad:

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

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

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

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

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

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

1995 Travel Grant FRD, University of Pretoria
Visits to the USA

1996 Travel Grant, University of Pretoria
Visit to the UK.

1997 Travel Grant University of Pretoria, Visit Czech Republic, Bulgaria

1998 Travel Grant, University of Pretoria, Visit Czech Republic, Italy, Sweden

1999 Travel Grant, University of Pretoria, Visit Hungary, Spain, USA

2000 Travel Grant, University of Pretoria, Visit Poland, Italy, Greece.

2001 Travel Grant, NRF, Visit Brazil

2006 German Grant Invited lecture in Rinteln, Germany

Consultant

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

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

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

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