CYMBIAN
ENVIRO-SOCIAL CONSULTING SERVICES

# Biophysical Specialist Study Report for the Bravo 5 Power Line Route Alternatives

## Draft Report

This is a report compiled for Zitholele Consulting as part of the Bravo Integration Project.


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## PURPOSE OF THIS DOCUMENT

Eskom propose to construct a 400 kV overhead power line, by-passing the existing Duvha substation, to form a new Bravo-Vulcan line near Emahlahleni, Mpumalanga. This by-pass line is planned to be approximately 10 km in length. The area to be investigated for this by-pass line is a 5 km corridor to the north-west of the existing Duvha substation.

As part of the environmental authorisation specialist studies have to be undertaken in order to inform the Environmental Impact Assessment Report (EIR). This report details the findings for Geology, Climate, Surface Water, Topography, Soils, Land Capability, Land Use, Flora, Fauna (especailly avifauna), Wetlands and Visual Impacts.

Zitholele Consulting appointed Cymbian Enviro-Social Consulting Services to undertake the aformentioned specialist studies. The purpose of this document is therefore to present the findings of the aforementioned assessments and to provide management measures to protect sensitive features located on site.

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# 1.0 INTRODUCTION

## 1.1 Project background

The growing demand for electricity is placing increasing pressure on Eskom's existing power generation and transmission capacity. Eskom is committed to implementing a Sustainable Energy Strategy that complements the policies and strategies of National Government. 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. For this reason, Eskom obtained environmental authorisation to construct the new Bravo Power Station between Bronkhorstspruit and Emahlahleni in 2007. Construction of this power station has commenced will civil and earthworks as noted during site investigations.

The construction and operation of the Bravo Power Station requires not only the construction of the Power Station itself, but also the construction of additional auxiliary structures such as power lines. The Bravo Integration Project spans the provinces of Gauteng and Mpumalanga and will be handled as five individual Environmental Impact Assessments (EIA), namely (Figure 1):

**Phase 1: Sol – Camden By-Pass Power Line**

The intention of Bravo 1 is to build two 400 kV bypasses lines for Zeus substation, the two 400 kV lines from Sol Substation and the two 400 kV power lines from Camden power station will be disconnected from Zeus substation and joined to each other to form two Camden- Sol 400 kV power lines. The location of the two by-pass lines is planned to be within approximately 10 km radius of the Zeus substation. The project is located within the Govan Mbeki District Municipality.

**Phase 2: Apollo and Kendal loop in and loop out lines**

Eskom propose to construct four new 400 kV overhead power lines, located within the Emalahleni Local Municipality in Mpumalanga, to loop in and out of Bravo Power Station. The existing Kendal-Apollo line will be looped in and out of Bravo to form the Bravo-Apollo and Bravo-Kendal lines. In addition, the existing Duvha-Minerva 400 kV overhead power line will be looped in and out of Bravo Power Station, to form the Bravo-Duvha and Bravo-Minerva lines. The study area in which the alternatives were selected is within the 10 km radius surrounding the new Bravo Power Station and each of the alternative 400 kV power lines will be not exceed 10 km in length.

**Phase 3: Construction of a 400kV power line from Bravo Power Station to Lulamisa Substation**

In order for the Bravo power station to be integrated within the existing Eskom infrastructure, Eskom propose to construct a new 400kV power line from the new Bravo Power Station to the existing Lulamisa substation, near Diepsloot. This line will be approximately 150 km in length. The construction of this proposed 400 kV power line is aimed to ensure sufficient electricity supply to the Diepsloot and Johannesburg North areas, where currently frequent electricity shortages are experienced. The alternative Bravo power line corridors are located on the eastern Highveld of Southern Africa. The corridors cover an area from Emahlaheni in the east, to Diepsloot in the west.

**Phase 4: Two new 90 km Kendal –Zeus 400 kV Power Lines**

Eskom propose to construct two new 400 kV power lines, one from Bravo to Zeus and the other one from the Kendal Power Station (near Ogies) to the Zeus substation (near Secunda), Mpumalanga. These lines will run parallel to each other and will be approximately 90 km in length. The three alternative route corridors will be 5 km wide. These three alternative corridors merge into two corridors approximately 30 km from the Zeus substation.

**Phase 5: New 10km Bravo-Vulcan Power Line**

Eskom propose to construct a 400 kV overhead power line, by-passing the existing Duvha Power Station, to form a new Bravo-Vulcan line near Emahlahleni, Mpumalanga. This by-pass line is planned to be approximately 10 km in length. The area to be investigated for this by-pass line is a 10 km radius surrounding the existing Duvha Power Station. This report details the biophysical findings for the Bravo 5 project.

Eskom Transmission has appointed Zitholele Consulting (Pty) Ltd, an independent company, to conduct an EIA to evaluate the potential environmental and social impacts of the proposed project. Zitholele Consulting has in turn appointed Cymbian Enviro-Social Consulting Services to undertake the bio-physical specialist studies required, including:

- Vegetation Assessment;
- Soil and Land Capability Assessment; and
- Wetland Delineation.
- Geology
- Visual
- Avifauna

Additional to the abovementioned assessments, all fauna observed were noted. These were noted to further inform the occurrence of sensitive species.

## 1.2 Regional setting and project locality

The Bravo Integration Project will span the provinces of Gauteng and Mpumalanga, stretching from Secunda, Ogies and Middelburg in Mpumalanga, to Bronkhorstspruit, Midrand and Kayalami in Gauteng. Refer to Figure 1 for a locality map for the entire Bravo Integration Project.

This report details the biophysical assessments undertaken for the Bravo 5 study area. The Bravo 5 site is located east of Emahlahleni, in the vicinity of the Duvha Power Station. This study area will include 3 route alternatives by-passing Duvha Power Station near Emahlahleni, Mpumalanga and connecting the line to the existing grid as shown in Figure 2.

## 1.3 Study scope

As part of the environmental authorisation process for the aforementioned project it is required for the Environmental Impact Assessment Process that certain biophysical specialist studies be undertaken. Zitholele Consulting appointed Cymbian Enviro-Social Consulting Services to undertake the following biophysical specialist studies:

- A Geology, Soil and Land Capability Assessment;
- A Topographical Assessment;
- A Visual Assessment;
- An Ecological Assessment and
- An Ornithological Assessment.

The Geology, Soil and Land Capability Assessments were conducted using a Geographic Information System (GIS) as well as a site investigation to identify soils on site. The Topographical and Visual assessment were completed using a GIS. The Ecological assessment was conducted by first undertaking a literature review and then followed up with site investigations to confirm the findings of the literature review. During the Ecological site investigations, all fauna were noted and identified.

## 1.4 Study approach

Cymbian undertook the aforementioned specialist studies during a week site visit conducted from the 17$^{th}$ - 18$^{th}$ of November 2008. The study area encompassed the area within a 5 km buffer zone or corridor width encompassing the power line alternatives.

Transects were walked on either side of the power line alternatives in which vegetation, soil, fauna and wetland characteristics were sampled. Each sampling point was marked using a GPS for mapping purposes, photos of each sampling point were also taken.

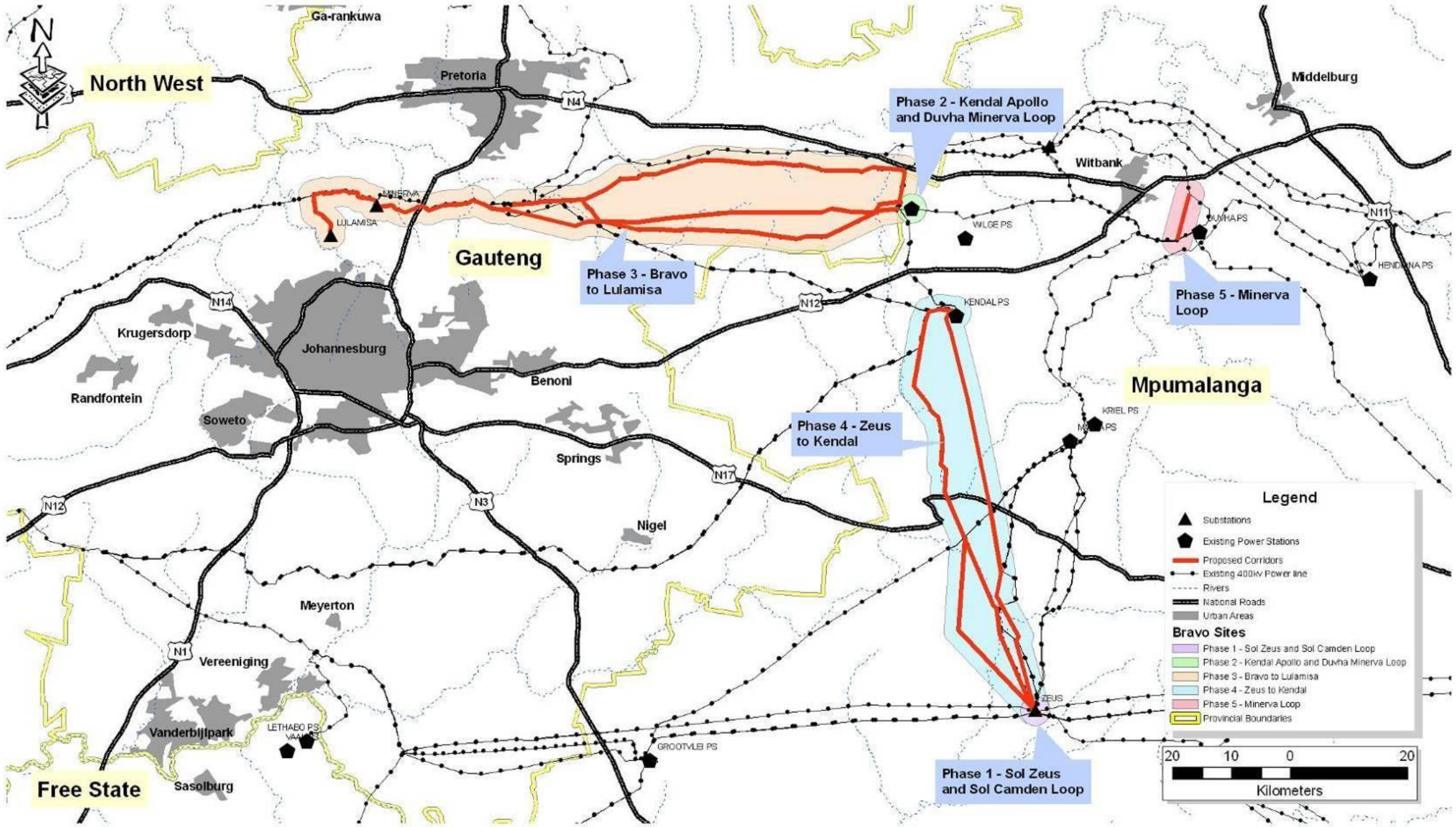


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**Figure 1: Site Location**

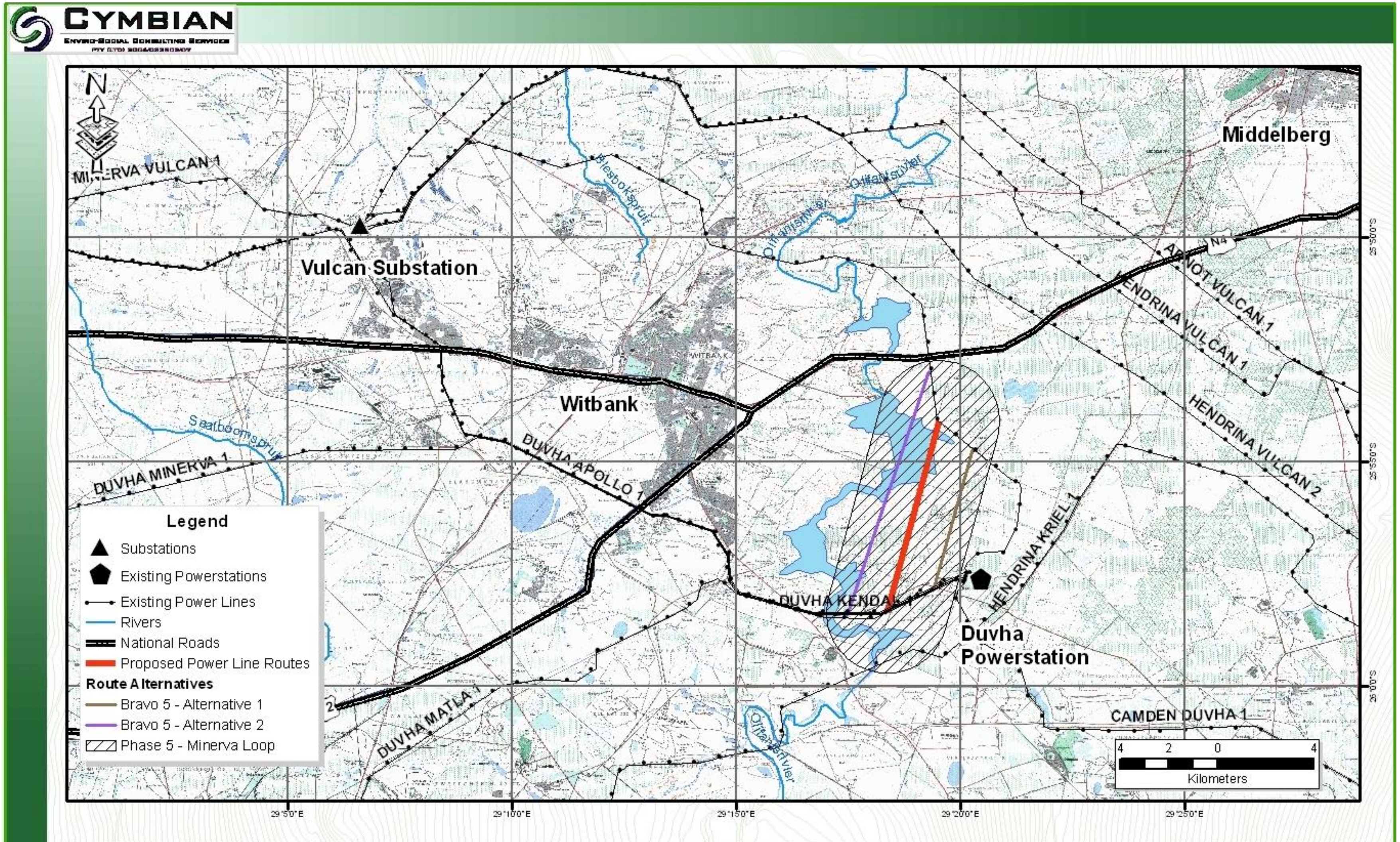


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**Figure 2: Bravo 5 Site Map**

## 1.5 Project team

The technical project team consists of:

- **Konrad Kruger** – Landscape Ecologist and Environmental Consultant
- **Glen Louwrens** – Conservation Ecologist and Junior Environmental Consultant
- **Brett Coutts** – Conservation Ecologist and Junior Environmental Consultant

**Konrad Kruger** graduated from the University of Pretoria with a BSc Honours in Geography in 2003. Konrad has been involved in a variety of environmental projects in the last three years and has become specialised in undertaking specialist studies, mapping and environmental consulting. Konrad has undertaken GIS mapping for mining, residential as well as industrial developments. Konrad is also an experienced land ecologist and will provide expertise for this project in terms of soil surveys, land capability assessments and mapping. He is currently in the process of acquiring his MSc in Geography (Landscape Ecology) from the University of Pretoria.

**Glen Louwrens** graduated from the University of the Witwatersrand with a BSc Honours in Zoology and Ecology in 2007. Currently a Junior Environmental Consultant at Cymbian Enviro-Social Consulting Services, he is experienced in GIS mapping and can provide expertise in terms of faunal and floral surveys.

**Brett Coutts** graduated from the University of the Witwatersrand with a BSc Honours in Zoology and Ecology in 2007. His Honours year was based with the Endangered Wildlife Trust (EWT), working on the porcupine quill trade. He has worked for Hydromulch between 2007 and 2008 as a junior project manager on environmental rehabilitation projects. Currently a Junior Environmental Consultant at Cymbian Enviro-Social Consulting Services, he is experienced in rehabilitation projects, population dynamics of small mammals and can provide expertise in terms of faunal and floral surveys.

## 1.6 Assumptions and Limitations

The following assumptions were made during the assessment:

- The information provided regarding the provided by Zitholele Consulting and ESKOM is accurate;
- If the corridors could not be accessed, data from adjacent sites could be used;
- A corridor width of 5 km was used;
- Fauna, flora and wetland delineation studies can only be completed during the summer months;
- Power line design will be similar to the existing high voltage power lines on site.

## 2.0 DETAILED PROJECT DESCRIPTION

### 2.1 Project Alternatives

Several strategic alternatives were considered at the conceptual phase of the Bravo Power Station EIA. This strategic information was again revisited during the planning phase of the Bravo Integration Project.

### 2.2 Design Alternatives

The primary motivating factors behind the consideration of underground power lines include the following:

1.) Areas prone to significant infrastructure damage due to extreme weather conditions, on an annual basis, usually consider underground power lines. The cost of power line replacement over the life of the infrastructure is usually more cost effective in such areas;

2.) The visual impact of underground power lines is much less than those of overhead power lines, and are usually considered in highly sensitive visual landscapes, such as wide open wilderness spaces and tourism facilities e.g. game farms and nature reserves.

The primary motivating factors behind the consideration of overhead power lines include the following:

1.) The cost of overhead lines is between 250% and 400% less. Eskom have a responsibility to provide cost effective and reliable energy resources;

2.) Overhead circuits can often be worked on while they are still energized. Nearly all work on underground circuits is performed while things are de-energized and grounded.

3.) Underground cables need a larger conductor to handle the same amperage as a smaller overhead conductor. This is due to the difficulty of dissipating heat to the earth. Larger conductors means higher cost.

4.) Overhead distribution circuits are much easier to modify to serve customers or make other changes. A simple set of fuses on an overhead circuit might cost ~R2 000.00, yet the underground equivalent costs over ~R10 000.00.

5.) An overhead line can generally span and not disturb sensitive features such as cultural resources sites, streams, most wetlands, isolated steep slopes, or a sensitive species location to mention a few. Underground lines however require the construction of a trench and results in a disturbed area of approximately 15 m in width for the entire length of the line.

As none of the areas affected by the proposed Bravo Integration Project are annually affected by extremely damaging environmental events, or fall within highly sensitive visual environments, it was decided to implement the more cost effective overhead power line alternative.

## 2.3 Route Alternatives

The various route alternatives were analysed within the 5 km buffer zone or corridor width encompassing the power line alternatives. The following criteria were used to determine appropriate route alternatives: regional environmental information; engineering feasibilities; economic implications as well as existing Eskom power lines and servitudes. The following three alternatives were identified (Figure 2):

**Alternative 1:**

Alternative one is to construct the proposed 400 kV by-pass line approximately 1.5 km towards the north-west of the Duhva Power Station. This alternative will be approximately 7.4 km in length.

**Alternative 2:**

Alternative two is to construct the proposed by-pass line approximately 4 km towards the north-west of the Duhva Power Station. This alternative will be approximately 10.5 km in length but may not be technically feasible due to it traversing the Olifants River and the Witbank Dam.

**Alternative 3:**

Alternative three is to construct the proposed by-pass line approximately 2 km to the north-west of the Duhva Power Station. This alternative will be approximately 9.5 km. The construction will take place outside of Eskom property, but may avoid crossing the Olifants River. Alternative 3 is currently the Eskom preferred alternative.

## 2.4 No-Go Alternative

The No-Go alternative will also be assessed further in the EIA. In the case that none of the three alternatives is suitable for the proposed power lines, the recommendation would be that the proposed power line not be constructed and further alternative alignments, or project solutions be generated.

## 2.5 Major Activities of the Project

The project involves 21 major activities:

1. Environmental Impact Study.
2. Negotiations for the servitude.
3. Land survey to determine the exact routing of the line and tower placement.
4. Profiling work to produce the profiles for construction.
5. Pegging of bend tower by a Transmission surveyor.
6. Erection of camp sites for the Contractors' workforce.
7. Negotiations with landowners for access roads to the servitude.
8. Servitude gate installation to facilitate access to the servitude.
9. Vegetation clearing to facilitate access, construction and the safe operation of the line.
10. Establishing of access roads on the servitude where required as per design parameters.
11. Pegging of tower positions for construction by the contractor.
12. Transportation of equipment, materials and personnel to site and stores.
13. Installation of foundations for the towers.
14. Tower assembly and erection.
15. Conductor stringing and regulation.
16. Taking over the line from the contractor for commissioning.
17. Final inspection of the line, commissioning and hand over to the Grid Line and Servitude Manager for operation.
18. Rehabilitation of disturbed areas.
19. Signing off of all Landowners upon completion of the construction and rehabilitation.
20. Handing over and taking over of the servitude by the Grid Environmental Manager.
21. Operation and maintenance of the line by the Grid.

## 2.6 Project Timeframes

The primary project milestones are represented in Table 1 below.

**Table 1: Primary milestones for the Bravo 5: 400kV by-pass line.**

| Milestones | Date |
|---|---|
| Final Scoping Report | 20 October 2008 |
| Undertake Specialist Studies | 15 January 2008 |
| Draft EIR and EMP | 10 February 2009 |
| Stakeholder Engagement on EIR / EMP | 11 March 2009 |
| Finalise EIR and EMP | 6 April 2009 |
| Submission to Relevant Authorities | 7 April 2009 |
| Environmental Authorisation | 19 May 2009 |
| Appeal Period | 21 July 2009 |
| Commence with Construction | To be advised |
| Construction (including EMP Auditing) | To be advised |
| Completion of Construction (including Rehabilitation) | To be advised |
| Close out Audit | To be advised |

# 3.0 RECEIVING ENVIRONMENT

This section details the receiving environment at the project location. Although the aim of this report is to detail the vegetation, wetlands and, soil and land capability component of the receiving environment; certain additional factors have been included, as they provide perspective to the soil and vegetation study. These include geology, topography, climate, surface water and land use.

## 3.1 Geology

### 3.1.1 Data Collection

A desktop screening assessment, using a Geographic Information System (GIS) tool, was undertaken of the geological environment. The geological data was taken from the Environmental Potential Atlas Data (ENPAT) from the Department of Environmental Affairs and Tourism (DEAT) as well as geological data supplied by the Gauteng Department of Agriculture, Conservation and Environment (GDACE).

### 3.1.2 Regional Description

The underlying geology is shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup), or the intrusive Karoo Suite dolerites which feature prominently in the area. Quartzite ridges of the Witwatersrand Supergroup and the Transvaal Supergroup comprising the Pretoria Group as well as the Selons River Formation of the Rooiberg Group are also characteristic of the area.

The volcanic Rooiberg Group is part o fthe Bushveld Magmatic Province, a voluminous suite of Precambrian magmatic rocks that also includes the Lebowa Granite Suite and the largest known terrestrial mafic intrusion, the Rustenburg Layered Suite. The Rooiberg Group comprises volcanic units that are up to 400 m thick, together with interbedded, thin, laterally extensive sedimentary strata. The lithology of the area comprises several geological sequences (refer to Figure 3).

The oldest rocks are the sedimentary rocks comprising the Transvaal Supergroup, Pretoria Group, Silverton (shales), Magaliesberg (quartzites) and Rayton (quartzites, shales and subgreywacke) Formations. The Pretoria Group is approximately 6-7 km thick and comprises predominant mudrocks alternating with quartzitic sandstones, significant interbedded basaltic-andesitic lavas, and subordinate conglomerates, diamictites and carbonate rocks, all of which have been subjected to low grade metamorphism.

Overlying the Transvaal Supergroup are the sedimentary rocks of the Karoo Supergroup, Dwyka Group (tillites, shale), the Ecca Group (shales, sandstones, conglomerates and coal beds in places near the base and the top). The other dominant rock type is the rocks collectively referred to as the Transvaal diabase. These are probably related to an early intrusive phase of the Bushveld Complex. They are intrusive into all horizons of the Transvaal Supergroup, and are particularly prolific in the strata of the Pretoria Group. The diabase sills can vary in thickness from 1m to >300m, occurring characteristically at the contact between the shales and quartzites. Because chemical decomposition is relatively far advanced in these warm humid areas, relatively deep residual soils can be expected. The rocks of the Bushveld Complex - the Rustenburg Layered Suite (the anorthosites, gabbros and norites of the Critical, Main and Upper Zones), the Rashoop Granophyre Suite (granophyres and pseudogranophyres) and the Lebowa Granite Suite (medium to coarse grained, pink or grey granite and porphritic granite) also occur.

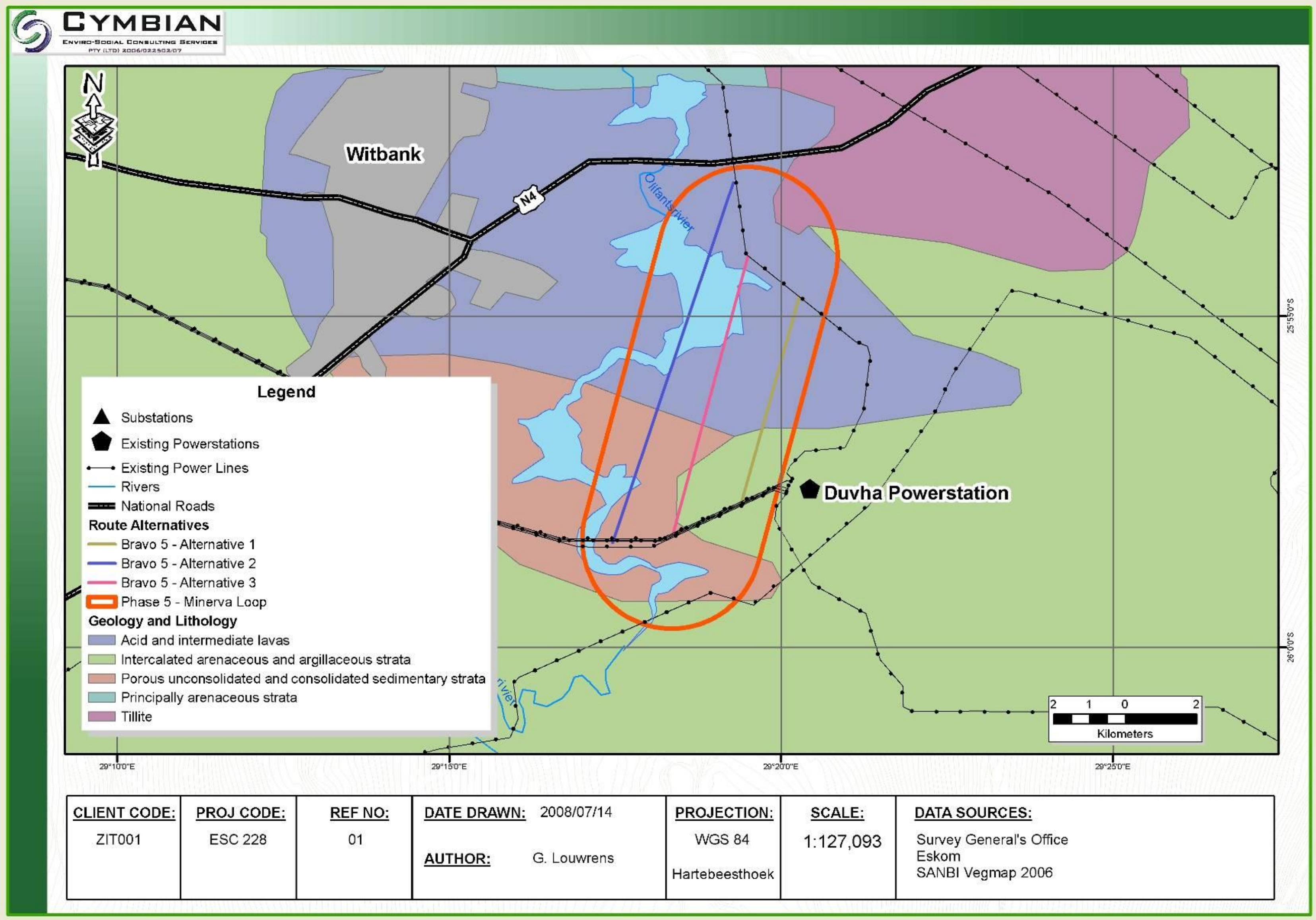



**Figure 3: Regional Geology**

## 3.2 Climate

### 3.2.1 Data Collection

Climate information was attained using the Climate of South Africa database, as well as from The Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006)[1].

### 3.2.2 Regional Description

Mpumalanga's climate is mild to sub-tropical with hot, wet summers and cold, dry winters. Mean annual precipitation ranges from less than 500 mm in the eastern Lowveld and 700 mm in the western Highveld to more than 1100 mm in the escarpment.

The study area displays warm summers and cold winters typical of the Highveld climate. The average summer and winter daytime temperatures (AVD) are 25°C and 20°C, respectively. The region falls within the summer rainfall region of South Africa, rainfall occurs mainly as thunderstorms (Mean Annual Precipitation 726mm) and drought conditions occur in approximately 12% of all years. Mean annual potential evaporation of 1926mm indicates a loss of water out of the system. The region experiences frequent frosts, with mean frost days from 13-42 days (higher at higher elevations), winds are usually light to moderate with the prevailing wind direction is north-westerly during the summer and easterly during winter.

The nearest weather station is the Middelburg station, with data available for a 25 year period from 1925-1950. The AVD temperature recorded for this period was 15.5°C, with an average daily maximum and minimum of 23.9°C and 7.1°C, respectively. Precipitation data for the Middelburg station is available

## 3.3 Surface Water

### 3.3.1 Data Collection

The surface water data was obtained from the WR90 database from the Water Research Council. The data used included catchments, river alignments and river names. In addition water body data was obtained from the CSIR land cover database (1990) to show water bodies and wetlands.

[1] *The Vegetation of South Africa, Lesotho and Swaziland*, Mucina and Rutherford 2006.

3.3.2 <u>Site Description</u>

The Duvha powerstation and the proposed power line route alternatives are located almost entirely within the quaternary catchment B11G, only a small section of Alternative 2 falls within the quaternary catchment B11J. Major drainage features in this catchment include the Witbank Dam and the Olifants River.

The site is bisected by numerous unnamed tributaries or streams of the Olifants River and Witbank Dam, all of these appear to be non-perennial and drain into the Witbank Dam and Olifants River. The Witbank Dam and Olifants River in turn drain northwards from the site.

The Witbank Dam and Olifants River located on site as illustrated in Figure 4 and Figure 5 below. The streams, Olifants River and Witbank Dam support a number of faunal and floral species uniquely adapted to these aquatic ecosystems and therefore all surface water bodies are earmarked as sensitive features and should be avoided as far as possible.

Alternative 2 and 3 traverse large sections of the Witbank Dam, with Alternative 2 stretching over some 3500 m and Alternative 3 stretching across some 994 m of the dam. This renders Alternative 2 and 3 not technically feasible, since the longest section of dam crossing stretches some 1500 m and 728 m respectively, both these distances exceed the maximum distance between pylons of 350 m. Thus, Alternative 1 is the only technically feasible alternative because it traverses only two of the streams on site. Although these streams support sensitive fauna and flora species, applying a buffer zone of 50 m around them in which no pylons are to be placed is a sufficient mitigation measure.

**Figure 4: The Witbank Dam on site.**

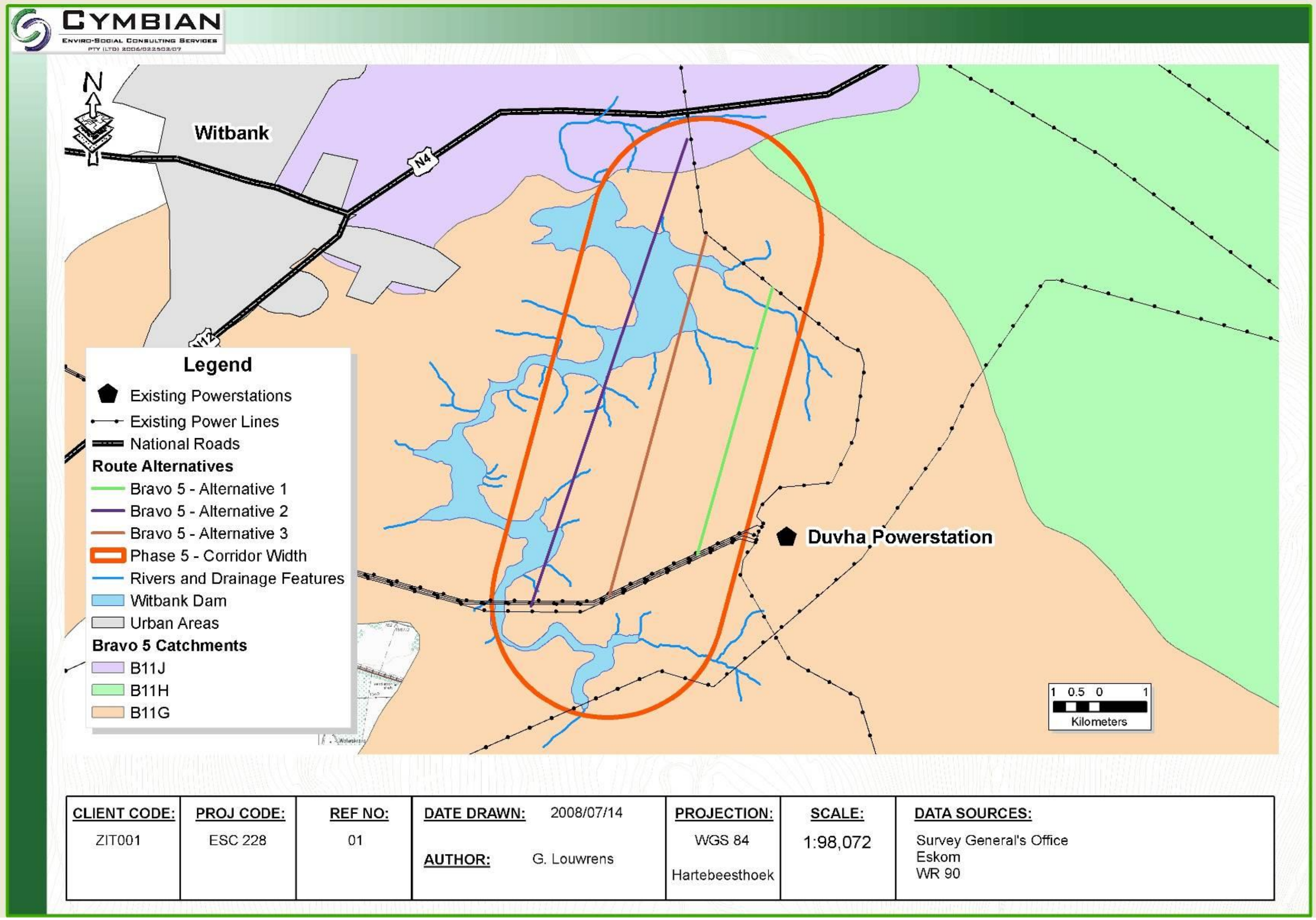



**Figure 5: Surface water and drainage features**

## 3.4 Topography

### 3.4.1 Data Collection

The topography data was obtained from the Surveyor General's 1:50 000 toposheet data for the region, namely 2529CD. Contours were combined from the topo mapsheets to form a combined contours layer. Using the Arcview GIS software the contour information was used to develop a digital elevation model of the region as shown in Figure 6 below.

### 3.4.2 Regional Description

The topography of the region is typified by slightly to moderately undulating plains, including some low hills and pan depressions. Some small scattered wetlands and pans occur in the area, rocky outcrops and ridges also form part of significant landscape features in the area. Altitude ranges between 1520-1780 metres above mean sea level (mamsl), but can reach also reach as low as 1300 mamsl.

### 3.4.3 Site Description

The study area's topography is representative of the region, that being slightly to moderately undulating plains and grassland of the Highveld plateau. This undulating topography gives rise to the number of streams and rivers in the area, which form at the bottom of the gently rolling hills. Elevations range from 1600 metres above mean sea level (mamsl) in the east to 1520 mamsl in the centre of the site.

Figure 6 below illustrates the digital elevation model created from the contours of the region. The low lying areas are clearly visible in light green and orange while the higher areas are shown in white and brown. The general slope of the terrain of the site is northwards and towards the centre of the site.

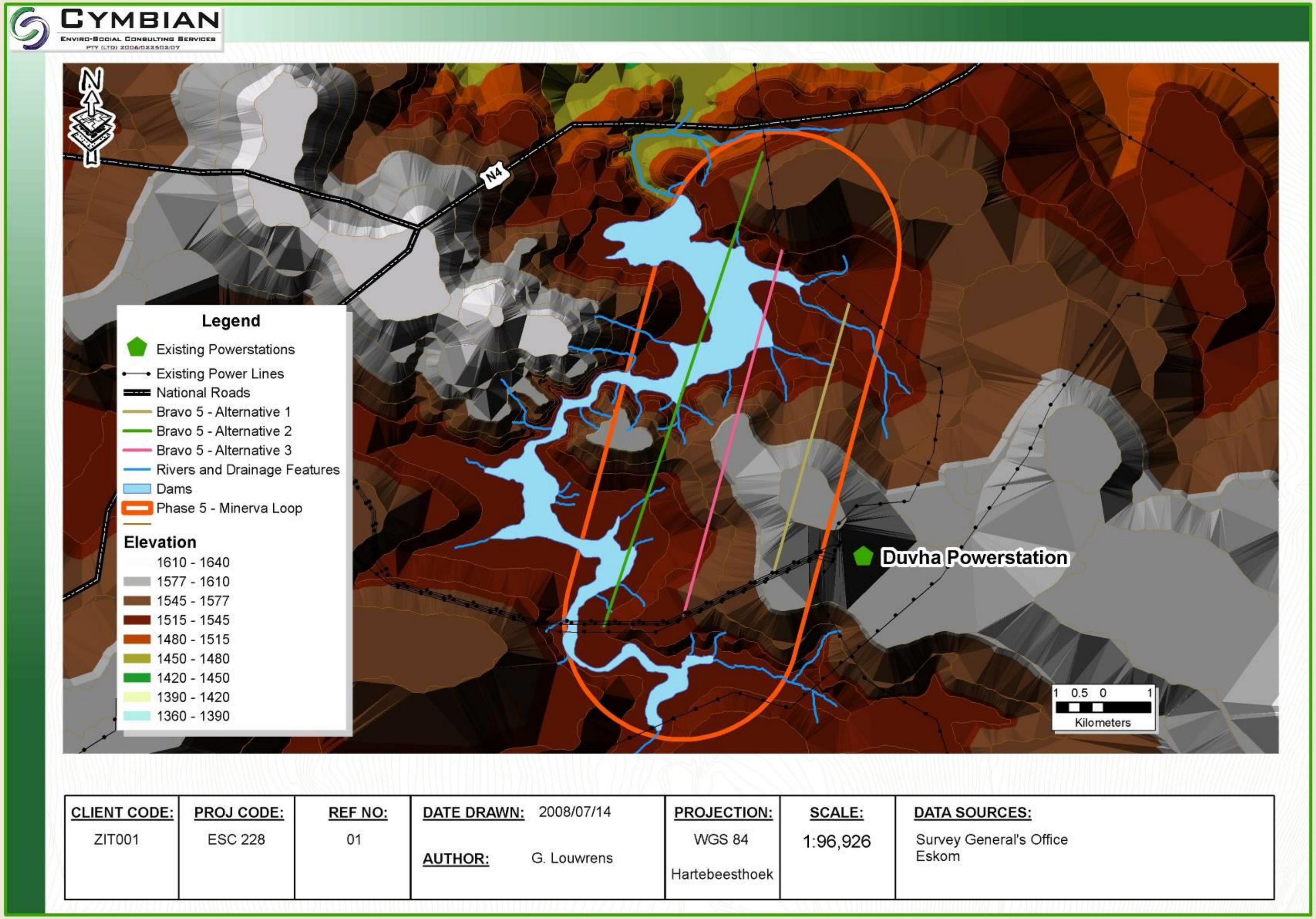



**Figure 6: Topography of Site**

## 3.5 Soils

### 3.5.1 Data Collection

The site visit was conducted on the 17th - 18th November 2008. Soils were augered at 150m intervals along the proposed power line routes using a 150 mm bucket auger, up to refusal or 1.2 m. Soils were identified according to Soil Classification; a taxonomic system for South Africa (Memoirs on the Natural Resources of South Africa, no. 15, 1991). The following soil characteristics were documented:

- Soil horizons;
- Soil colour;
- Soil depth;
- Soil texture (Field determination)
- Wetness;
- Occurrence of concretions or rocks; and
- Underlying material (if possible).

### 3.5.2 Regional Description

The soils in the region are mostly derived from the geology of the region namely, predominantly shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) and are generally deep sandy soils with a red to yellow-brown colour. The Quartzite and Rocky Ridges of the area generally support shallow Glenrosa and Mispah soils, while Melanic and Clay soils are present along streams, rivers and dams.

### 3.5.3 Site Description

During the site visit four main soil forms were identified namely, Mispah, Clovelly, Hutton and Katspruit. Each of the soil forms are described in detail in the sections below and Figure 7 illustrates the location of the soil types. The land capability (agricultural potential) of the abovementioned soil form is described in more detail in Section 3.6.

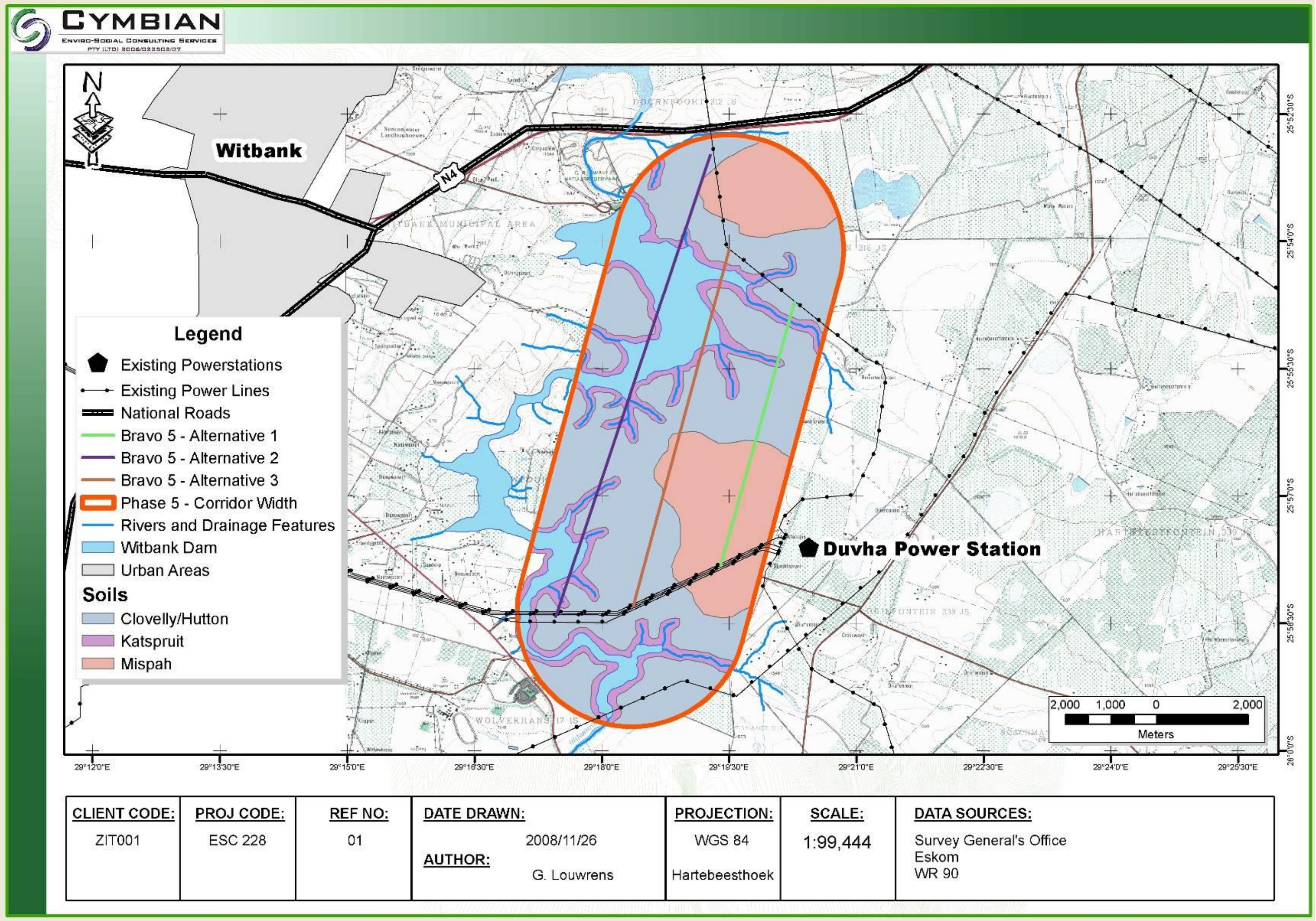



**Figure 7: Soil Type Map**

**Mispah soil form**

The Mispah soil form is characterised by an Orthic A – horizon overlying hard rock. Mispah soil is horizontally orientated, hard, fractured sediments which do not have distinct vertical channels containing soil material. There is usually a red or yellow-brown apedal horizon with very low organic matter content. Please refer to Figure 8 for an illustration of a typical Mispah soil form.

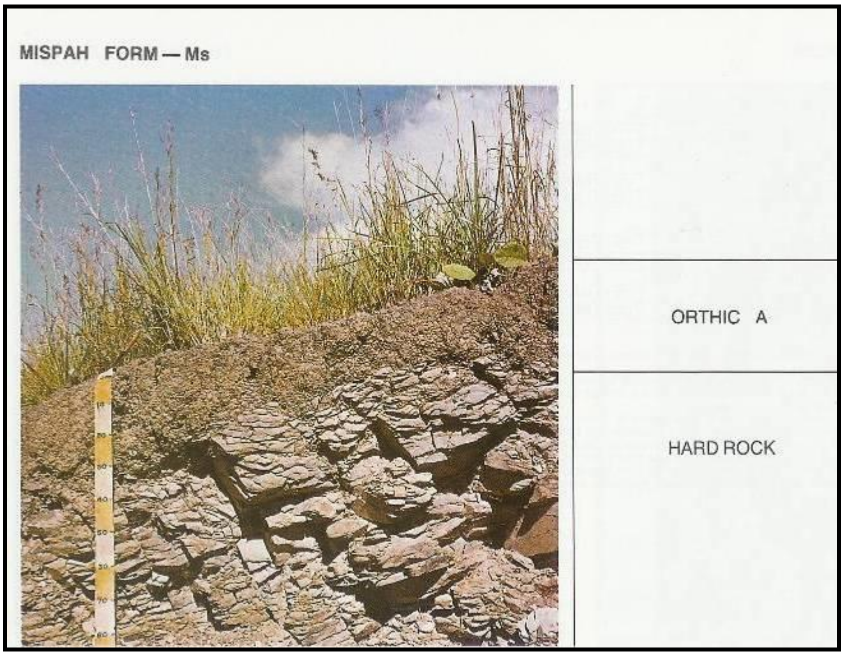



**Figure 8: Mispah soil form (Memoirs on the Natural Resources of South Africa, no. 15, 1991).**

**Clovelly Soil Form**

Clovelly soils can be identified as an apedal "yellow" B-horizon as indicated in Figure 9 below. These soils along with Hutton soils are the main agricultural soil found within South Africa, due to the deep, well-drained nature of these soils. The soils are found on the valley slopes and constitute 44.6 % (1 178 ha) of the site.

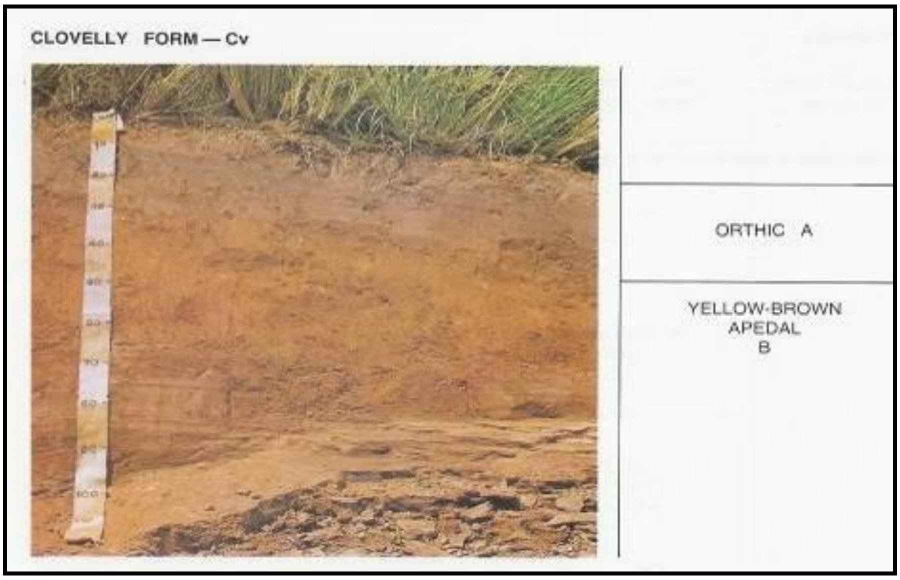



**Figure 9: Clovelly soil form (Soil Classification, 1991)**

### Hutton Soil Form

Hutton’s are identified on the basis of the presence of an apedal (structureless) “red” B-horizon as indicated in Figure 10 below.  These soils are the main agricultural soil found in South Africa, due to the deep, well-drained nature of these soils.  The Hutton soils found on the site are restricted to the midslopes of the site.  .

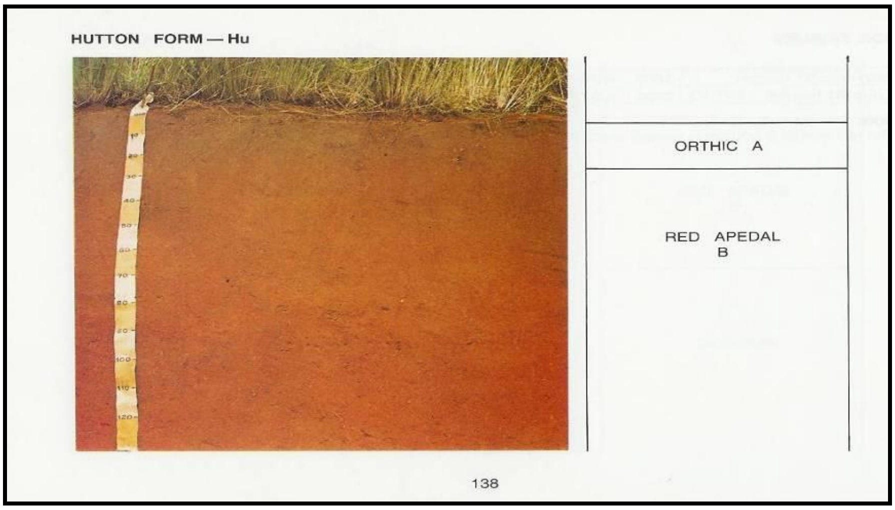



**Figure 10: Hutton Soil Form (Soil Classification, 1991)**

**Katspruit Soil Form**

The Katspruit soil form is most commonly found in areas of semi-permanent wetness. The soil is made up of an Orthic A-horizon over a diagnostic G-horizon and is indicated in Figure 11 below. The G-horizon has several unique diagnostic criteria as a horizon, namely:

- It is saturated with water for long periods unless drained;
- Is dominated by grey, low chroma matrix colours, often with blue or green tints, with or without mottling;
- Has not undergone marked removal of colloid matter, usually accumulation of colloid matter has taken place in the horizon;
- Has a consistency at least one grade firmer than that of the overlying horizon;
- Lacks saprolitic character; and
- Lacks plinthic character.

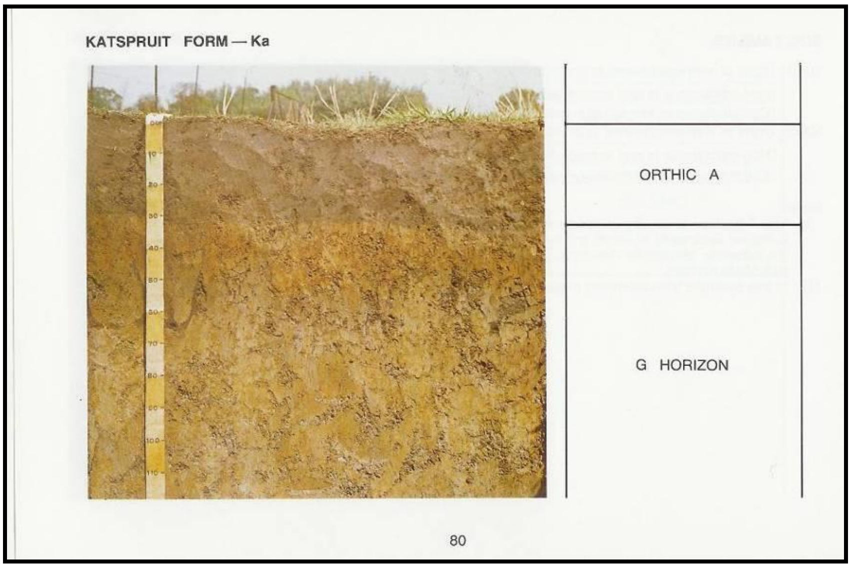



**Figure 11: Katspruit Soil form (Soil Classification, 1991)**

## 3.6 Land Capability

### 3.6.1 Data Collection

A literature review was conducted in order to obtain any relevant information concerning the area, including information from the Environmental Potential Atlas (ENPAT), Weather Bureau and Department of Agriculture. Results from the soil study were taken into account when determining the land capability of the site.

The land capability assessment methodology as outlined by the National Department of Agriculture was used to assess the soil's capability on site.

### 3.6.2 Regional Description

The regional land capability is mostly class VI soils with many limitations. There are large patches of arable land and this is evidenced from the large number of cultivated lands found in the region. In the areas where the soil is too shallow or too wet to cultivate, livestock are grazed.

### 3.6.3 Site Description

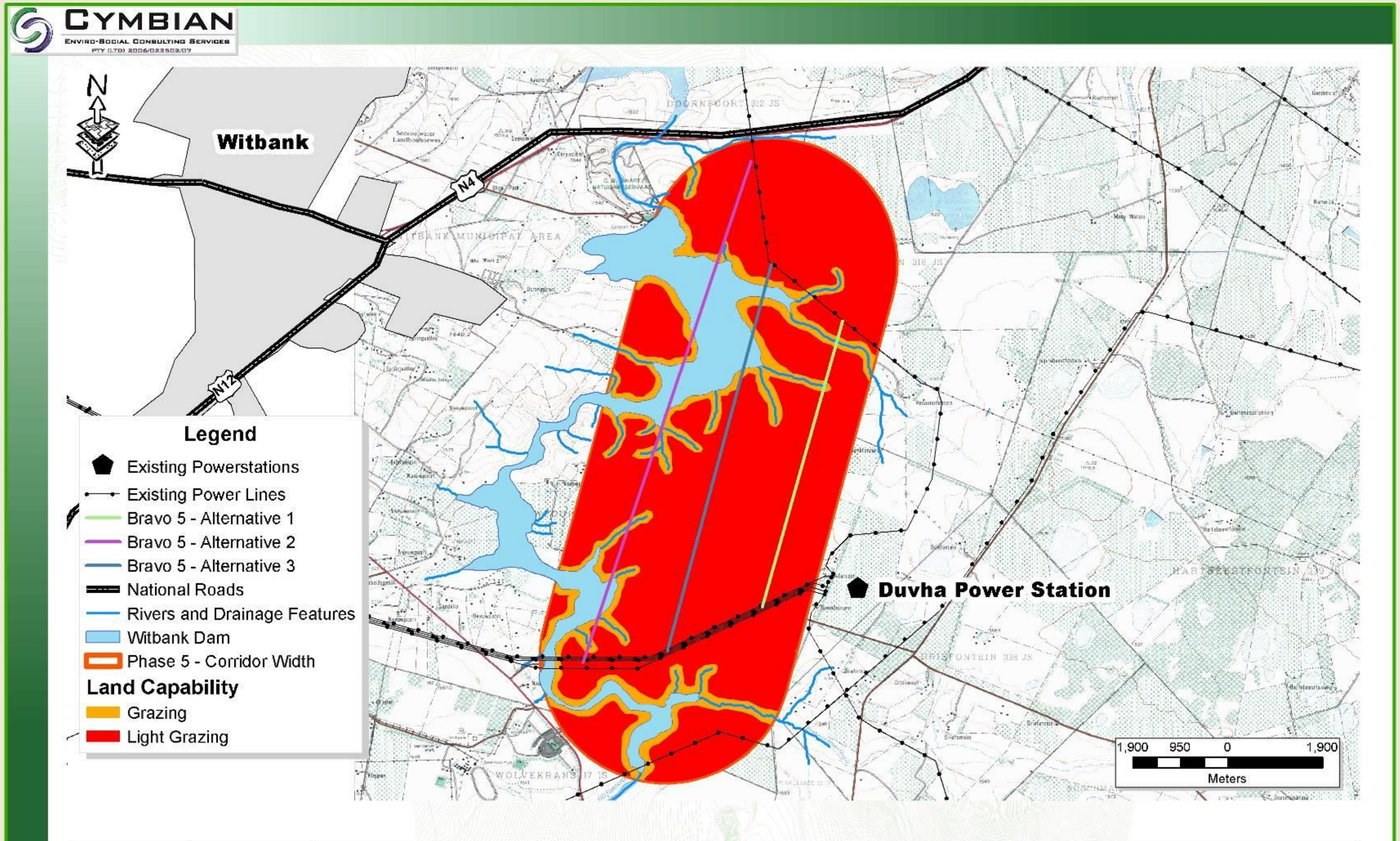
The soils identified on site were classified according to the methodology proposed by the Agricultural Research Council – Institute for Soil, Climate and Water (2002). Factors evaluated are tabled below.

The site is made up of two main land capability classes, namely class VI-VII – light grazing and class V – grazing. The class VI and VII soils are not suitable for cultivation mainly due to shallow nature of the soils of this class. The class VI and VII soils have continuing limitations that cannot be corrected; in this case rock complexes, flood hazard, stoniness, and a shallow rooting zone constitute these limitations. The class V soils found on site are limited to the areas surrounding drainage lines or streams and the Witbank Dam and are limited by the frequent flooding risk, shallow depth and poor drainage. Figure 12 illustrates the various land capability units on site.

**Table 2: Land Capability of the soils on site for agricultural use**

| Soil | Clovelly & Hutton | Mispah | Katspruit |
|---|---|---|---|
| Area (ha) | 263.0 | 101.0 | 63.0 |
| % of site | 61.6 | 23.7 | 14.7 |
| Rock Complex | Yes – hard rock | Yes – hard rock | |
| Flooding Risk | F1 – None | F1 - None | F4 - Common |
| Erosion Risk | E4 – Moderate to High | E4 – Moderate to High | E3 - Moderate |
| Slope % | 10.0 | 10.4 | 7.0 |
| Texture | T1 – 15 – 45% Clay | T1 – 15 – 45% Clay | T1 – 15 – 45% Clay |
| Depth | D4 – 10 – 30 cm | D4 – 10 – 30 cm | D3 – 40 – 60 cm |
| Drainage | W2 – Well drained | W2 – Well drained | W5 – Poorly drained |
| Mech Limitations | MB2 – Large Stones and Boulders, Unploughable | MB3 – Shallow soils on rock | MB0 - None |
| pH | pH > 5 | pH > 5 | pH > 5 |
| Soil Capability | VI | VII | V |
| Climate Class | C2 | C2 | C1 |
| Land Capability | VI – Light Grazing | VII – Light Grazing | V - Grazing |

| No limitation | Low to Moderate | Moderate | High | Very Limiting |
|---|---|---|---|---|




| CLIENT CODE: | PROJ CODE: | REF NO: | DATE DRAWN: | PROJECTION: | SCALE: | DATA SOURCES: |
|---|---|---|---|---|---|---|
| ZIT001 | ESC 228 | 01 | 2008/11/26<br>AUTHOR:<br>G. Louwrens | WGS 84<br>Hartebeesthoek | 1:97,136 | Survey General's Office<br>Eskom<br>WR 90 |

**Figure 12: Land Capability Map**

## 3.7 Land Use

### 3.7.1 Data Collection

The Land Use data was obtained from the CSIR Land Cover database utilising a GIS desktop study and supplemented with visual observations on site.

### 3.7.2 Regional Description

Land-Use is dominated by maize and sunflower farming, coal mines and power stations. Land uses also occurring in the area include Commercial / Industrial, Conservation areas, Cultivated land, Forestry areas, Residential, Subsistence farming and Vacant or Unspecified land, however for the purposes of this report, land use of the region is grouped into urban, cultivation, grassland / plantations, mines and quarries and waterbodies / wetlands.

### 3.7.3 Site Description

The Land-Use on site is dominated by maize, grazed fields, quarries, residential and conservation. From the map below (Figure 14) it can be seen that the proposed by-pass line and buffer zone include all classes of land use. Water bodies are the only land use regarded as sensitive and as such certain mitigatory measures will be outlined. The study area is located in an area which is predominantly unimproved grassland and this type of land cover is associated with intensive grazing. It was noted that Corobrik make use of a quarry on site to manufacture bricks and that a small section of the ash dump from Duvha Power Station is located on site, the Golden Miles Estate is also located on site (Figure 13). With this in mind Alternative 1 is the most preferred alternative as it avoids the water bodies and also disturbs the shortest section of grazing land before entering the power station site.

| | |
|---|---|
|  |  |
| Ash Dump from the Duvha Power | Fields used for grazing |

Corobrik quarry on site

Corobrik quarry on site

Golden Mile Residential Estate on site


Golden Mile Residential Estate on site

Residential properties surrounding the Witbank Dam

Residential properties surrounding the Witbank Dam

**Figure 13: Land Uses encountered on site**

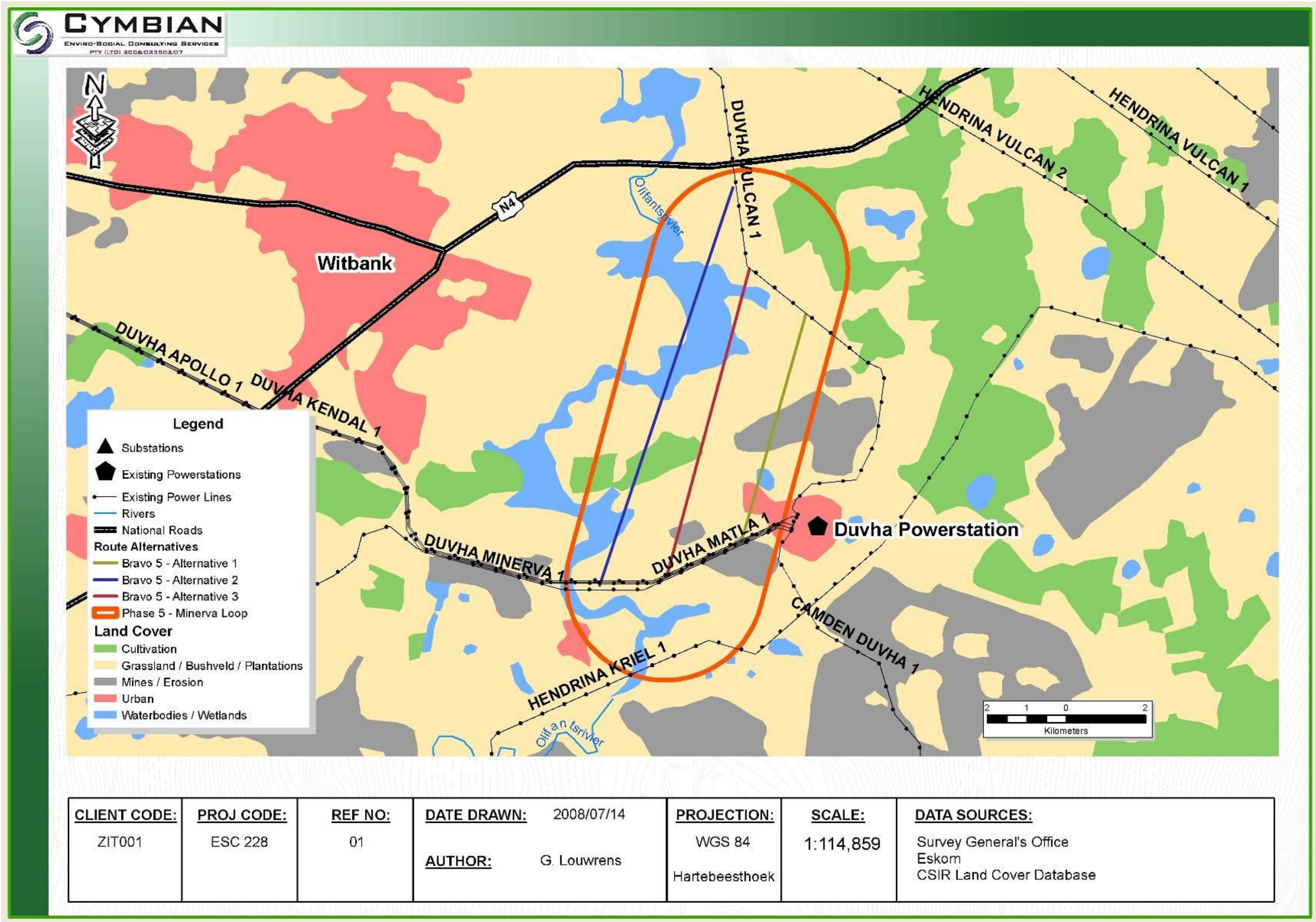



**Figure 14: Land Use Map**

## 3.8 Vegetation

### 3.8.1 Data Collection

The floral study involved extensive fieldwork, a literature review and a desktop study utilizing GIS. The site was investigated during a one week site visit, conducted from the 10$^{th}$-12$^{th}$ September 2008, in early spring. The area within the servitude was sampled using transects placed at 300m intervals. At random points along the transect an area of 20m x 20m was surveyed. All species within the 20m x 20m quadrant were identified, photographed and their occurrence noted. Sensitive features such as ridges or wetlands were sampled by walking randomly through the area concerned and identifying all species within the area.

The floral data below is taken from The Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006). Also, while on site, the following field guides were used:

- Guide to Grasses of Southern Africa (Frits van Oudtshoorn, 1999);
- Field Guide to Trees of Southern Africa (Braam van Wyk and Piet van Wyk, 1997);
- Field Guide to the Wild Flowers of the Highveld (Braam van Wyk and Sasa Malan, 1998);
- Problem Plants of South Africa (Clive Bromilow, 2001);
- Medicinal Plants of South Africa (Ben-Erik van Wyk, Bosch van Oudtshoorn and Nigel Gericke, 2002)

The occurrence of the species was described as either:

- Very common (>50 % coverage);
- Common (10 – 50 % coverage);
- Sparse (5 – 10 % coverage); and
- Individuals (< 5 % coverage).

### 3.8.2 Regional Description

According to the South African National Biodiversity Institute, the study area falls within the Grassland Biome, where most of the county's maize production occurs. The study area comprises of the Rand Highveld Grassland, Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands vegetation units as classified by Mucina and Rutherford[1]. Each of these vegetation units are described in more detail below.

*Rand Highveld Grassland*

Rand Highveld Grassland is found in the highly variable landscape with extensive sloping plains and ridges in the Gauteng, North-West, Free State and Mpumalanga Provinces. The vegetation type is found in areas between rocky ridges from Pretoria to Emahlahleni, extending onto ridges in the Stoffberg and Roossenekal regions as well as in the vicinity of Derby and Potchefstroom, extending southwards and north-eastwards from there. The vegetation is species rich, sour grassland alternating with low shrubland on rocky outcrops. The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon and Elionurus*. High numbers of herbs, especially *Asteraceae* are also found. In rocky areas shrubs and trees also prevail and are mostly *Protea caffra, Acacia caffra, Celtis africana and Rhus spp.*

This vegetation type is poorly conserved (approx 1 %) and has a target of 24 % of the vegetation type to be conserved. Due to the low conservation status this vegetation type is classified as endangered. Almost half of the vegetation type has been transformed by cultivation, plantations, urbanisation or dam-building. Scattered aliens (*Acacia mearnsii*) are present in the unit.

*Eastern Highveld Grassland*

The Eastern Highveld Grassland is found in the Mpumalanga and Gauteng Provinces on the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. The landscape is dominated by undulating plains and low hills with short dense grassland dominating belong to the genera *Themeda, Aristida, Digitaria, Eragrostis, Tristachya etc*. Woody species are prevalent on the rocky outcrops. In terms of conservation and disturbance, 44 % of the vegetation type is already transformed by cultivation, plantations, mines, and urbanisation. No serious alien invasion, but *Acacia mearnsii* can dominate in certain areas

*Eastern Temperate Freshwater Wetlands*

Another vegetation type associated with the region is the Eastern Temperate Freshwater Wetlands, found around water bodies and embedded within the Grassland biome. Eastern Temperate Freshwater Wetlands are typically found in flat landscapes or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hydrophillous (water loving) vegetation of temporarily flooded grasslands and ephemeral herblands. Important species include *Cyperus congestus*, *Phragmites australis*, *Marsilea farinose*, *Rorippa fluviatalis*, *Disa zuluensis*, *Crassula tuberella* and the carnivorous herb *Utricularia inflexa*. These wetlands are one of the most sensitive vegetation units found in the region and have been extensively modified by mining and industrial activities in the region.

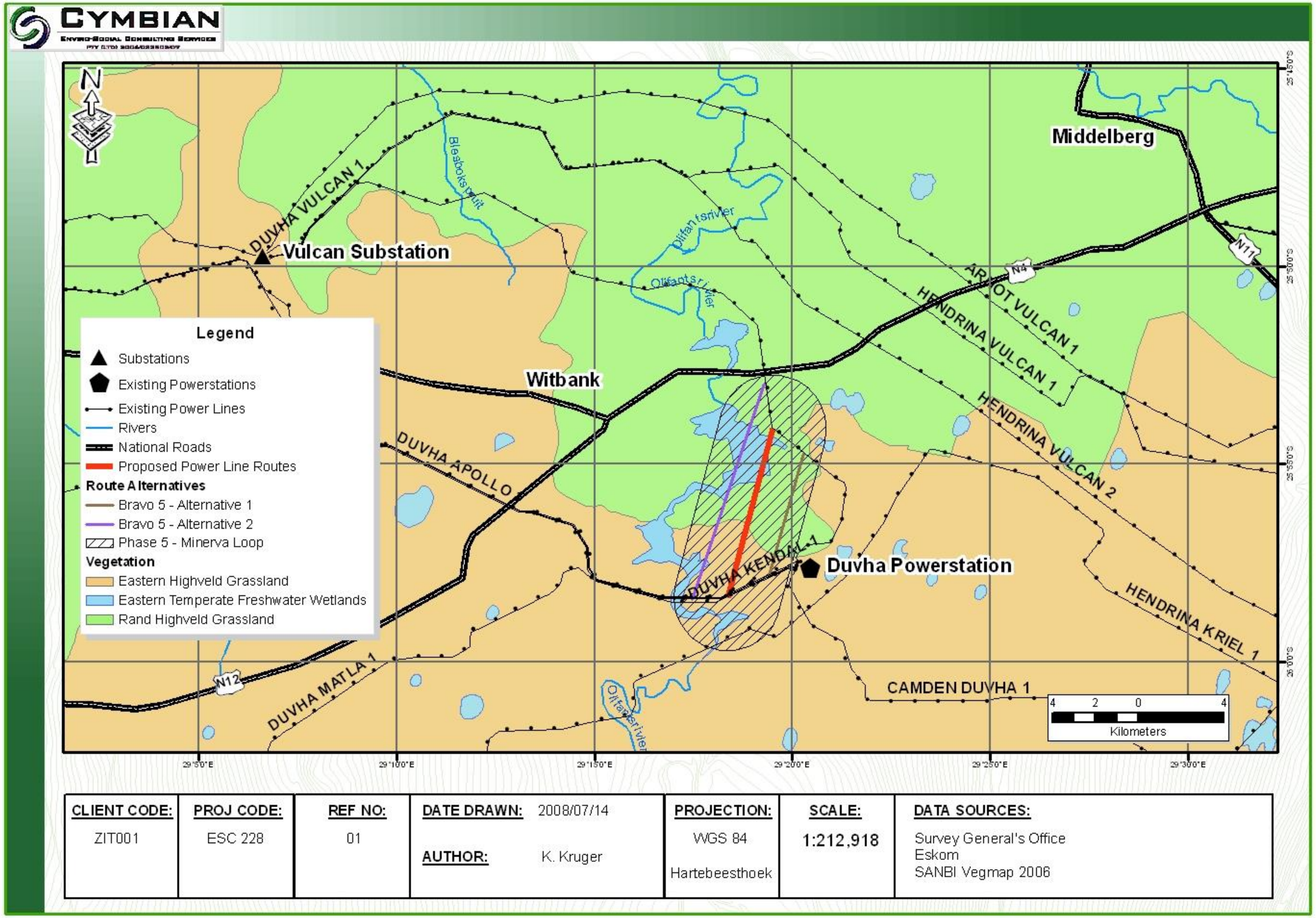



**Figure 15: Regional Vegetation**

### 3.8.3 Site Description

Three main vegetation types were identified, namely Disturbed/Grazed Grassland, Undisturbed/Natural Grassland and Wetland and Riparian communities. Each of these vegetation types are described in more detail below and illustrated in Figure 19 below. The species list for the site is attached in Appendix 1. The species that could occur in the quarter degree grid was obtained from the Plants of Southern Africa (POSA) online database upheld by the South African National Botanical Institute (SANBI) and supplemented with field notes. The list provides species names, common names, as well as notes on which species were observed on site. In total 136 species could occur in the area with 43 confirmed species.

**Disturbed/Grazed Grassland**

Disturbed grassland or other disturbed areas such as road reserves or fallow fields, not cultivated for some years, are also usually *Hyparrhenia* dominated. However, while *Hyparrhenia* – is present in this vegetation unit, it is not dominate. This grassland is a result of high disturbance as a result of over-grazing, characterised by Bankrupt Bush (*Stoebe vulgaris*), an invader dwarf shrub which usually indicates grassland's degraded condition.

This grassland mostly has low species richness, with only a few other species able to establish or survive in the shade of the dense sward of tall grass. Most of these species are relict pioneers or early seral species. The most prominent species include the grasses *Cynodon dactylon, Eragrostis plana, E. racemosa, E. curvula and E. capensis*. Herbaceous species such as *Anthospermum rigidum, Conyza podocephala, Crabbea angustifolia and Helichrysum rugulosum* are present. Alien species such as *Acacia mearnsii* (Black Wattle) have also invaded this vegetation unit.

Figure 16 below provides an illustration of the Disturbed/Grazed Grassland unit.

| | |
|---|---|
|  |  |
| Disturbed/Grazed Grassland with the Duvha Power Station in the background. | *Dovyalis zeyher*i (Wild Apricot) on a rocky outcrop that forms parts of the Disturbed/Grazed Grassland. |
|  |  |
| *Stoebe vulgaris* (Bankrupt bush) characterising the Disturbed/Grazed Grassland. | Disturbed/Grazed Grassland with invasive *Acacia mearnsii* (Black wattle) in the background. |
|  |  |
| Disturbed/Grazed Grassland with the Corobrik quarry in the background. | Disturbed/Grazed Grassland with *Acacia mearnsii* (Black wattle). |
| **Figure 16: Disturbed/Grazed Grassland** | |

### Undisturbed/Natural Grassland

This grassland comprises both the Eastern Highveld Grassland and the Rand Highveld Grassland and is dominated by the grasses of these vegetation types *(*Figure 17*).*

The vegetation is species rich located on a landscape is dominated by undulating plains and low hills with short dense, sour grassland alternating with low shrubland on rocky outcrops. The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon, Aristida, Digitaria, Tristachya and Elionurus*. High numbers of herbs, especially *Asteraceae* are also found. In rocky areas shrubs and trees also prevail and are mostly *Protea caffra, Acacia caffra, Celtis africana and Rhus spp.*

| | |
|---|---|
|  |  |
| Undisturbed/Natural Grassland with existing power lines traversing the vegetation. | Undisturbed/Natural Grassland. |
| **Figure 17: Undisturbed/Natural Grassland** | |

### Wetland and Riparian communities

Wetland and Riparian communities are seasonally wet areas that occur in sandy areas where water seeps into lowlying drainage lines after rains. These areas are usually covered by hygrophytes such as sedges and reeds. The dominant sedge in the study area is *Juncus rigidus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occurs.

Wetlands are of a more permanent nature and occur in low-lying areas such as tributaries of streams and rivers. Wetlands are typically found in flat landscapes or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hydrophillous (water loving) vegetation of temporarily flooded grasslands and ephemeral herblands. Typical plants are the

Orange River Lily (*Crinum bulbispermum*), bulrush (*Typha capensis*) and reeds (*Phragmites australis*), sedges of the *Cyperus, Fuirena and Scirpus* genera also occur (Figure 18).


| | |
|---|---|
| Wetland and Riparian communities with Wibank Dam in the background. | Wetland and Riparian communities with Witbank Dam in the background. |

**Figure 18: Wetland and Riparian communities**

3.8.4 Red data Flora Species

The Mpumalanga Parks Board provided information as to sensitive plant species occurring in the area and it was found that only one sensitive plant species, *Hypoxis hemerocallidea*, occurs in the quarter degree square 2529CD. *Hypoxis hemerocallidea* is rated as "Least Concern" in Mpumalanga and throughout the rest of South Africa, however populations are declining. It should be noted that during the site visit, *Hypoxis hemerocallidea* was not found to occur on site; however its presence can not be completely excluded.

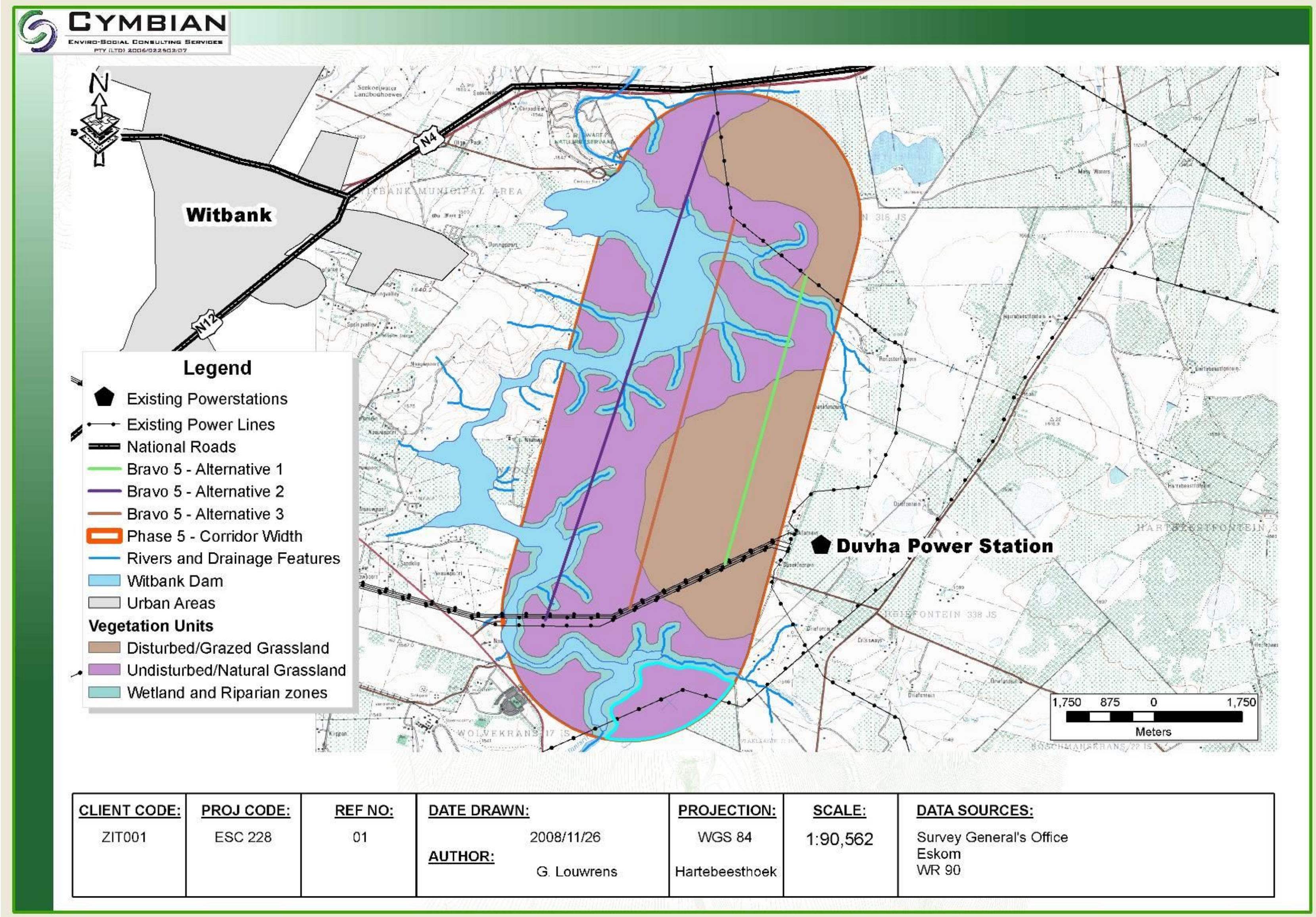



**Figure 19: Vegetation units found on site**

## 3.9 Fauna

### 3.9.1 Data Collection

A literature review of the faunal species that could occur in the area was conducted. C-Plan data provided from the Mpumalanga provincial department was used to conduct a desktop study of the area. This data consists of terrestrial and aquatic components, ratings provide an indication as to the importance of the area with respect to biodiversity. Additionally, all fauna were noted during the site visit conducted on the 17$^{th}$ – 20$^{th}$ November 2008.

### 3.9.2 Regional Description

As a consequence of mining and farming in the area, it appears that only small animals are to be found at the site. Small mammals known to occur in the area include hedgehog, rabbits, polecat, meerkat and the ubiquitous rats and mice. Given the habitat, it is likely that korhaans, larks, longclaws, species of Euplectes (bishops and widows), weavers, starlings and sparrows occur in the grassland.

The area surrounding the proposed loop in lines does include areas of terrestrial and aquatic habitats. These areas should be treated as sensitive and should therefore be managed accordingly; if feasible they should be avoided.

### 3.9.3 Site Description

The scope of work indicated that an avifauna assessment was required. An avifaunal assessment will be undertaken and the report will be provided as part of the EIA. All herpetofauna and mammals observed on site were noted during the site visit.

**Habitat**

The habitat on site is described in the vegetation site description in Section 3.8.3 above. All of the vegetation types identified have been disturbed to a certain extent, as the main land use in the area is grazing of livestock. The largest portion of the site is comprised of Undisturbed Grassland, totalling approximately 50.1 % of the study site. The remainder of the site comprises Disturbed Grassland and Riparian and Wetland zones. All of these are suitable habitat to a number of protected species found in the region.

### Species potentially occurring on site

A detailed list of the species potentially occurring on site is attached in Appendix 2.

***Herpetofauna***

Herptofauna could potentially occur in all the habitat types. The Riparian and Wetland zones could potentially support amphibians representative of the region, specifically *Pyxicephalus adspersus* (African Bullfrog) which is a species rated as "near threatened" and is a protected species in South Africa.

The quarter degree square is known to contain *Geochelone pardalis* (Leopard tortoise), *Aparallactus capensis* (Cape Centipede Eater), *Atractaspis bibronii* (Southern or Bibron's Burrowing Asp), *Causus rhombeatus* (Common Night Adder), *Crotaphopeltis hotamboeia* (Herald or Red-lipped Snake), *Dasypeltis scabra* (Common or Rhombic Egg Eater), *Hemachatus haemachatus* (Rinkhals), *Lycodonomorphus rufulus* (Common Brown Water Snake), *Naja annulifera annulifera* (Snouted Cobra), *Psammophylax tritaeniatus* (Striped Skaapsteker), *Agama atra (*Southern Rock Agama*), Bitens arietans* (Puff Adder)*, Cordylus vittifer* (Transvaal Girdled Lizard)*, Gerrhosaurus flavigularis* (Yellow Throated Plated Lizard), *Lygodactylus ocellatus* (Spotted Dwarf Gecko), *Pachydactylus affinis* (Transvaal Thick-toed Gecko), *Telescopus semiannulatus semiannulatus* (Eastern Tiger Snake), *Psammophis brevirostris brevirostris* (Leopard or Short-snouted Grass Snake) and *Varanus niloticus (*Water Monitor). *Hemachatus haemachatus* (Rinkhals), *Psammophis brevirostris brevirostris* (Leopard or Short-snouted Grass Snake) and *Cordylus vittifer* (Transvaal Girdled Lizard) are endemic to Southern Africa, while *Lygodactylus ocellatus* (Spotted Dwarf Gecko) and *Pachydactylus affinis* (Transvaal Thick-toed Gecko) are endemic to South Africa.

None of the above mentioned Herpetofauna were encountered on site during the site visit that took place from the 17$^{th}$-20$^{th}$ November 2008.

***Avifauna***

Avifauna that could potentially occur on site is provided in Table 3 below. The avifaunal assessment (Appendix 3) focused on identifying a preferred alignment for the new Bravo-Vulcan 400kV line from a bird impact perspective, and the description of associated impacts on birds. Recommendations were also provided to mitigate for potential impacts.

**Table 3: Avifauna Species List**

| Species | Common name |
|---|---|
| *Phalacrocorax africanus* | Reed Cormorant |
| *Ardea cinerea* | Grey Heron |
| *Ardea melanocephala* | Blackheaded Heron |
| *Bubulcus ibis* | Cattle Egret |
| *Bostrychia hagedash* | Hadeda Ibis |
| *Plegadis falcinellus* | Glossy Ibis |
| *Alopochen aegyptiacus* | Egyptian Goose |
| *Elanus caeruleus* | Blackshouldered Kite |
| *Francolinus swainsonii* | Swainson's Francolin |
| *Numida meleagris* | Helmeted Guineafowl |
| *Fulica cristata* | Redknobbed Coot |
| *Gallinula chloropus* | Moorhen |
| *Anthropoides paradisea* | Blue Crane |
| *Sagittarius serpentarius* | Secretary Bird |
| *Eupodotis cafra* | Whitebellied Korhaan |
| *Vanellus armatus* | Blacksmith Plover |
| *Vanellus coronatus* | Crowned Plover |
| *Streptopelia semitorquata* | Redeyed Dove |
| *Streptopelia senegalensis* | Laughing Dove |
| *Asio capensis* | Marsh Owl |
| *Colius striatus* | Speckled Mousebird |
| *Mirafra africana* | Rufousnaped Lark |
| *Corvus albus* | Pied Crow |
| *Saxicola torquata* | Stone Chat |
| *Phylloscopus trochilus* | Willow Warbler |
| *Cisticola fulvicapilla* | Neddicky |
| *Motacilla clara* | Cape Wagtail |
| *Anthus cinnamomeus* | Grassveld Pipit |
| *Passer domesticus* | House Sparrow |
| *Ploceus velatus* | Masked Weaver |
| *Euplectes orix* | Red Bishop |
| *Emberiza capensis* | Cape Bunting |

The species that could potentially occur on site include waterfowl, grassland specialists and common generalists. This is attributed to the variety of habitats that occur on site, as well as the adequate supply of fresh water.

Sensitive species known to occur in the quarter degree square include *Oxyura maccoa* (Maccoa Duck) and *Geronticus calvus* (Bald Ibis) which is endemic to South Africa.

The following conclusions from the avifaunal impact assessment are put forward:

- A number of power line sensitive, Red Data species could potentially occur along any of the alignments, although the occurrence of these species would be the exception rather than the rule.
- The proposed power line, unless mitigated, will pose a limited collision risk to power line sensitive bird species in the study area. Another potential risk is the destruction of sensitive wetland habitat through the construction of access roads.
- Of the Red Data species potentially present in the area, none are particularly at risk by the power line due to the very small densities at which the species occur. The latter is a result of the extensive habitat degradation that has taken place.
- There is, however, a substantial risk of collisions for several non Red Data species which warrants the application of mitigation measures.

The following recommendations are put forward:

- A sensitivity map indicating the areas where anti-collision devices need to be applied to the proposed line is shown in Figure 20 below.
- The construction of access roads in sensitive wetland habitat should be avoided.

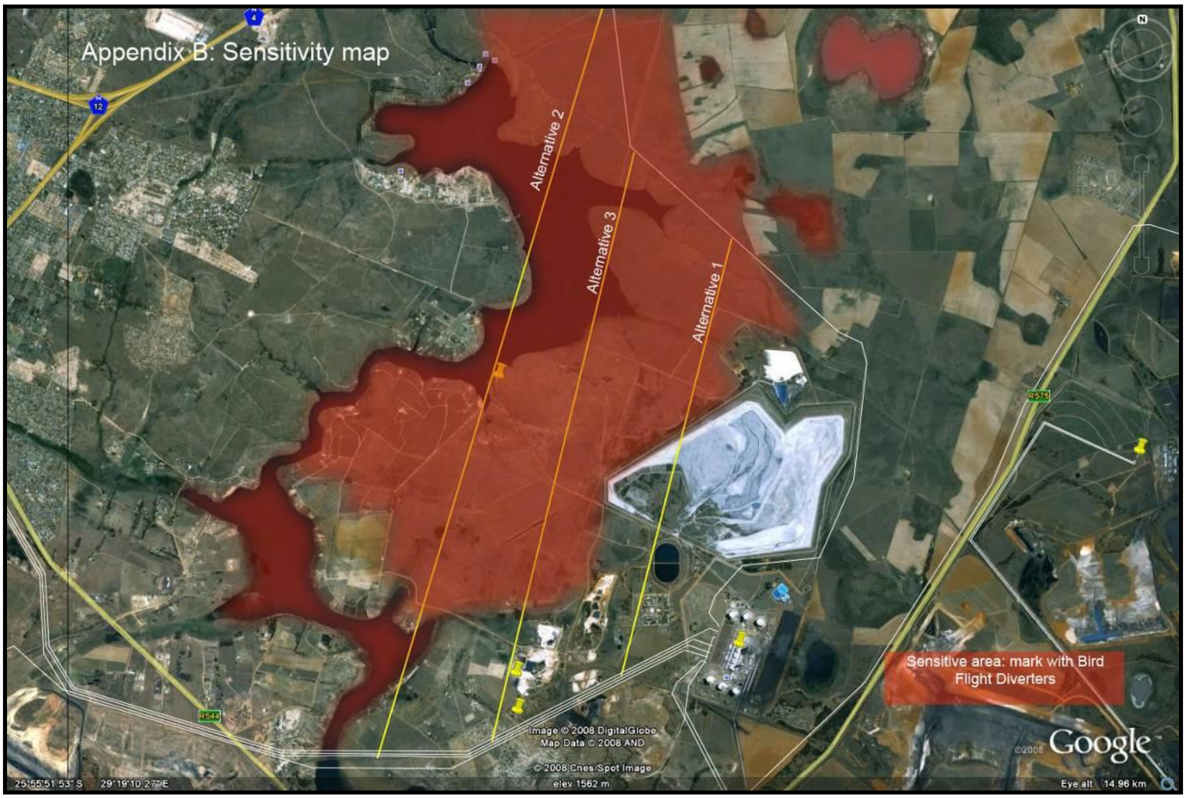



**Figure 20: Avifaunal Sensitivity Map**

From the analysis undertaken in the avifaunal impact assessment, Alternative 1 is the preferred alignment from a bird interaction perspective.

***Mammals***

Large mammals have to a large extent been removed from the area and the only indication of large mammal species that could have previously occurred in the area are re-introduced mammals found on a few game farms and lodges encountered during the site visit. These include Springbok (*Antidorcas marsupialis*), Blesbok (*Damaliscus dorcas phillipsi*), Blue Wildebeest (*Connochaetes taurinus*) and Burchell's Zebra (*Equus burchelli*). During the site visit, Yellow Mongoose (*Cynictis pencillata*) were spotted as well as signs of other small mammals such as droppings. Other small mammals known to occur in the area include Hedgehog (*Atelerix frontalis*), Striped Polecat (*Ictonyx striatus*), Suricate / Meerkat (*Suricata suricatta*), Aardvark / Antbear (*Orycteropus afer*) and the ubiquitous rats and mice. Sensitive mammal species that could occur in the quarter degree square 2529CD include *Genetta tigrina* (Large-spotted Genet), *Lepus saxatilis* (Scrub hare), *Hyaena brunnea* (Brown Hyaena), *Sylvicapra grimmia* (Common/Grey Duiker), *Tragelaphus scriptus* (Bushbuck), *Vulpes chama* (Cape Fox) None of these species were identified on site.

## 3.10 Wetland and Riparian Zone Delineation

### 3.10.1 Riparian Zones vs. Wetlands

**Wetlands**

The riparian zone and wetlands were delineated according to the Department of Water Affairs and Forestry (DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones. According to the DWAF guidelines *a wetland* is defined by the National Water Act as:

*"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

In addition the guidelines indicate that wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and

- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil.

During the site investigation the following indicators of potential wetlands were identified:

- Terrain unit indicator;
- Soil form Indicator;
- Soil wetness indicator; and
- Vegetation indicator.

**Riparian Areas**

According to the DWAF guidelines *a riparian area* is defined by the National Water Act as:

"*Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas*"

**The difference between Riparian Areas and Wetlands**

According to the DWAF guidelines the difference between a wetland and a riparian area is:

"*Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded… Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments*."

#### 3.10.2 Delineation

The site was investigated for the occurrence of wetlands and riparian areas, using the methodology described above and described in more detail in the DWAF guidelines.

**Terrain Unit Indicator**

The terrain on site varies from 1600 mamsl to 1520 mamsl as illustrated in Figure 6. From Figure 6 it can be seen that the site is located in an area of undulating hills with the dominant terrain units on site being the midslope, footslope and valley bottom units. According to the DWAF guidelines the valley bottom is the terrain unit where wetlands are most likely to occur, but they are not excluded from any of the other terrain units.

**Soil Form Indicator**

The site is located on a slope that drains towards the Witbank Dam. Water enters the soils profile and then flows through the profile down-slope. This action of water movement through the slope typifies the soils of the largest part of the site (eluvial and plinthic soils). Closer to the dam (within the valley bottom terrain unit) the soils gradually deepen due to the down-slope transport of soil (colluvium). In addition these soils have gradually higher percentages of clays that over time have been washed down-slope and accumulate at the valley bottom where the slope angle reduces. The detailed soil mapping exercise was limited to the footslope and valley bottom area in order to delineate the wetland / riparian zones.

During a three day site visit the soils on site were identified (Refer to Section 3.5). Of the soils identified on site the Katspruit soil form is indicative of the permanent wetland zone.

**Soil Wetness Indicator**

The soils on site were subjected to a soil wetness assessment. If soils showed signs of wetness within 50 cm of the soil surface, it was classified as a hydromorphic soil and divided into the following groups:

**Temporary Zone**

- Minimal grey matrix (<10%);
- Few high chroma mottles; and
- Short periods of saturation.

**Seasonal Zone**

- Grey matrix (>10%);
- Many low chroma mottles present; and
- Significant periods of wetness (>3 months / annum).

**Permanent Zone**

- Prominent grey matrix;
- Few to no high chroma mottles;

- Wetness all year round; and
- Sulphuric odour.

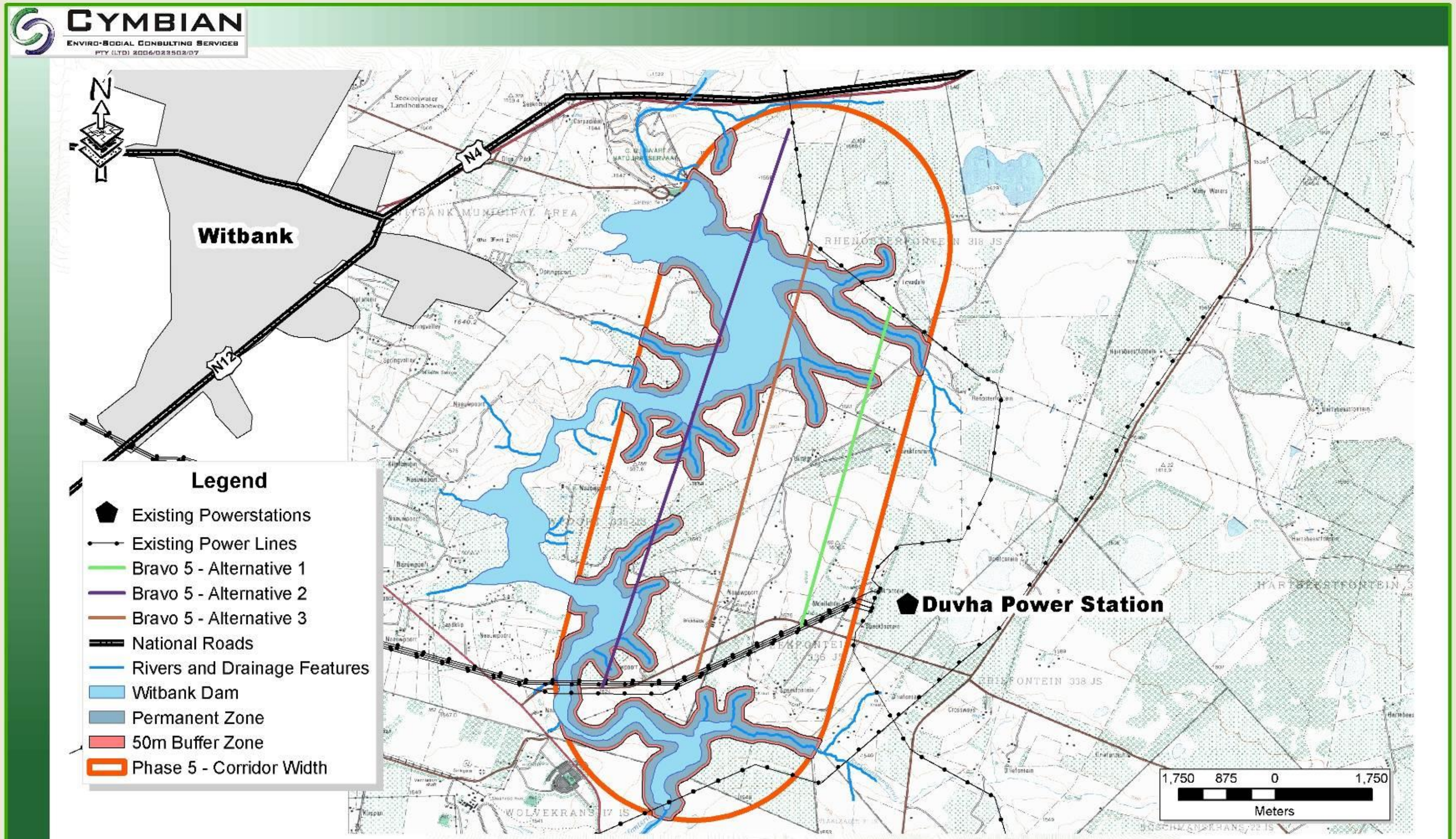
The Katspruit soil form had signs of wetness within the top 50 cm of the soil profile. The Katspruit soil form was classified as the permanent zone, the temporary and seasonal zone could not be delineated since the soil forms diagnostic of these zones probably occur at a depth greater than that of the soil auger used. Therefore, while the temporary and seasonal zones could not be delineated, they are still likely to occur. The soil forms are illustrated in Figure 7.

**Vegetation Indicator**

The vegetation units on site are described in Section 3.8.3 above and illustrated in Figure 19. The vegetation found in the Undisturbed/Natural Grassland and the Riparian and Wetland zone vegetation units both have species present to indicate the presence of wetlands.

### 3.10.3 Wetlands and Buffer Zones

According to the methodology that was followed for delineation of wetlands by DWAF, the permanent zone classifies as a wetland present on site. It should however be noted that several of the so-called wetlands could also be classified as riparian zones as they follow the drainage path of the non-perennial streams on site. All the areas identified above perform critical ecosystem functions and also provide habitat for sensitive species. It is suggested that a 50 m buffer be placed from the edge of the permanent zone in order to sufficiently protect the wetlands and riparian zones. Figure 21 above illustrates the various wetland zones as well as the buffer placed along the edge of the permanent zone. From the figure it is once again clear that Alternative 1 is the best alignment, as it avoids most of the sensitive wetlands as well as the buffer zones.

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| ZIT001 | ESC 228 | 01 | 2008/11/26<br>AUTHOR:<br>G. Louwrens | WGS 84<br>Hartebeesthoek | 1:91,092 | Survey General's Office<br>Eskom<br>WR 90 |

**Figure 21: Wetland and Riparian Zone Map**

## 3.11 Biodiversity Rating

In order to quantify the sensitivity of the fauna, flora and wetlands, a biodiversity assessment is undertaken.

### 3.11.1 Biodiversity Assessment Methodology

Each vegetation unit and its associated fauna were subjected to a biodiversity assessment according to the following methodology. The biodiversity of an area is measured as a combination of the variety of species and habitats within the area, as well as the ecological processes and functional value of the site. This can be captured in two broader categories namely conservation status and functional status. The conservation status encompasses species diversity, habitat diversity and ecological processes. The functional status encompasses ecological services and human use services.

It is suggested, due to the number of variables to be considered, that the following scoring system is used to first determine the value of each of the components (conservation status and functional status) from which the overall biodiversity value is determined.

**Conservation status**

The conservation status of a particular habitat / vegetation unit is determined using the methodology described in Table 4 below. The conservation status encompasses species diversity, habitat diversity and ecological processes. Each of the habitats found on site are rated accordingly in Section 3.11.2 below.

**Table 4: Conservation Status Determination**

| **A. How much of the larger vegetation type or system of which the defined area is a representative example, still exists?** | **Rating** |
|---|---|
| Only a small area still exists (< 500km$^2$ ) | 5 |
| A moderate area still exists (500 to 1000 km$^2$ ) | 3 |
| A large areas still exist (> 1000 km$^2$) | 1 |
| **B. What is (based on a qualitative assessment) the species and habitat diversity of the defined area?** | **Rating** |
| Noticeably high | 5 |
| Difficult to assess | 3 |
| Obviously low | 1 |
| **C. What is the condition (qualitative assessment) of the defined area?** | **Rating** |
| Pristine and largely undisturbed | 5 |
| Moderately disturbed | 3 |
| Highly disturbed | 1 |

The possible results for the conservation status of the defined area are based on a combination of the attributes, as follows.

***A (Size) + B (Diversity) + C (Condition) = Conservation Status***

Based on the combined score, the conservation status can range from very high to low, as described below in Table 5:

**Table 5: Conservation Status Rating**

| Conservation Status | Rating |
|---|---|
| High conservation status, needs to be maintained and improved | 11 – 15 |
| Moderate conservation status, heavily disturbed and will require improvement | 6 – 10 |
| Low conservation status, heavily reduced and of limited value. | 3 – 5 |

### Functional status

The functional status encompasses ecological services and human use services. All these elements are rated according to the methodology described in Table 6 below. A detailed rating of each habitat is given in Section 3.11.2 below.

**Table 6: Functional Status Determination**

| A. Are there currently any signs of obvious recreational use of the area, such as walking/hiking, bird watching, mountain biking, fishing, etc? | Rating |
|---|---|
| Obvious signs of regular use | 5 |
| Signs of periodic use | 3 |
| No noticeable signs of use | 1 |
| **B. Does the area carry out any ecological service, such as water purification, flood attenuation, riverbank stabilisation, soil stabilisation, etc?** | **Rating** |
| Has an obvious functional role | 5 |
| Difficult to determine its functional role | 3 |
| Clearly has no to very limited functional role | 1 |
| **C. Does the area serve an aesthetic role?** | **Rating** |
| Forms part of a larger landscape that is widely visible and has a high aesthetic appeal | 5 |
| Forms part of a landscape that has high aesthetic appeal but which is not widely visible | 3 |
| Forms part of a landscape that has low aesthetic appeal | 1 |

The possible results for the functional status of the defined area are based on a combination of the attributes, as follows.

***A (recreational use) + B (ecological service) + C (aesthetic value) = Functional Status***

Based on the combined score, the functional status can range from very high to low as illustrated in Table 7 below:

**Table 7: Functional Status Rating**

| Functional Status | Rating |
|---|---|
| High service value | 11 – 15 |
| Moderate service value | 6 – 10 |
| Low service value | 3 – 5 |

**Biodiversity value**

The perceived biodiversity value of an area to human development is not always easy to describe, but it includes the natural system and its variety of species, the ecological processes and the service or functional value that it provides. The combination of the conservation status and functional status scores provides a ranking of the overall biodiversity value for a defined area, as shown in the matrix in Table 8 below.

**Table 8: Biodiversity Value Rating**

| | Functional status | | |
|---|---|---|---|
| Conservation status | High service value | Moderate service value | Low service value |
| High | High | High | Moderate |
| Moderate | Moderate | Moderate | Low |
| Low | Moderate | Low | Low |

### 3.11.2 Biodiversity Rating

The following vegetation units were identified on site:

- Undisturbed/Natural grassland;
- Disturbed/Grazed Grassland; and
- Wetland and Riparian zones.

Each of the abovementioned vegetation units are rated for their biodiversity value below.

**Undisturbed/Natural grassland**

This vegetation unit has a **high** biodiversity rating as indicated in Table 9 below. The **high** conservation value is attributed to the high grassland species diversity in the unit and the large area of grassland not conserved remaining. The **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the grassland.

**Table 9: Biodiversity Rating for the *Undisturbed/Natural grassland* unit**

| | | | |
|---|---|---|---|
| Conservation status | Size of vegetation unit | Species diversity | Condition |
| | 3 – Moderate | 5 - High | 3 – Moderately Disturbed |
| Functional status | Use | Ecological service | Aesthetic value |
| | 3 – Periodic | 5 – Obvious | 5 - High |
| Biodiversity Rating | Conservation status | Functional status | Biodiversity |
| | 11 – High | 13 - High | High |

**Disturbed/Grazed Grassland**

This vegetation unit has a **moderate** biodiversity rating as indicated in Table 10 below. The **moderate** conservation value is attributed to the moderate grassland species diversity in the unit and the moderate area of moist grassland remaining. The **moderate** functional rating is attributed to the moderate ecological service and the moderate aesthetic value of this grassland.

**Table 10: Biodiversity Rating for the *Disturbed/Grazed grassland* unit**

| | | | |
|---|---|---|---|
| Conservation status | Size of vegetation unit | Species diversity | Condition |
| | 3 – Moderate | 3 - Moderate | 3 – Moderately Disturbed |
| Functional status | Use | Ecological service | Aesthetic value |
| | 3 – Periodic | 3 – Dificult to determine | 3 - Moderate |
| Biodiversity Rating | Conservation status | Functional status | Biodiversity |
| | 9 – Moderate | 9 - Moderate | Moderate |

**Wetland and Riparian zones**

This vegetation unit has a **high** biodiversity rating as indicated in Table 11 below. The **high** conservation value is attributed to the high grassland species diversity in the unit and the small area of wetlands remaining. The **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the wetlands and seepage areas.

**Table 11: Biodiversity Rating for the *seepage areas and wetlands***

| | Size of vegetation unit | Species diversity | Condition |
|---|---|---|---|
| **Conservation status** | 5 – Small | 5 – High | 3 – Moderately Disturbed |
| | **Use** | **Ecological service** | **Aesthetic value** |
| **Functional status** | 1 – none | 5 – Obvious | 5 - High |
| | **Conservation status** | **Functional status** | **Biodiversity** |
| **Biodiversity Rating** | 13 – High | 11 - High | High |

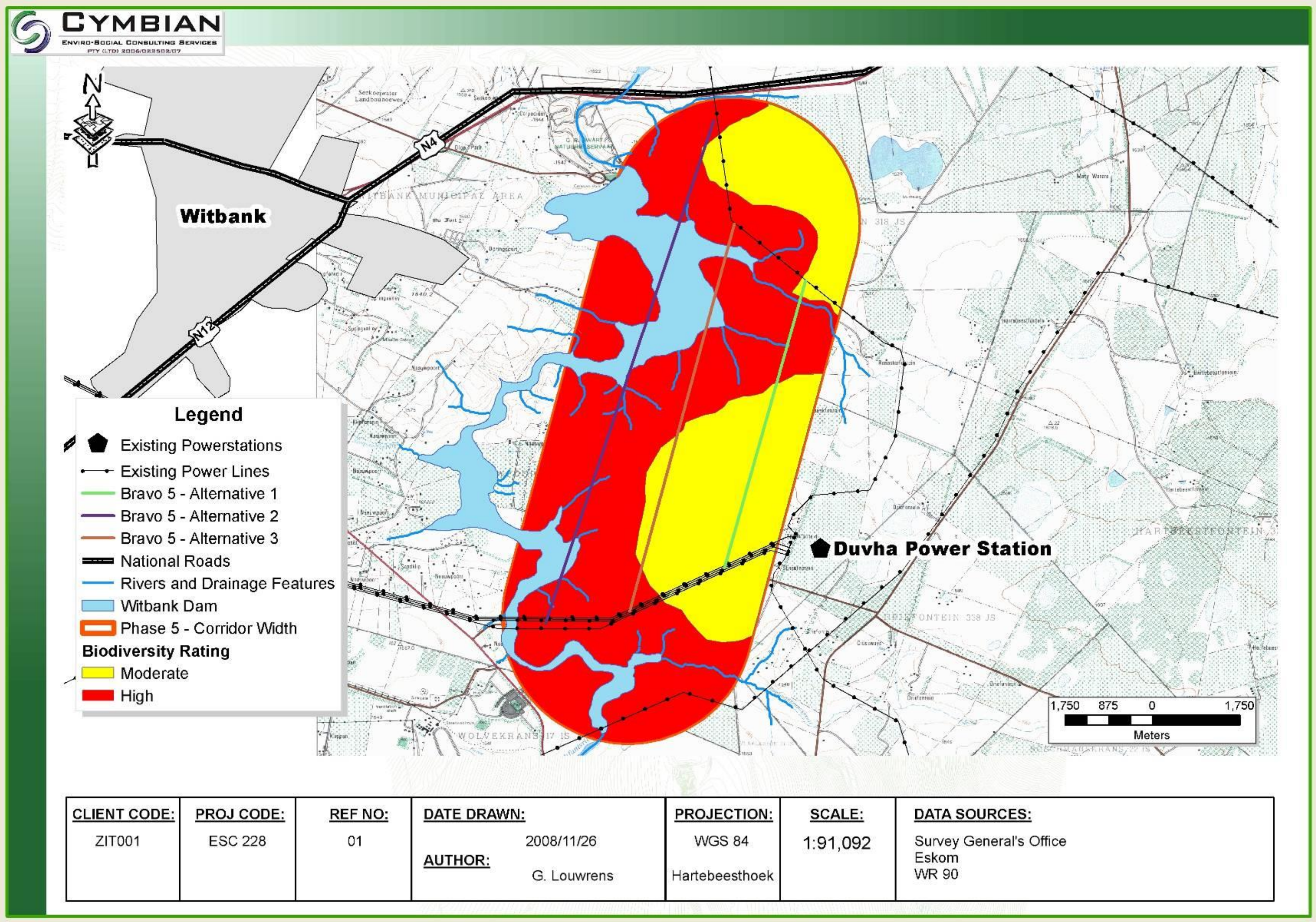



**Figure 22: Biodiversity Rating Map**

# 4.0 VISUAL IMPACT ASSESSMENT

## 4.1 Introduction

The site and surrounding area may be characterised as agricultural land utilised mainly for the grazing of cattle. The topography of the region and study site is gently undulating to moderately undulating landscape of the Highveld plateau.

The proposed power lines are located in the area north-west of the Duvha Power Station with the power station and other existing power lines featuring prominently in the landscape. The Witbank Dam and its associated drainage features represent other significant features in the landscape.

## 4.2 Methodology

The methodology adopted for the visual assessment includes the following tasks:

- Examine the baseline information (contours, building dimensions, vegetation, inter alia);
- Determine the area from which any of the upgrade may be visible (viewshed);
- Identify the locations from which views of the upgrade may be visible (observation sites), which include buildings and roads;
- Analyse the observation sites to determine the potential level of visual impact that may result from the upgrade; and

Each component of the assessment process is explained in detail in the following sections of the Report.

### 4.2.1 The Viewshed

The viewshed represents the area from which the proposed site would potentially be visible. The extent of the viewshed is influenced primarily by the combination of topography and vegetation, which determine the extent to which the site would be visible from surrounding areas.

The viewshed was determined by Cymbian through the following steps and presumptions:

- The likely viewshed was determined by desktop study (ArcGIS) using contour plans (20 m interval); and
- An offset of 2 m (maximum) for the observer and an offset of 30 m (maximum) for the proposed power lines were utilized during the spatial analysis.

### 4.2.2 Visibility Assessment

Site visibility is an assessment of the extent to which the proposed upgrade would potentially be visible from surrounding areas. It takes account of the context of the view, the relative number of viewers, duration of view and view distance.

The underlying rationale for this assessment is that if the proposed upgrade (power lines) is not visible from surrounding areas then the development will not produce a visual impact. On the other hand if one or more power lines are highly visible to a large number of people in surrounding areas then the potential visual impact is likely to be high.

Based on a combination of all these factors an overall rating of visibility was applied to each observation point. For the purpose of this report, categories of visibility have been defined as high (H), moderate (M) or low (L).

### 4.2.3 Assessment Criteria

For the purpose of this report, the quantitative criteria listed in Table 12 have been determined and used in the Visibility Assessment. The criteria are defined in more detail in the subsection following.

**Table 12: Visual Impact Assessment Criteria**

| CRITERIA | DEFINITIONS |
|---|---|
| ***Category of Viewer*** | |
| ***Static*** | ***Farms, homesteads or industries*** |
| ***Dynamic*** | ***Travelling along road*** |
| ***View Elevation*** | |
| ***Above*** | ***Higher elevation than proposed upgrade.*** |
| ***Level*** | ***Level with upgrade view*** |
| ***Below*** | ***Lower elevation then upgrade viewed*** |
| ***View Distance*** | |
| ***Long*** | ***> 5 km*** |
| ***Medium*** | ***1 – 5 km*** |
| ***Short*** | ***200 m – 1000 m*** |
| ***Very Short*** | ***< 200 m*** |
| ***Period of View*** | |
| ***Long Term*** | ***> 120 minutes*** |
| ***Medium Time*** | ***1 – 120 minutes*** |
| ***Short Term*** | ***< 1 minute*** |

**Category Viewer**

The visibility of the upgrade will vary between static and dynamic view types. In the case of static views, such as views from a farmhouse or homestead, the visual relationship between an upgrade and the landscape will not change. The cone of vision is relatively wide and the viewer tends to scan back and forth across the landscape.

In contrast views from a moving vehicle are dynamic as the visual relationship between the upgrade / structures is constantly changing as well as the visual relationship between the upgrade and the landscape in which they are seen. The view cone for motorists, particularly drivers, is generally narrower than for static views.

**View Elevation**

The elevation of the viewer relative to the object observed, which in this case are the upgrade / structure, significantly influences the visibility of the object by changing the background and therefore the visual contrast. In situations where the viewer is at a higher elevation than the building/structure it will be seen against a background of landscape. The level of visual contrast between the upgrade and the background will determine the level of visibility. A white/bright coloured structure seen against a background of dark/pale coloured tree-covered slopes will be highly visible compared to a background of light coloured slopes covered by yellow/brown dry vegetation.

In situations where the viewer is located at a lower elevation than the proposed upgrade it will mostly be viewed against the sky. The degree of visual contrast between a white coloured structure will depend on the colour of the sky. Dark grey clouds will create a significantly greater level of contrast than for a background of white clouds.

**View Distance**

The influence of distance on visibility results from two factors:

- With increasing distance the proportion of the view cone occupied by a visible structure will decline; and
- Atmospheric effects due to dust and moisture in the air reduce the visual contrast between the structure and the background against which they are viewed.

**Period of View**

The visibility of structures will increase with the period over which they are seen. The longer the period of view the higher the level of visibility. However, it is presumed that over an extended period the level of visibility declines as people become accustomed to the new element in the landscape.

Long term views of the upgrade will generally be associated with rest camps located within the viewshed. Short term and moderate term views will generally relate to tourist moving through the viewshed mostly by vehicle.

**Site Visibility**

The procedure followed by Cymbian to assess Site Visibility involved:

- Generate a viewshed analysis of the area utilizing ArcGIS 9.
- Determine the various categories of observation points (e.g. Static, Dynamic).

### 4.2.4 Impact Assessment Methodology

Visual impact is defined as the significance and/or severity of changes to visual quality of the area resulting from a development or change in land use that may occur in the landscape.

Significance or severity is a measure of the response of viewers to the changes that occur. It represents the interaction between humans and the landscape changes that they observe. The response to visible changes in the landscape may vary significantly between individuals.

Perception results from the combination of the extent to which the proposed upgrade is visible (level of visibility) and the response of individuals to what they see. A major influence on the perception of people/tourist in relation to the proposed upgrade will be the visual character and quality of the landscape in which it would be located. Natural landscape areas such as national parks, mountain areas or undeveloped sections of coast are valued for their high visual quality. The introduction of buildings and associated infrastructure may be seen as a negative impact on these areas of high visual quality. In the case of rest camps many people perceive them in a positive manner because they represent tourism/conservation infrastructure usually elegantly designed, non-conspicuous and contributing the local and national economy.

The potential visual impact of the proposed upgrade will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on the level of the visual contrast between buildings/structures and the existing landscape within which they would be viewed.

The degree of contrast between the upgrade and the surrounding landscape will result from one or more of the following visual characteristics:

- Colour;
- Shape or form;
- Scale;
- Texture; and
- Reflectivity.

## 4.3 Visual Character

### 4.3.1 Landscape Character

The site and the surrounding area can be described as an agricultural landscape with intermittent mining and power generation activities. Elevations along the slope range from 1520 mamsl and 1600 mamsl. All the power line alternatives are located on this slope with very little screening from topography or vegetation, however the presence of numerous existing power lines in the area would provide a screening effect for the proposed lines. Please refer to Figure 6 for the topography of the site.

The major drainage features in the area include the Witbank Dam and the Olifants River. Alternatives 2 and 3 cross large sections of the Witbank Dam while Alternative 1 crosses only a small section of the unnamed tributaries. For an illustration of the surface water features please refer to Figure 5.

The landscape surrounding the proposed power lines can be described as open grassland with numerous fields used for grazing. In addition a large section of the site is occupied by the Witbank Dam. The natural vegetation does not provide any screening of the power lines. There are several existing power lines on site, and in deed the intention of the project is to connect existing power lines and by-pass the Duvha Power Station.

Residential homes, mining infrastructure and the Duvha Power Station comprise infrastructure in the area. There numerous formal and informal roads in the area.

4.3.2 Viewshed

It should be noted that the viewshed for each of the alternatives, which is plotted on Figure 23, Figure 24 and Figure 25, is an approximation that may vary in some locations. Potential views to the proposed upgrade are likely to be blocked in some localised situations by buildings, vegetation or local landform features at specific locations within the viewshed. Similarly, glimpses of the proposed upgrade may be visible from some isolated high-elevation locations outside the plotted viewshed. The figures illustrate the visibility of each of the alternatives. The coloured areas indicate areas that are visible with the red areas having very high visibility and the green having lower visibility. It should be noted that Alternatives 2 and 3 are more visible than Alternative 1 due to the fact that they are located along the Witbank Dam while Alternative 1 is located within a less sensitive visually.

Notable features of the viewshed are summarised by the following points:

- The viewshed for Alternative 1 is low to moderate while Alternatives 2 and 3 are moderate to high;
- The area in the immediate vicinity of Alternative 2 has a high viewshed, this is compounded by it traversing the Witbank Dam; and
- To the south of Alternative 3, the viewshed reaches a moderate to high;

## 4.4 Impact Assessment

The visual simulations prepared by Cymbian illustrate the extent to which the upgrade will be visible from key observation points (static and dynamic views).

The vertical form/dimensions of the buildings/structures would be hidden by their location among existing buildings and within a well vegetated area. The visual contrast is increased by the “shape” and scale of the buildings/structures, which generally will not be viewed along the skyline.

**Static Views**

The upgrade would potentially be visible from the surrounding farmland and the high-lying areas, as well as isolated areas in Witbank. Middelburg remains outside of the viewshed. The potential number of viewers from the surrounding farmland should be low as the farmlands are quite sparsely populated but the views would vary greatly depending on site specific conditions like the orientation of the homes as well as the location of other buildings, fences, vegetation and localized landforms. All these elements have the potential to block views from the surrounding areas to the proposed upgrade.

### Dynamic Views

The power lines will be visible to a moderate number of viewers, mainly those travelling along the N4 highway and some travellers along the N12 highway. Views from the N4 extend approximately 9 km and represent a view period of approximately 36 seconds travelling at 120 km/h. The level of visibility would be moderate to high due to the view distance of less than 5 km. The effects are similar for the N12. Please refer to Table 13 for a summary of the dynamic impacts. This assessment is similar for all three route alternatives.

The power line upgrade would also be visible from several farm roads which are located around the proposed site. The viewing distance varies between 1 and 11 km for these roads and if the viewing distance is less than 2 km, the potential visual impact would be considered as moderate.

**Table 13: Dynamic Impact Table**

| *Road Name* | *Speed limit (km/h)* | *Length of Road (km)* | *Approximate Period of View (sec)* | *View Distance* |
|---|---|---|---|---|
| *Alternative 1 – N4* | *120* | *2.6* | *78* | *6.2 – 11 km* |
| *Alternative 2 – N4* | *120* | *1.2* | *36* | *8.2 – 11 km* |
| *Alternative 3 – N4* | *120* | *2.6* | *78* | *6.2 – 11 km* |
| *Alternative 1 – N12* | *120* | *2.2* | *79* | *5 – 6 km* |
| *Alternative 2 – N12* | *120* | *2.8* | *101* | *5 – 6 km* |
| *Alternative 3 – N12* | *120* | *2.2* | *79* | *5 – 6 km* |

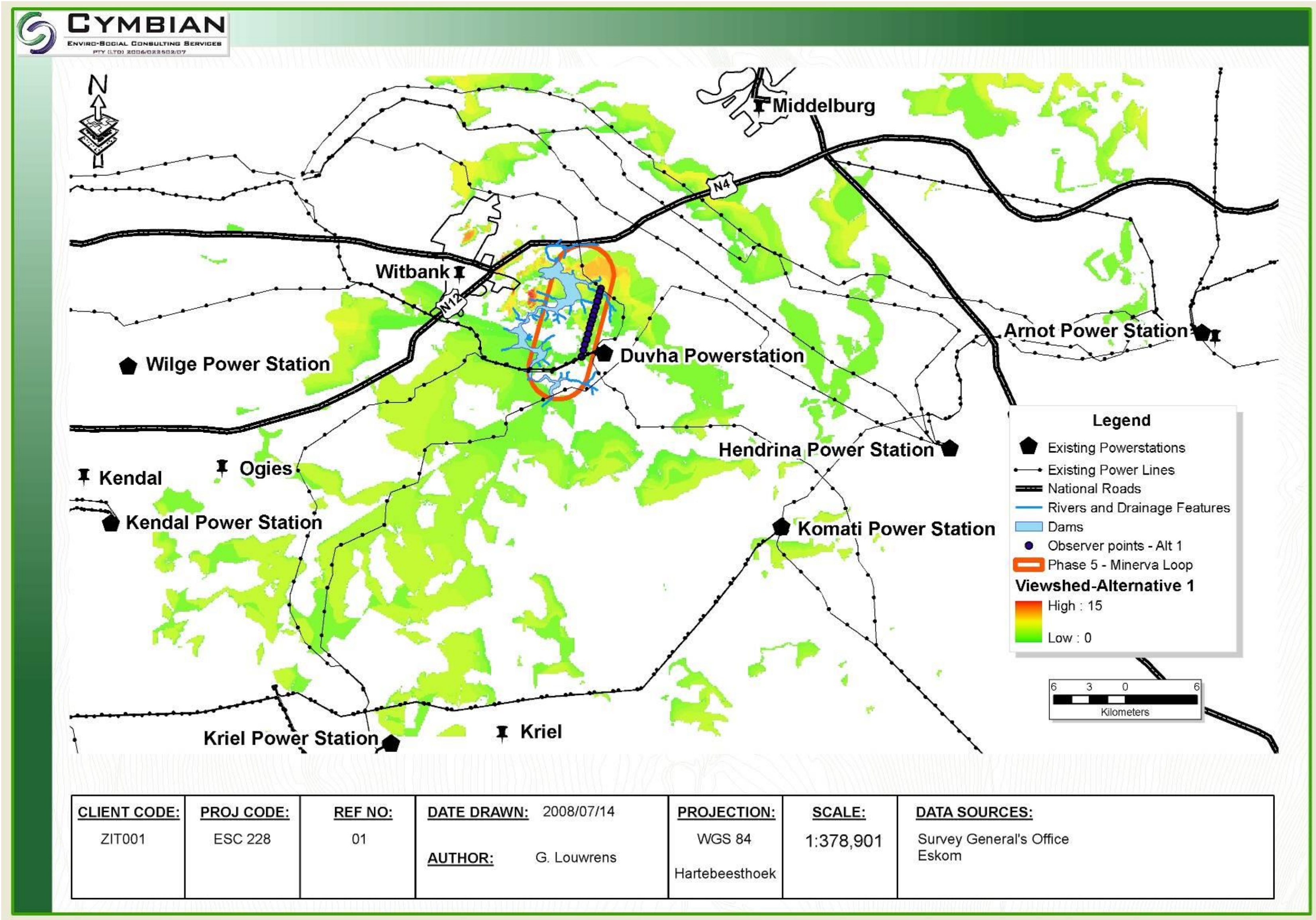



**Figure 23: Viewshed from the Alternative 1 alignment.**

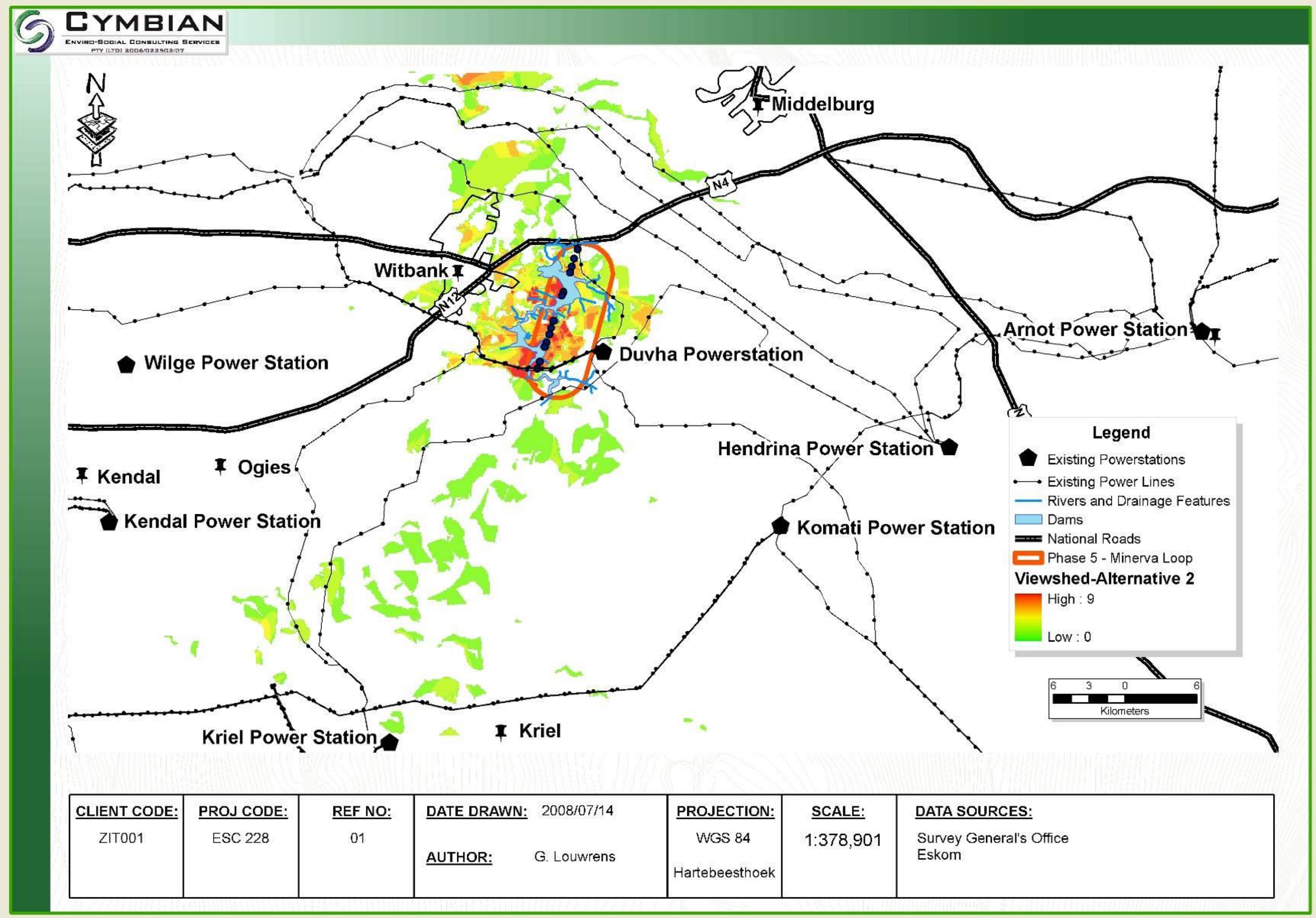
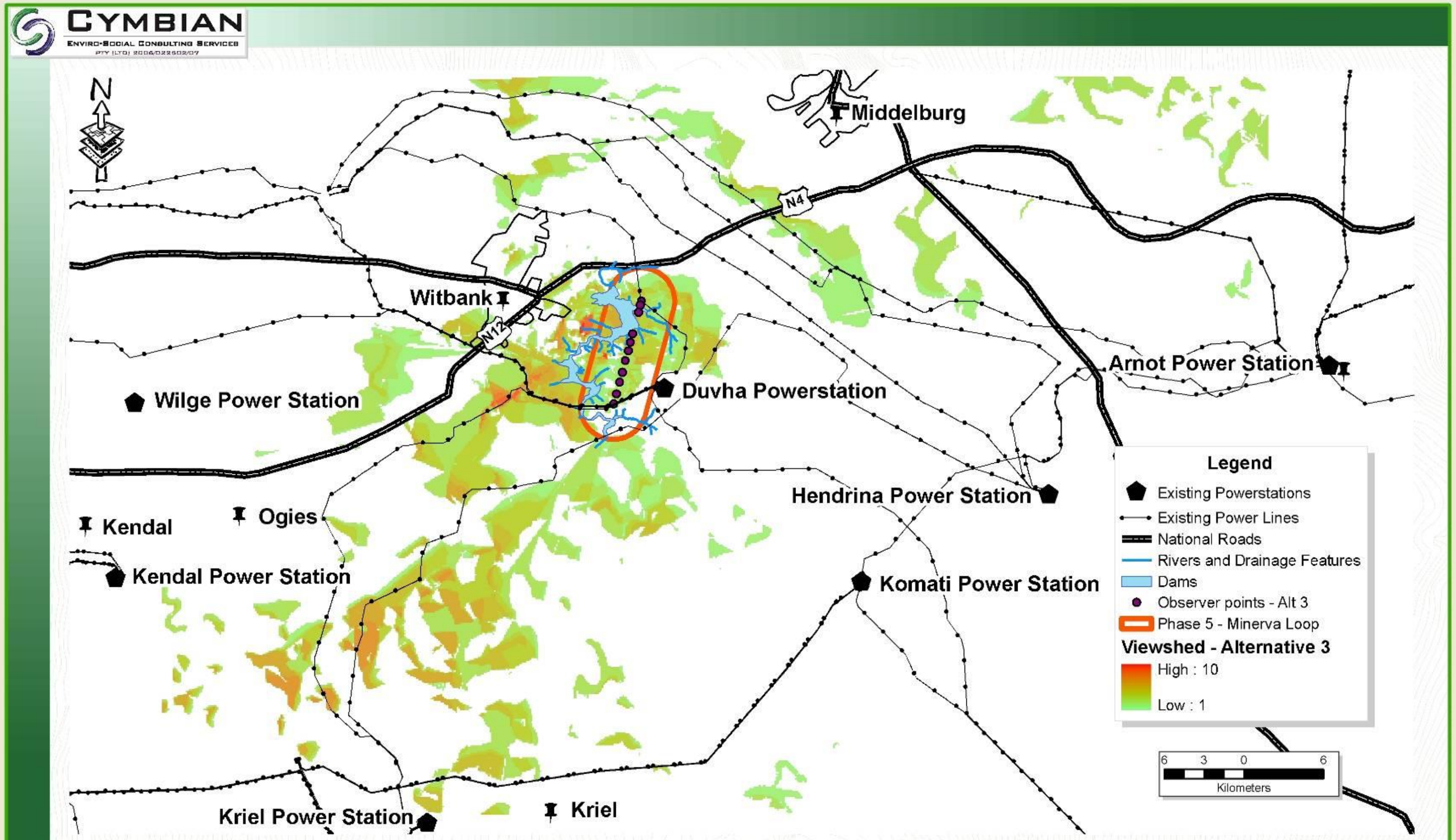



**Figure 24: Viewshed from the Alternative 2 alignment**

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| ZIT001 | ESC 228 | 01 | | WGS 84<br>Hartebeesthoek | 1:378,901 | Survey General's Office<br>Eskom |

**Figure 25: Viewshed from the Alternative 3 alignment**

**Conclusion**

Table 14 lists the observation points together with the category of viewer, context of view, relative numbers of viewers and approximate distance of observation point to the proposed site. The location of these observation points are shown in Figure 23 and Figure 24.

**Table 14: Visual Impact Matrix**

| *Potential Observation Point* | *Category of Potential Receptor* | *Context of View* | *Approximate View Distance* | *Period of View* | *Visibility Rating* |
|---|---|---|---|---|---|
| *Surrounding Farmland* | *Static* | *Level* | *0 – 11 km* | *Long Term* | *Medium* |
| *Emahlahleni* | *Static* | *Level Above* | *> 10 km* | *Long Term* | *Medium* |
| *Gravel Roads* | *Dynamic* | *Above & below* | *1 – 11 km* | *Medium* | *Low* |
| *Tar Roads* | *Dynamic* | *Level - Above* | *5 – 11 km* | *Short* | *Low* |

It should however be noted that there are a number of existing power lines in the study area as shown in the Figures above. Viewers in the viewshed have become accustomed to these power lines in the landscape and an additional 10 km of power line will not increase the impact significantly.

# 5.0 ALTERNATIVE SENSITIVITY ANALYSIS

This section provides a short sensitivity matrix, which compares the three different alternatives and their associated environmental sensitivities.

**Table 15: Alternative Sensitivity Matrix**

| Sensitivity | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| Geology | None | None | None |
| Climate | None | None | None |
| Topography | None | None | None |
| Land Use | Traverses short section of ash dump, surrounding land used as grazing for cattle | Traverses Witbank Dam and farmland | Traverses Witbank Dam and agricultural land |
| Surface Water | Traverses only a short section of the un-named tributaries on site | Traverses a large section of the Witbank Dam | Traverses the largest Section of the Witbank Dam |
| Soils & Land Capability | Mainly agricultural and non sensitive soils | Along sensitive wetland and clay soils | Along sensitive wetland and clay soils |
| Flora | None | Sensitive vegetation units and plants present | Sensitive vegetation units and plants present |
| Fauna | None | None | None |
| Wetlands | None | Traverses wetland | Traverses wetland |
| Visual | Low Visibility | Moderate visibility | Highly visibility |
| **Total Sensitivities** | **1** | **4** | **4** |

On the basis of the matrix presented above, it is suggested that the Bravo 5 Alternative 1 be utilised as the preferred alternative for the proposed project, as it has the least sensitive features associated with the alignment.

# 6.0 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology was utilised so that a wide rage of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- significance;
- spatial scale;
- temporal scale;
- probability; and
- degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in Table 16.

**Table 16: Quantitative rating and equivalent descriptors for the impact assessment criteria**

| Rating | Significance | Extent Scale | Temporal Scale |
|---|---|---|---|
| 1 | VERY LOW | *Isolated sites / proposed site* | Incidental |
| 2 | LOW | *Study area* | Short-term |
| 3 | MODERATE | *Local* | Medium-term |
| 4 | HIGH | *Regional / Provincial* | Long-term |
| 5 | VERY HIGH | *Global / National* | Permanent |

A more detailed description of each of the assessment criteria is given in the following sections.

## 6.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1000km$^2$) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 17 below.

**Table 17 : Description of the significance rating scale**

| Rating | | Description |
|---|---|---|
| 5 | Very high | Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit. |
| 4 | High | Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these. |
| 3 | Moderate | Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc. |
| 2 | Low | Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these. |
| 1 | Very low | Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale. |
| 0 | No impact | There is no impact at all - not even a very low impact on a party or system. |

## 6.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 18.

**Table 18 : Description of the significance rating scale**

| Rating | | Description |
|---|---|---|
| 5 | Global/National | The maximum extent of any impact. |
| 4 | Regional/Provincial | The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level). |
| 3 | Local | The impact will affect an area up to 5 km from the proposed study area. |
| 2 | Study Area | The impact will affect an area not exceeding the study area. |
| 1 | Isolated Sites / proposed site | The impact will affect an area no bigger than the power line alignments. |

## 6.3 Duration Scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 19.

**Table 19: Description of the temporal rating scale**

| Rating | | Description |
|---|---|---|
| 1 | Incidental | The impact will be limited to isolated incidences that are expected to occur very sporadically. |
| 2 | Short-term | The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater. |
| 3 | Medium term | The environmental impact identified will operate for the duration of life of plant. |
| 4 | Long term | The environmental impact identified will operate beyond the life of operation. |
| 5 | Permanent | The environmental impact will be permanent. |

## 6.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Table 20 below.

**Table 20 : Description of the degree of probability of an impact occurring**

| Rating | Description |
|---|---|
| 1 | Practically impossible |
| 2 | Unlikely |
| 3 | Could happen |
| 4 | Very Likely |
| 5 | It's going to happen / has occurred |

## 6.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 21. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

**Table 21 : Description of the degree of certainty rating scale**

| Rating | Description |
|---|---|
| Definite | More than 90% sure of a particular fact. |
| Probable | Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring. |
| Possible | Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring. |
| Unsure | Less than 40% sure of a particular fact or the likelihood of an impact occurring. |
| Can't know | The consultant believes an assessment is not possible even with additional research. |
| Don't know | The consultant cannot, or is unwilling, to make an assessment given available information. |

## 6.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

$$\textbf{\textit{Impact Risk}} = \frac{(\text{SIGNIFICANCE} + \textit{Spatial} + \text{Temporal})}{\mathbf{3}} \times \frac{\text{Probability}}{\mathbf{5}}$$

An example of how this rating scale is applied is shown below:

**Table 22 : Example of Rating Scale**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| | LOW | *Local* | Medium-term | *Could Happen* | |
| Impact to air | **2** | ***3*** | **3** | **3** | **1.6** |

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2,67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to five classes as described in the table below.

**Table 23 : Impact Risk Classes**

| Rating | Impact Class | Description |
|---|---|---|
| 0.1 – 1.0 | **1** | **Very Low** |
| 1.1 – 2.0 | **2** | **Low** |
| 2.1 – 3.0 | **3** | **Moderate** |
| 3.1 – 4.0 | **4** | **High** |
| 4.1 – 5.0 | **5** | **Very High** |

Therefore with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

## 6.7 Cumulative Impacts

It is a requirement that the impact assessments take cognisance of cumulative impacts. In fulfilment of this requirement the impact assessment will take cognisance of any existing impact sustained by the operations, any mitigation measures already in place, any additional impact to environment through continued and proposed future activities, and the residual impact after mitigation measures.

It is important to note that cumulative impacts at the national or provincial level will not be considered in this assessment, as the total quantification of external companies on resources is not possible at the project level due to the lack of information and research documenting the effects of existing activities. Such cumulative impacts that may occur across industry boundaries can also only be effectively addressed at Provincial and National Government levels.

Using the criteria as described above an example of how the cumulative impact assessment will be done is shown below:

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Initial / Existing Impact (I-IA) | **2** | **2** | **2** | *1* | 0.4 |
| Additional Impact (A-IA) | **1** | ***2*** | **0** | *1* | 0.2 |
| Cumulative Impact (C-IA) | **3** | ***4*** | **2** | *1* | 0.6 |
| Residual Impact after mitigation (R-IA) | **2** | ***1*** | **2** | *1* | 0.3 |

As indicated in the example above the Additional Impact Assessment (A-IA) is the amount that the impact assessment for each criterion will increase. Thus if the initial impact will not increase, as shown for temporal scale in the example above the A-IA will be 0, however, where the impact will increase by two orders of magnitude from 2 to 4 as in the spatial scale the A-IA is 2. The Cumulative Impact Assessment (C-IA) is thus the sum of the Initial Impact Assessment (I-IA) and the A-IA for each of the assessment criteria.

In both cases the I-IA and A-IA are assessed without taking into account any form of mitigation measures. As such the C-IA is also a worst case scenario assessment where no mitigation measures have been implemented. Thus a Residual Impact Assessment (R-IA) is also made which takes into account the C-IA with mitigation measures. The latter is the most probable case scenario, and for the purpose of this report is considered to be the final state Impact Assessment.

## 6.8 Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

Significance or magnitude- IN CAPITALS
Temporal Scale – in underline
Probability – *in italics and underlined*.
Degree of certainty - **in bold**
Spatial Extent Scale – *in italics*

# 7.0 ENVIRONMENTAL IMPACT ASSESSMENT

The Impact Assessment will highlight and describe the impact to the environment following the abovementioned methodology and will assess the following components:

- Geology;
- Climate;
- Surface Water;
- Topography;
- Soils;
- Land Capability
- Land Use;
- Flora;
- Fauna; and
- Visual Assessment.

The impact assessment was undertaken for the construction, operational and decommissioning phases of the project. The impact of each line/route alternative was also assessed separately, however, where the impact was not significantly different, only one impact assessment was undertaken. Also, at the time of writing this report, no technical data was available as to the type of tower to be used for the construction of the transmission lines. Therefore, it is assumed that the Self-supporting strain and suspension tower type would be used. Contained in this assumption is that the maximum distance between towers would be 300 m and that the tower would be erected on concrete footings with dimensions of 2 x 2 x 2 m (area = 4 $m^2$ and volume = 8 $m^3$).

## 7.1 Construction Phase

During the construction phase, the 400 kV power line will be erected. A 400 kV Transmission line requires a servitude width of 55 m. Where there are physical constraints such as other power lines adjacent to the new servitude, a minimum of 35 m-separation distance from such lines is required. Without physical constraints, parallel lines will have at least 55 m-separation distance. The power line cables are strung between pylons / towers, which are steel structures erected on concrete footings fixed in the substrate (soil or rock) below the pylon.

The major impacts during construction are the construction activities associated with the erection of the power lines and include, amongst others, heavy vehicle movement, construction of an access road and any wastes generated.

7.1.1 Geology

**Initial Impact**

Impacts that could occur to geology are limited to the physical removal of geological strata, resulting in permanent damage to those strata. There are no present indications that any existing impacts to geology have ocurred and therefore there is no initial impact rating.

**Additional Impact**

There is no additional impact resulting from the power line construction since there are no significant geological features on site. The impact would be limited to the construction of the pylon footings, and should be a maximum of three pylons and therefore 12 footings. The 12 footings will disturb a combined area of 96 $m^3$ of geological strata. This VERY LOW impact **could** *probably* occur in *isolated sites* over the long term. This results in a final impact class of **Low** as rated in the table below.

**Table 24: Geology Additional Impact Assessment**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Geology | VERY LOW | *Isolated sites* | Long Term | *Probably* | Low |
| | **1** | **1** | **4** | **4** | **1.6** |

**Cumulative Impact**

Since there is no initial impact, the cumulative impact is the same as rated for the additional impact above.

**Mitigation Measures**

- No blasting is undertaken on site without a suitable blast design, compiled in line with relevant SANS codes and approved by an appropriately qualified professional;

**Residual Impact**

Although mitigation measures will not reduce the significance of impact to geology they will ensure that the impacts are contained. Mitigation measures will ensure that the likelihood of secondary impacts occurring is significantly reduced. The residual impact to geology at the completion of the construction phase will be the same as for the additional impact assessment.

### 7.1.2 Topography

**Initial Impact**

There are no present indications that any existing impacts to topography have ocurred and therefore there is no initial impact rating.

**Additional Impact**

The construction of the power lines should not impact on the topography and therefore there is no additional impact.

**Cumulative Impact**

Since there is no initial impact, the cumulative impact is the same as rated for the additional impact above.

**Mitigation Measures**

No mitigation measures are required as there is no impact to topography from the proposed development.

**Residual Impact**

There is no residual impact to topography from the proposed development.

### 7.1.3 Soils, Land Capability and Land Use

**Initial Impact**

The study site has predominantly been used for grazing of livestock and some agricultural uses. The section of soils that will be crossed by the power line alternatives are presently not impacted upon, but in the near future the construction of the new power line will impact the soils. Other existing impacts are the existing pylon footings and cultivation of soils.

The initial impact to soils and land capability is **definitely** a HIGH negative impact acting over the long term, and is *presently occurring* in the *study area*. As indicated in Table 25 below the impact rating class is a High Impact.

**Table 25: Soil and Land Capability Initial Impact Assessment**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Soils | HIGH | *Study Site* | Long Term | *Is occurring* | High |
| | **4** | **2** | **4** | **5** | **3.33** |

**Additional Impact**

The additional impact from the new power lines will mainly be as a result of the construction of the power line pylons and their footings. Alternatives 1, 2 and 3 are approximately 7.4 km, 10.5 and 9.5 in length respectively and each will have a double power line. Therefore if using the average pylon distance of 300 m it can be assumed that there would be 56 pylons constructed. At the time of writing this report, the proponent has not determined which of the various pylon designs will be utilised, and therefore the actual impact could vary. For this analysis it is assumed that pylons similar to the existing power lines will be utilised. This will result in 4 footings impacting on the soils per pylon.

In addition to the pylon footings the soils will also be disturbed by the establishment of a construction road as well as the movement of construction vehicles. The impact from each of the routes are summarised below.

**Table 26: Soil Impact**

| Soil Type | Alternative 1 (km) | Alternative 2 (km) | Alternative 3 (km) |
|---|---|---|---|
| **Katspruit** | 0.4 km | 6.6 km | 2.5 km |
| **Mispah** | 2.75 km | 0.25 km | 1.5 km |
| **Clovelly/Hutton** | 2.85 km | 3.65 km | 5.0 km |

As indicated in Table 26 above, Alternatives 2 and 3 cross more sensitive soils than Alternative 1. That said, the impact rating class between the two alternatives differ and is therefore rated separately.

For Alternative 1 the additional impact to soils and land capability is **probably** a LOW negative impact acting over the long term, and *will definitely occur* at *isolated sites*. As indicated in Table 27 below the impact rating class is a Moderate Impact.

**Table 27: Soil and Land Capability Additional Impact Assessment – Alternative 1**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Impact to Soils | Low | *Isolated Site* | Long Term | *Will occur* | Moderate |
| | **2** | **1** | **4** | **5** | **2.3** |

For Alternatives 2 and 3 the additional impact to soils and land capability is **probably** a MODERATE negative impact acting over the long term, and *will definitely occur* at *isolated sites*. As indicated in Table 28 below the impact rating class is a Moderate Impact.

**Table 28: Soil and Land Capability Additional Impact Assessment – Alternatives 2 and 3**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Soils | Moderate | *Isolated Site* | Long Term | *Will occur* | Moderate |
| | **3** | **1** | **4** | **5** | **2.67** |

**Cumulative Impact**

The cumulative impact remains as rated for the initial impact i.e. a High impact class.

**Mitigation Measures**

- Avoid placement of pylon footings in the clay soils on site;
- Spread absorbent sand on areas where oil spills are likely to occur, such as the refuelling area in the hard park;
- Oil-contaminated soils are to be removed to a contained storage area and bio-remediated or disposed of at a licensed facility;
- If soils are excavated for the footing placement, ensure that the soil is utilised elsewhere for rehabilitation/road building purposes; and
- Ensure that soil is stockpiled in such a way as to prevent erosion from storm water.

**Residual Impact**

The residual impact remains a High Impact, as the mitigation measures will not reduce the overall impact.

### 7.1.4 Surface Water

**Initial Impact**

The surface water features on site constitute sensitive surface water features. The Witbank Dam and Olifants River constitute senstive surface water features on site. The impact is assessed in Table 29 below.

**Table 29: Surface Water Initial Impact Rating**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Surface water | VERY LOW | *Study Site* | Medium Term | *Could happen* | Low |
| | **1** | ***2*** | **3** | **3** | **1.2** |

The initial impact to surface water is VERY LOW, occurs in *Isolated sites / proposed site* and will be Medium Term and *It's going to happen / has occurred*. This results in a rating of 1.2 or a Low impact class.

**Additional Impact**

During the construction phase there should be limited impacts to surface water features as all the wetlands and riparian zones have been declared no-go zones that should be avoided. It is anticipated that the placement of the pylons will be done in such a way as to avoid the surface water features on site. Note that the wetlands are assessed separately below.

Waste generated during the construction phase may enter the environment through surface water runoff i.e. litter or pollution such as hydrocarbons can be washed into aquatic systems affecting those systems negatively. Storm-water flowing over the site will also mobilise loose sediments, which may enter the surface water environment affecting water quality. Storm-water containing sediment can be discharged to grassland buffers to ensure sediments fall out prior to water entering surface water bodies. Care must be taken that storm-water containing hydrocarbons and other pollution sources are not discharged.

Impacts will be felt as wide as the *study area* when storm-water flows from the power line sites into the study area. The impact to the surface water will **probably** be of a VERY LOW negative significance, and will act in the short-term. This impact *could happen*. This results in a Very Low impact class as assessed in Table 30.

**Table 30: Surface Water Additional Impact Rating**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Surface water | VERY LOW | *Study area* | Short Term | *Could happen* | Very Low |
| | **1** | ***2*** | **2** | **3** | **1.0** |

**Cumulative Impact**

The cumulative impact of the current activities and the future activities will not increase the impact rating from a Low Impact as rated in the initial impact assessment.

**Mitigation Measures**

- Demarcated areas where waste can be safely contained and stored on a temporary basis during the construction phase should be provided at the hard park;
- When adequate volumes (not more than 1 month) have accumulated all waste is to be removed from site and disposed of at a licensed facility;
- Waste is not to be buried on site;
- Hydro-carbons should be stored in a bunded storage area;
- All hazardous materials *inter alia* paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment;
- Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur;
- Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented;
- No construction vehicles or activities will be allowed to work within 50 m of any of the streams or wetlands on site.
- If possible utilise Alternative 1 as the preferred alternative.

**Residual Impact**

The mitigation measures proposed will reduce the risk of the additional impact occurring, but it will not reduce the residual impact class, which remains at a Low impact as rated in the initial impact assessment.

### 7.1.5 Flora

**Initial Impact**

The initial impacts to flora include extensive grazing, cultivation and alien invasive colonisation. The initial impact to flora is **definitely** a MODERATE negative impact acting over the long term, and is *presently occurring* in the *study area*. As indicated in Table 31 below the impact rating class is a Moderate Impact.

**Table 31: Flora Initial Impact Assessment**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Flora | MODERATE | *Study Site* | Long Term | *Is occurring* | Moderate |
| | **3** | **2** | **4** | **5** | **3.00** |

## Additional Impact

The additional impact to flora during the construction phase will be as a result of vegetation clearance for access roads and the removal of vegetation in the areas of the pylon footings. Table 32 below illustrates the length that each route alternative will cross the vegetation types identified.

**Table 32: Flora Impact**

| Soil Type | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| **Undisturbed/Natural Grassland** | 1.37 km | 3.52 km | 3.6 km |
| **Disturbed/Grazed Grassland** | 4.2 km | 0.2 km | 2.76 km |
| **Wetland and Riparian Zones*** | 0.45 km | 6.45 km | 1.7 km |

* Indicates sensitive vegetation types

The additional impact from the Alternative 1 alignment to flora is **probably** a VERY LOW negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 33 below the impact rating class is a Low Impact.

**Table 33: Flora Additional Impact Assessment – Alternative 1**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Flora | Very Low | *Isolated Site* | Short Term | *Will occur* | Low |
| | **1** | **1** | **2** | **5** | **1.33** |

Due to the alignment of Alternatives 2 and 3 in line with the sensitive vegetation types, the impact is higher and will be active for a longer period. As there is sensitive species along this alignment the additional impact from the Alternatives 2 and 3 to flora is **probably** a HIGH negative impact acting over the long term, and *will occur* in *isolated sites*. As indicated in Table 34 below the impact rating class is a Moderate Impact.

**Table 34: Flora Additional Impact Assessment – Alternative 2**

| Impact | Significance | Spatial | Temporal | Probability | Rating |
|---|---|---|---|---|---|

| | | Scale | Scale | | |
|---|---|---|---|---|---|
| Impact to Flora | High | *Isolated Site* | Long Term | *Will occur* | Moderate |
| | **4** | **1** | **4** | **5** | **3** |

**Cumulative Impact**

The cumulative impact to flora will remain as assessed for the initial impact assessment with a Moderate impact class.

**Mitigation Measures**

- All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse);
- The sensitive vegetation unit should be avoided and construction limited to 50 m from the edge of the wetlands and streams;
- Alternative 1 should be considered as the preferred alternative;
- All alien invasive species on site should be removed and follow up monitoring and removal programmes should be initiated once construction is complete;
- Adhere to the ESKOM vegetation management guideline (Appendix 4).

**Residual Impact**

If the mitigation measures are implemented and Alternative 1 is constructed then the residual impact to flora is **probably** a MODERATE negative impact acting over the medium term, and *will occur* in the *study area*. As indicated in Table 35 below the impact rating class is a Moderate Impact.

**Table 35: Flora Residual Impact Assessment**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Flora | MODERATE | *Study Site* | Medium Term | *Will happen* | Moderate |
| | **3** | **2** | **3** | **5** | **2.33** |

7.1.6 Fauna

**Initial Impact**

As described in the habitat assessment in Section 3.9, the site is relatively disturbed with the disturbed/grazed grassland, the undisturbed/natural grassland and the wetland and riparian zones the main habitat still available for fauna. The site is 34.7 % disturbed and while this is not ideal habitat for fauna, it will still provide habitat for various fauna. The suitable areas did show high species diversity, indicating that the impact is limited to isolated sites throughout the study area.

The study area is criss crossed with existing high voltage power lines that could potentially impact on the faunal life, especially large avi-faunal species. While there appears to be no negative impacts associated with electro magnetic fields generated by the power lines, Eskom's document, *Transmission Bird Collision Prevention Guideline* (Ref. no.: TGL41-335)[5], the major impact to birds or avi-fauna is in the form of collisions with power lines. According to the document, it was found that the majority of birds affected are large flighted birds, which are also often endangered or threatened species.

These large flighted birds are also long lived, with low breeding rate and often mate for life. Therefore, a single mortality due to a collision with a power line should be viewed as a high impact. In addition some of the most sensitive species to power line collisions such as Blue Crane are found in the study site in addition to other sensitive species such as White-Bellied Korhaan and Secretary Birds.

The current impact on fauna on site is **probably** of a HIGH negative significance, affecting the *region*, and acting in the long-term. The impact can *likely occur*. The impact class is classified as a High impact.

**Table 36: Fauna Initial Impact Assessment**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Fauna | HIGH | *Region* | Long Term | *Likely* | High |
| | **4** | **4** | **4** | **4** | **3.2** |

### Additional Impact

The impact to fauna during the construction phase of the power lines will mostly be in the form of disturbance from the construction workers and vehicle noise. Due to the fact that the area is habitat to sensitive species, the impact could be quite high. Once again Alternatives 2 and 3 are significantly closer to the habitat for the sensitive species and therefore the impacts are assessed separately.

The additional impact from the Alternative 1 alignment to fauna is **probably** a MODERATE negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 37 below the impact rating class is a Low Impact.

**Table 37: Fauna Additional Impact Assessment – Alternative 1**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Fauna | MODERATE | *Isolated Site* | Short Term | *Will occur* | Low |
| | **3** | **1** | **2** | **5** | **2** |

The additional impact from the Alternative 2 and 3 alignments to fauna is **probably** a HIGH negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 37 below the impact rating class is a Moderate Impact.

**Table 38: Fauna Additional Impact Assessment – Alternative 1**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Fauna | High | *Isolated Site* | Short Term | *Will occur* | Moderate |
| | **4** | **1** | **2** | **5** | **2.3** |

### Cumulative Impact

The cumulative impact to fauna should remain as assessed for the initial impact assessment as the impacts are identical. Therefore the impact remains a High impact to Fauna.

### Mitigation Measures

- All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse);
- The sensitive habitat should be avoided and construction limited to 50 m from the edge of the wetlands and streams;
- Alternative 1 should be considered as the preferred alternative;
- All alien invasive species on site should be removed and follow up monitoring and removal programmes should be initiated once construction is complete;
- Adhere to the ESKOM vegetation management guideline (Appendix 4); and
- Install power lines according to the ESKOM bird collision prevention guideline.

### Residual Impact

The mitigation measures proposed above will ensure that the construction of the proposed power line remains a Moderate impact but the Residual Impact remains High. If the mitigation measures were to be extended into the existing power lines and bird flappers be installed, the residual impact could be mitigated to a Moderate Impact Class.

7.1.7 Wetlands

The impact assessment for wetlands is the same as assessed for the surface water component in Section 6.1.4.

7.1.8 Visual Impact

**Initial Impact**

At present the viewers in the viewshed are seeing the Duvha Power Station and the various mining activities including the Corobrik works and the various coal collieries in the area. In addition to the Power Station there are numerous power lines already traversing the landscape. The initial impact to the visual environment is HIGH negative acting in the long term, and *has already occurred*. The impact has **definitely** impacted on the *local region*.

**Table 39: Visual Impact Assessment – Initial Impact**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Visual | High | *Local* | Long Term | *Has occurred* | High |
| | **4** | **3** | **4** | **5** | **3.6** |

As illustrated in Table 39 above the initial impact to the visual environment is rated as a High impact.

**Additional Impact**

The additional impact from the power lines as described in Section 4.4 indicated that the additional impact to the visual environment is **probably** a LOW negative impact acting in the short term and impacting on the *local region*. This impact *will definitely occur*.

**Table 40: Visual Impact Assessment – Additional Impact**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| Impact to Visual | Low | *Local* | Short Term | *Will occurr* | Moderate |
| | **2** | **3** | **2** | **5** | **2.3** |

From Table 40 above it is clear that the additional impact from the construction of the power lines will be a Moderate impact.

**Cumulative Impact**

There are a high number of existing visual impacts on site as well as a high number of power lines. The cumulative impact from the developments will remain as assessed for the initial impact above; therefore the impact remains a High negative impact.

**Mitigation Measures**

- Only the footprint of the proposed power line should be exposed. In all other areas, the natural vegetation should be retained;
- Dust suppression techniques should be in place at all times during the construction phase;
- Access roads should be minimised to prevent unnecessary dust.

**Residual Impact**

The mitigation measures proposed above will ensure that the construction of the proposed power line remains a High impact to the visual environment.

## 7.2 Operational Phase

The main impacts during the operatational phase are the electro magnetic field associated with the power lines and the occurrence of the physical structures in the landscape. See *Electric and Magnetic Fields – A summary of Technical and Biological Aspects* (2006)[2] for a detailed discussion regarding the impact of electro magnetic fields (Appendix 5).

### 7.2.1 Geology

The impact assessment does not change from that of the construction phase, refer to Section 6.1.1 above.

### 7.2.2 Topography

The impact assessment does not change from that of the construction phase, refer to Section 6.1.2 above.

[2] *Electric and Magnetic Fields – A summary of Technical and Biological Aspects*, Empetus cc, 2006.

7.2.3 Soils, Land Capability and Land Use

The impact assessment does not change from that of the construction phase, refer to Section 6.1.3 above.

7.2.4 Surface water

The impact assessment does not change from that of the construction phase, refer to section 6.1.4 above.

7.2.5 Vegetation

The impact assessment does not change from that of the construction phase, refer to section 6.1.5 above.

7.2.6 Fauna

**Initial impact**

The initial impact remains as assessed in Section 6.1.6, a High impact.

**Additional impact**

During the operational phase the proposed development will add approximately 10 km of high voltage power lines to the existing network of power lines in the area. Sensitive blue cranes occur in the area and a single death of one of these protected species would be seen as a high impact.. The additional impact to faune will **probably** be a HIGH negative impact, acting in the long term, and affected the *local area* and this impact *could occur*. This calculates to a Moderate impact class as illustrated in Table 41 below.

**Table 41: Fauna Additional Impact Rating – Operations**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| **Impact to Fauna** | HIGH | *Local* | Long Term | *Could occur* | Moderate |
| | **4** | ***3*** | **4** | **3** | **2.2** |

**Cumulative impact**

During the operational phase the proposed development will add approximately 10 km of high voltage power lines to the existing network of power lines in the area. The addition is relatively small in consideration of the approximately 180 km of existing high voltage powerlines in the area. The cumulative impact to fauna remains a High impact as assessed in the initial impact assessment.

**Mitigation Measures**

- The sensitive habitat should be avoided and power lines limited to 50 m from the edge of the wetlands and streams;
- Alternative 1 should be considered as the preferred alternative;
- Adhere to the ESKOM vegetation management guideline (Appendix 4); and
- Install power lines according to the ESKOM bird collision prevention guideline.

**Residual impact**

In order to prevent power line collisions from birds, anti-collision devices can be installed to the power lines. These include static, dynamic, reflective and illuminated devices. As mentioned in Appendix 3 these devices have resulted in a 60% reduction in bird collisions but they will not completely eliminate the impact risk to birds. In addition this reduction will only be effective if the anti-collision devices are installed on all the power lines in the region. If the anti collision devices are only installed for the proposed 10 km of new power line, the impact would remain a High impact. If the devices are to be installed on all the regional power lines the impact to fauna would **prabably** be a HIGH negative impact, acting on the *regional scale* in the long term. The prabability would however be reduced to *unlikely*.

**Table 42: Fauna Residual Impact Rating**

| Impact | Significance | Spatial Scale | Temporal Scale | Probability | Rating |
|---|---|---|---|---|---|
| **Impact to Fauna** | HIGH | *Regional / Provincial* | Long Term | *Unlikely* | Low |
| | **4** | ***4*** | **4** | **2** | **1.6** |

The residual impact to fauna as calculated in Table 42 above has a rating of 1.6 and a Low impact class.

### 7.2.7 Visual

The impact assessment does not change from that of the construction phase, refer to Section 6.1.7 above.

## 7.3 Decommisioning Phase

### 7.3.1 Geology

The impacts to geology during the decomissioning phase of the development remain as assessed in the construction phase in Section 6.1.1 above.

### 7.3.2 Topography

The impacts to topography during the decomissioning phase of the development remain as assessed in the construction phase in Section 6.2.2 above.

### 7.3.3 Soils, Land Capability and Land Use

The impacts to soils during the decomissioning phase of the development remain as assessed in the construction phase in Section 6.2.3 above.

### 7.3.4 Surface water

The impacts to surface water during the decomissioning phase of the development remain as assessed in the construction phase in Section 6.2.4 above.

### 7.3.5 Vegetation

The impacts to vegetation during the decomissioning phase of the development remain as assessed in the construction phase in Section 6.2.5 above.

### 7.3.6 Fauna

Even though the removal of the 10 km of proposed power lines will reduce the number of power lines in the area that could impact on fauna, the impact after decomissioning will remain as assessed in Section 6.2.6 above due to the remaining network if high voltage power lines.

### 7.3.7 Visual

Even though the removal of the 10 km of proposed power lines will reduce the number of power lines in the area that could impact on the visual environment, the impact after decomissioning will remain as assessed in Section 6.2.7 above due to the remaining network if high voltage power lines.

# 8.0 ENVIRONMENTAL MANAGEMENT

This section describes the suggested commitments that should be included in the Environmental Management Plan (EMP) to be compiled by the environmental consultant responsible for the EIA.

## 8.1 Geology and Soils

| ***Management Component*** | ***Geology and Soils*** |
|---|---|
| ***Primary Objective*** | |
| ***To ensure that the soils are stockpiled in the correct manner to prevent erosion and contamination of surface water runoff.*** | |
| ***Core Criteria:*** | ***Monitoring Criteria*** |
| ***No blasting is undertaken on site without a suitable blast design, compiled in line with relevant SANS codes and approved by an appropriately qualified professional.*** | ***Site Development Plan, EMP monitoring and Intermittent observation*** |
| ***Avoid placement of pylon footings in the clay soils on site*** | |
| ***Spread absorbent sand on areas where oil spills are likely to occur, such as the refuelling area in the hard park*** | |
| ***Oil-contaminated soils are to be removed to a contained storage area and bio-remediated or disposed of at a licensed facility*** | |
| ***If soils are excavated for the footing placement, ensure that the soil is utilised elsewhere for rehabilitation/road building purposes*** | |
| ***Ensure that soil is stockpiled in such a way as to prevent erosion from storm water.*** | |

## 8.2 Fauna

| Management Component | Fauna – especially red data birds |
|---|---|
| Primary Objective | |
| To ensure that the development minimises the potential impact to endangered species and their habitat. | |
| Core Criteria: | Monitoring Criteria |
| All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse) | Site Development Plan, EMP monitoring and Intermittent observation |
| No construction activity and disturbance will be permitted in the seasonal seepage zone where the red data birds were observed. | |
| Bird flappers are to be installed on all power lines in order to prevent bird collisions. | |
| Construction activities, people and vehicles will not be allowed outside of the area demarcated for construction. | |
| No hunting, snaring or collection of eggs will be allowed. | |
| If any Blue Crane nests or young are found, contact the Mpumalanga Parks Board for assistance. Also avoid the area at all cost (250m buffer) | |
| If adult birds are observed on site, avoid startling the birds, as they could fly into the already existing power lines. | |
| No animals/pets will be allowed in the construction site. | |
| Adhere to the ESKOM bird collision prevention guideline (Appendix 3) | |
| Poisoning of any sort is strictly forbidden. | |
| Remove all food wastes daily and discard at a licensed waste facility | |
| Provide vermin-proof bins for construction workers | |
| Designate eating areas and prevent food and waste build up | |
| No cooking fires will be permitted, the grassland is highly susceptible to veld fires and these destroy bird eggs | |

## 8.3 Vegetation

| ***Management Component*** | ***Vegetation*** |
|---|---|
| ***Primary Objective*** | |
| ***To ensure the control of alien invasive species and that the rehabilitation of indigenous vegetation to as close to the original state as possible.*** | |
| ***Core Criteria:*** | ***Monitoring Criteria*** |
| ***All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse)*** | ***Site Development Plan, EMP monitoring and Intermittent observation*** |
| ***Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.*** | |
| ***Control of alien invasive species in line with the requirements of Conservation of Agricultural Resources Act will be undertaken.*** | |
| ***Alien invasive plant material will be preferentially removed in entirety through mechanical means (e.g. chainsaw, bulldozer, hand-pulling of smaller specimens). Chemical control is only required as a last resort.*** | |
| ***If during the establishment period, any noxious or excessive weed growth occurs, such vegetation will be removed.*** | |
| ***No construction activity and disturbance will be permitted in the seasonal seepage zone.*** | |
| ***It is the developer's responsibility to implement a monitoring programme that will be instituted to ensure that re-growth of alien invasive plants species does not occur, or that such re-growth is controlled.*** | |
| ***The sensitive vegetation unit should be avoided and construction limited to 50 m from the edge of the wetlands and streams*** | |
| ***Adhere to the ESKOM vegetation management guideline (Appendix 4)*** | |

## 8.4 Rivers, wetlands and Streams

<table>
<tr><td>Management Component</td><td colspan="2">Rivers and streams</td></tr>
<tr><td colspan="3">Primary Objective</td></tr>
<tr><td colspan="3">To ensure that the rivers and streams are protected and incur minimal negative impact from the development as possible.</td></tr>
<tr><td colspan="2">Core Criteria:</td><td>Monitoring Criteria</td></tr>
<tr><td colspan="2">The Contractor will minimise the extent of any damage to the flood plain that is necessary to complete the works, and will not pollute any river as a result of construction activities.</td><td rowspan="9">Storm water Management Plan, Site Development Plan, EMP monitoring and Intermittent observations</td></tr>
<tr><td colspan="2">The Contractor will not cause any physical damage to any aspects of a watercourse, other than that necessary to complete the works as specified and in accordance with the accepted method statement.</td></tr>
<tr><td colspan="2">No construction vehicles or activities will be allowed to work within 50 m of any of the streams or wetlands on site</td></tr>
<tr><td colspan="2">Demarcated areas where waste can be safely contained and stored on a temporary basis during the construction phase should be provided at the hard park</td></tr>
<tr><td colspan="2">When adequate volumes (not more than 1 month) have accumulated all waste is to be removed from site and disposed of at a licensed facility</td></tr>
<tr><td colspan="2">Waste is not to be buried on site</td></tr>
<tr><td colspan="2">All hazardous materials inter alia paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment</td></tr>
<tr><td colspan="2">Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur</td></tr>
<tr><td colspan="2">Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented</td></tr>
</table>

# 9.0 CONCLUSION

In conclusion the proponent is proposing the construction and operation a 400 kV overhead power line, by-passing the existing Duvha Power Station, to form a new Bravo-Vulcan line near Emahlahleni, Mpumalanga.

Cymbian was appointed to investigate the biophysical aspects of the proposed site as well as the potential visual impact of the development. The aspects investigated include topography, soils, land use, land capability, wetland, fauna, flora and the visual environment.

It was found that the major areas of concern were the sensitive wetlands and riparian zones on site, along with the sensitive avifaunal and floral species that occur in these environments. In addition it was noted that the visual impact of the development could be high.

Upon review of the existing procedures and mitigation measures that Eskom have applied in the past and which are based on sound scientific research it was found that the impacts to fauna could be reduced.

The impacts to the wetland and riparian zones could be reduced by utilising the Alternative 1 route alignment, thereby avoiding most of the wetlands and seepage zones.

The visual impact was found to the relatively small, when considering the high number of existing power lines in the area as well as the imminent Duvha Power Station.

In conclusion the proposed development will impact on the environment, but these impacts can be managed and mitigated to the point where they are within acceptable norms. It is suggested that the Alternative 1 route alignment be utilised in order to decrease the risk of impacting in fauna and flora.

# Appendix 1: Floral Species List

| Download from POSA (http://posa.sanbi.org) on September 30, 2008, 11:24 am - Grid: 2529CD | | | | |
|---|---|---|---|---|
| Family | *Species* | Common name | Present | Occurrence |
| AMARYLLIDACEAE | *Cyrthanthus breviflorus* | Yellow Fire lily | x | Individuals |
| ANACARDIACEAE | *Rhus magalismontana Sond. subsp. magalismontana* | Bergtaaibos | | |
| ANACARDIACEAE | *Sclerocarya birrea (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro* | Marula | | |
| APIACEAE | *Afrosciadium magalismontanum (Sond.) P.J.D.Winter* | Wild Parsley | | |
| APIACEAE | *Heteromorpha arborescens (Spreng.) Cham. & Schltdl. var. abyssinica (Hochst. ex A.Rich.) H.Wolff* | Parsley Tree | | |
| APOCYNACEAE | *Asclepias gibba (E.Mey.) Schltr. var. gibba* | | | |
| APOCYNACEAE | *Asclepias stellifera Schltr.* | Spring Stars | | |
| APOCYNACEAE | *Brachystelma rubellum (E.Mey.) Peckover* | | | |
| APOCYNACEAE | *Pachycarpus schinzianus (Schltr.) N.E.Br.* | Bitterwortel | | |
| APOCYNACEAE | *Parapodium costatum E.Mey.* | | | |
| APONOGETONACEAE | *Aponogeton natalensis Oliv.* | Wateruintjie | x | Individuals |
| AQUIFOLIACEAE | *Ilex mitis (L.) Radlk. var. mitis* | Cape Holly | | |
| ASPHODELACEAE | *Kniphofia ensifolia Baker subsp. ensifolia* | | | |
| ASTERACEAE | *Bidens pilosa* | Blackjack | x | Common |
| ASTERACEAE | *Bidens formosa* | Cosmos | x | Individuals |
| ASTERACEAE | *Crassocephalum x picridifolium (DC.) S.Moore* | | | |
| ASTERACEAE | *Dicoma macrocephala DC.* | | | |
| ASTERACEAE | *Helichrysum aureonitens Sch.Bip.* | | x | Individuals |
| ASTERACEAE | *Helichrysum nudifolium (L.) Less. var. nudifolium* | Hottentot's Tea | | |
| ASTERACEAE | *Helichrysum setosum Harv.* | Yellow Everlasting | | |
| ASTERACEAE | *Helichrysum splendidum (Thunb.) Less.* | | | |
| ASTERACEAE | *Nidorella hottentotica DC.* | | | |
| ASTERACEAE | *Stoebe vulgaris* | Bankrupt Bush | x | Sparse |
| ASTERACEAE | *Tagetes minuta* | Khaki weed | x | Common |
| ASTERACEAE | *Vernonia poskeana Vatke & Hildebr. subsp. botswanica G.V.Pope* | | | |
| BRYACEAE | *Bryum argenteum Hedw.* | Silver Moss | | |
| CAPPARACEAE | *Maerua cafra (DC.) Pax* | Common bush-cherry, White-wood | | |
| CARYOPHYLLACEAE | *Corrigiola litoralis L. subsp. litoralis var. perennans Chaudhri* | | | |
| CARYOPHYLLACEAE | *Dianthus mooiensis F.N.Williams subsp. mooiensis var. mooiensis* | Wild Pink | | |
| CARYOPHYLLACEAE | *Dianthus transvaalensis Burtt Davy* | | | |

| | | | | |
|---|---|---|---|---|
| CONVOLVULACEAE | *Ipomoea crassipes Hook. var. crassipes* | | | |
| CONVOLVULACEAE | *Ipomoea magnusiana Schinz* | | | |
| CRASSULACEAE | *Crassula setulosa Harv. var. setulosa forma setulosa* | | | |
| CYPERACEAE | *Bulbostylis densa (Wall.) Hand.-Mazz. subsp. afromontana (Lye) R.W.Haines* | | | |
| CYPERACEAE | *Bulbostylis hispidula (Vahl) R.W.Haines subsp. pyriformis (Lye) R.W.Haines* | | | |
| CYPERACEAE | *Cyperus esculentus* | Yellow Nutsedge | x | Sparse |
| CYPERACEAE | *Lipocarpha nana (A.Rich.) Cherm.* | | | |
| CYPERACEAE | *Pycreus pumilus (L.) Domin* | | | |
| DICRANACEAE | *Campylopus savannarum (Müll.Hal.) Mitt.* | | | |
| ERIOCAULACEAE | *Eriocaulon abyssinicum Hochst.* | | | |
| EUPHORBIACEAE | *Euphorbia inaequilatera Sond. var. inaequilatera* | | | |
| EXORMOTHECACEAE | *Exormotheca holstii Steph.* | | | |
| FABACEAE | *Eriosema psoraleoides (Lam.) G.Don* | | | |
| FABACEAE | *Indigofera arrecta Hochst. ex A.Rich.* | | | |
| FABACEAE | *Indigofera zeyheri Spreng. ex Eckl. & Zeyh.* | | | |
| FABACEAE | *Lotononis foliosa Bolus* | | x | Individuals |
| FABACEAE | *Rhynchosia monophylla Schltr.* | | x | Individuals |
| FABACEAE | *Rhynchosia nervosa Benth. ex Harv. var. nervosa* | | | |
| FABACEAE | *Virgilia divaricata Adamson* | | | |
| FABACEAE | *Zornia milneana Mohlenbr.* | | x | Individuals |
| FOSSOMBRONIACEAE | *Fossombronia gemmifera Perold* | | | |
| HALORAGACEAE | *Myriophyllum aquaticum (Vell.) Verdc.* | | | |
| HALORAGACEAE | *Myriophyllum spicatum L.* | | | |
| HYACINTHACEAE | *Albuca setosa Jacq.* | Slymuintjie | x | Individuals |
| HYPOXIDACEAE | *Hypoxis acuminata* | | x | Individuals |
| HYPOXIDACEAE | *Hypoxis filiformis Baker* | | x | Individuals |
| HYPOXIDACEAE | *Hypoxis iridifolia* | | x | Individuals |
| IRIDACEAE | *Gladiolus crassifolius Baker* | | x | Individuals |
| IRIDACEAE | *Lapeirousia sandersonii Baker* | | | |
| ISOETACEAE | *Isoetes transvaalensis Jermy & Schelpe* | | | |
| LAMIACEAE | *Becium angustifolium (Benth.) N.E.Br.* | | | |
| LAMIACEAE | *Becium obovatum* | | x | Individuals |
| LAMIACEAE | *Mentha aquatica L.* | | | |
| LAMIACEAE | *Pycnostachys reticulata (E.Mey.) Benth.* | | | |
| LENTIBULARIACEAE | *Utricularia arenaria* | | x | Individuals |
| LENTIBULARIACEAE | *Utricularia stellaris L.f.* | | | |

| | | | | |
|---|---|---|---|---|
| LILIACEAE | *Protasparagus setaceus* | Asparagus Fern | x | Individuals |
| LOBELIACEAE | *Monopsis decipiens* | | x | Individuals |
| MALPIGHIACEAE | *Triaspis hypericoides (DC.) Burch. subsp. nelsonii (Oliv.) Immelman* | | | |
| MALVACEAE | *Pavonia transvaalensis (Ulbr.) A.Meeuse* | Klapperbossie | | |
| MALVACEAE | *Triumfetta obtusicornis Sprague & Hutch.* | Maagbossie | | |
| MENYANTHACEAE | *Nymphoides thunbergiana (Griseb.) Kuntze* | | | |
| MESEMBRYANTHEMACEAE | *Delosperma leendertziae N.E.Br.* | | | |
| MESEMBRYANTHEMACEAE | *Frithia humilis Burgoyne* | | | |
| MESEMBRYANTHEMACEAE | *Mossia intervallaris (L.Bolus) N.E.Br.* | | | |
| MOLLUGINACEAE | *Limeum viscosum (J.Gay) Fenzl subsp. viscosum var. glomeratum (Eckl. & Zeyh.) Friedrich* | | | |
| MORACEAE | *Ficus abutilifolia (Miq.) Miq.* | | | |
| MORACEAE | *Ficus salicifolia Vahl* | | | |
| MYRTACEAE | *Eucalyptus spp* | Blue Gum | x | Sparse |
| NYMPHAEACEAE | *Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.* | | | |
| OCHNACEAE | *Ochna gamostigmata Du Toit* | | | |
| ONAGRACEAE | *Epilobium hirsutum L.* | | | |
| ORCHIDACEAE | *Centrostigma occultans (Welw. ex Rchb.f.) Schltr.* | | | |
| ORCHIDACEAE | *Habenaria clavata (Lindl.) Rchb.f.* | | | |
| ORCHIDACEAE | *Satyrium hallackii Bolus subsp. ocellatum (Bolus) A.V.Hall* | | | |
| OROBANCHACEAE | *Striga gesnerioides (Willd.) Vatke* | | | |
| OXALIDACEAE | *Oxalis obliquifolia* | Sorrel | x | Individuals |
| PALLAVICINIACEAE | *Symphyogyna brasiliensis Nees & Mont.* | | | |
| PARMELIACEAE | *Canoparmelia pustulescens (Kurok.) Elix* | | | |
| PEDALIACEAE | *Dicerocaryum senecioides (Klotzsch) Abels* | | | |
| PHYLLANTHACEAE | *Phyllanthus maderaspatensis L.* | Kleurbossie | x | Individuals |
| POACEAE | *Andropogon eucomus Nees* | Old Man's Beard | x | Sparse |
| POACEAE | *Calamagrostis epigejos (L.) Roth var. capensis Stapf* | | | |
| POACEAE | *Cymbopogon excavatus* | Broad-leaved Turpentine Grass | x | Individuals |
| POACEAE | *Cynodon dactylon* | Coch Grass | x | Sparse |
| POACEAE | *Echinochloa jubata Stapf* | | | |
| POACEAE | *Elionurus muticus* | Wire Grass | x | Individuals |
| POACEAE | *Eragrostis capensis (Thunb.) Trin.* | Heart-seed Love Grass | x | Individuals |
| POACEAE | *Eragrostis chloromelas Steud.* | Narrow Curly leaf | x | Common |
| POACEAE | *Eragrostis hierniana Rendle* | | | |

| | | | | |
|---|---|---|---|---|
| POACEAE | *Eragrostis inamoena K.Schum.* | | | |
| POACEAE | *Eragrostis plana* | Tough Love Grass | x | Sparse |
| POACEAE | *Eragrostis racemosa (Thunb.) Steud.* | Narow Heart Love Grass | x | Sparse |
| POACEAE | *Eragrostis tef (Zuccagni) Trotter* | Tef | x | Sparse |
| POACEAE | *Hyparrhenia hirta (L.) Stapf* | Common Thatching Grass | x | Common |
| POACEAE | *Hyparrhenia quarrei Robyns* | | | |
| POACEAE | *Hyparrhenia tamba (Steud.) Stapf* | Blue Thatching Grass | | |
| POACEAE | *Hyperthelia dissoluta (Nees ex Steud.) Clayton* | | | |
| POACEAE | *Loudetia simplex* | Russet Grass | x | Sparse |
| POACEAE | *Miscanthus junceus (Stapf) Pilg.* | Wireleaf Daba Grass | | |
| POACEAE | *Perotis patens Gand.* | Cat's Tail | x | Individuals |
| POACEAE | *Schizachyrium sanguineum* | Red Autumn Grass | x | Sparse |
| POACEAE | *Setaria nigrirostris (Nees) T.Durand & Schinz* | | | |
| POACEAE | *Setaria sphacelata var. sphacelata* | Common Bristle Grass | x | Individuals |
| POACEAE | *Sporobolus fimbriatus* | Dropseed Grass | x | Sparse |
| POACEAE | *Themeda triandra* | Red Grass | x | Sparse |
| POACEAE | *Urochloa brachyura (Hack.) Stapf* | | x | Sparse |
| POLYGALACEAE | *Polygala ohlendorfiana Eckl. & Zeyh.* | | | |
| POLYGALACEAE | *Polygala transvaalensis Chodat subsp. transvaalensis* | | | |
| PORTULACACEAE | *Anacampseros subnuda Poelln. subsp. subnuda* | | | |
| PORTULACACEAE | *Portulaca hereroensis Schinz* | | | |
| PORTULACACEAE | *Portulaca quadrifida L.* | | | |
| POTAMOGETONACEAE | *Potamogeton schweinfurthii A.Benn.* | | | |
| PTERIDACEAE | *Cheilanthes involuta (Sw.) Schelpe & N.C.Anthony var. obscura (N.C.Anthony) N.C.Anthony* | | | |
| RANUNCULACEAE | *Ranunculus meyeri Harv.* | | x | Individuals |
| RICCIACEAE | *Riccia atropurpurea Sim* | | | |
| RICCIACEAE | *Riccia okahandjana S.W.Arnell* | | | |
| RICCIACEAE | *Riccia volkii S.W.Arnell* | | | |
| RUBIACEAE | *Richardia scabra L.* | | | |
| SCROPHULARIACEAE | *Chaenostoma leve (Hiern) Kornhall* | | | |
| SELAGINELLACEAE | *Hebenstretia angolensis Rolfe* | Katstert | x | Individuals |
| SELAGINELLACEAE | *Selaginella dregei (C.Presl) Hieron.* | | | |
| SOLANACEAE | *Solanum sisymbrifolium* | Wild tomato | x | Individuals |
| THELYPTERIDACEAE | *Thelypteris confluens (Thunb.) C.V.Morton* | | | |
| THYMELAEACEAE | *Gnidia sericocephala (Meisn.) Gilg ex Engl.* | | | |
| XYRIDACEAE | *Xyris capensis Thunb.* | | | |

# Appendix 2: Animal Species List

| Faunal Species List | |
|---|---|
| **Species** | **Common name** |
| **Reptiles** | |
| *Bitens arietans* | Puff Adder |
| *Varanus niloticus* | Water Monitor |
| **Birds** | |
| *Phalacrocorax africanus* | Reed Cormorant |
| *Ardea cinerea* | Grey Heron |
| *Ardea melanocephala* | Blackheaded Heron |
| *Bubulcus ibis* | Cattle Egret |
| *Bostrychia hagedash* | Hadeda Ibis |
| *Plegadis falcinellus* | Glossy Ibis |
| *Alopochen aegyptiacus* | Egyptian Goose |
| *Elanus caeruleus* | Blackshouldered Kite |
| *Francolinus swainsonii* | Swainson's Francolin |
| *Numida meleagris* | Helmeted Guineafowl |
| *Fulica cristata* | Redknobbed Coot |
| *Gallinula chloropus* | Moorhen |
| *Anthropoides paradisea* | Blue Crane |
| *Sagittarius serpentarius* | Secretary Bird |
| *Eupodotis cafra* | Whitebellied Korhaan |
| *Vanellus armatus* | Blacksmith Plover |
| *Vanellus coronatus* | Crowned Plover |
| *Streptopelia semitorquata* | Redeyed Dove |
| *Streptopelia senegalensis* | Laughing Dove |
| *Asio capensis* | Marsh Owl |
| *Colius striatus* | Speckled Mousebird |
| *Mirafra africana* | Rufousnaped Lark |
| *Corvus albus* | Pied Crow |
| *Saxicola torquata* | Stone Chat |
| *Phylloscopus trochilus* | Willow Warbler |
| *Cisticola fulvicapilla* | Neddicky |
| *Motacilla clara* | Cape Wagtail |
| *Anthus cinnamomeus* | Grassveld Pipit |
| *Passer domesticus* | House Sparrow |
| *Ploceus velatus* | Masked Weaver |
| *Euplectes orix* | Red Bishop |
| *Emberiza capensis* | Cape Bunting |
| **Mammals** | |
| *Antidorcas marsupialis* | Springbok |
| *Damaliscus dorcas phillipsi* | Blesbok |
| *Cynictis pencillata* | Yellow Mongoose |
| *Orycteropus afer* | Aardvark / Antbear |

# Appendix 3:  Bird Collision Prevention Guidelines and Bird Impact Assessment Study

# Appendix 4: Vegetation Management Guideline

# Appendix 5: Electric and Magnetic Fields – A summary of Technical and Biological Aspects

9.1