CYMBIAN
ENVIRO-SOCIAL CONSULTING SERVICES

Biophysical Specialist Study Report for the Bravo 4 Power Line Route Alternatives

Draft Report

This is a report compiled for Zitholele Consulting

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PURPOSE OF THIS DOCUMENT

The growing demand for electricity is placing increasing pressure on Eskom's existing power generation and transmission capacity. Eskom are 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 400 kV Bravo (Kusile) Power Station between Bronkhorstspruit and Witbank in 2007. Construction of this power station has already commenced.

The new Bravo power station needs to be integrated with the existing Eskom electricity infrastructure. This proposed project is to construct a two new 400 kV overhead power lines from the Kendal Power Station to the Zeus Substation. Each of these lines, running parallel to each other, will be approximately 90 km in length.

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.

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 400 kV Bravo (Now renamed Kusile) Power Station between Bronkhorstspruit and Witbank in 2007. Construction of this power station has commenced in 2008.

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 aims to obtain authorisation and construct these auxiliary structures. In specific detail the project will look at high voltage power lines that span 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 400kV 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 400 kV 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 Witbank 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. **This report details the biophysical findings for the Bravo 4 project.**

Phase 5: New 10km Bravo-Vulcan Power Line

Eskom propose to construct a 400 kV overhead power line, by-passing the existing Duvha substation, to form a new Bravo-Vulcan line near Middelburg, 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 substation.

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
- Fauna (especially avifauna)

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 4 study area. The Bravo 4 site is located between the Zeus substation south of Secunda and Kendal Power Station to the north. This study area will include 3 route alternatives connecting the Zeus Sub Station with the Kendal Power Station 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 and Ornithological assessment were 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 and Ornithological 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 3rd - 7th of November 2008. The study area was 75km in length encompassing the area from the Kendal Power Station to the Zeus Substation, within a 10 km radius of 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.

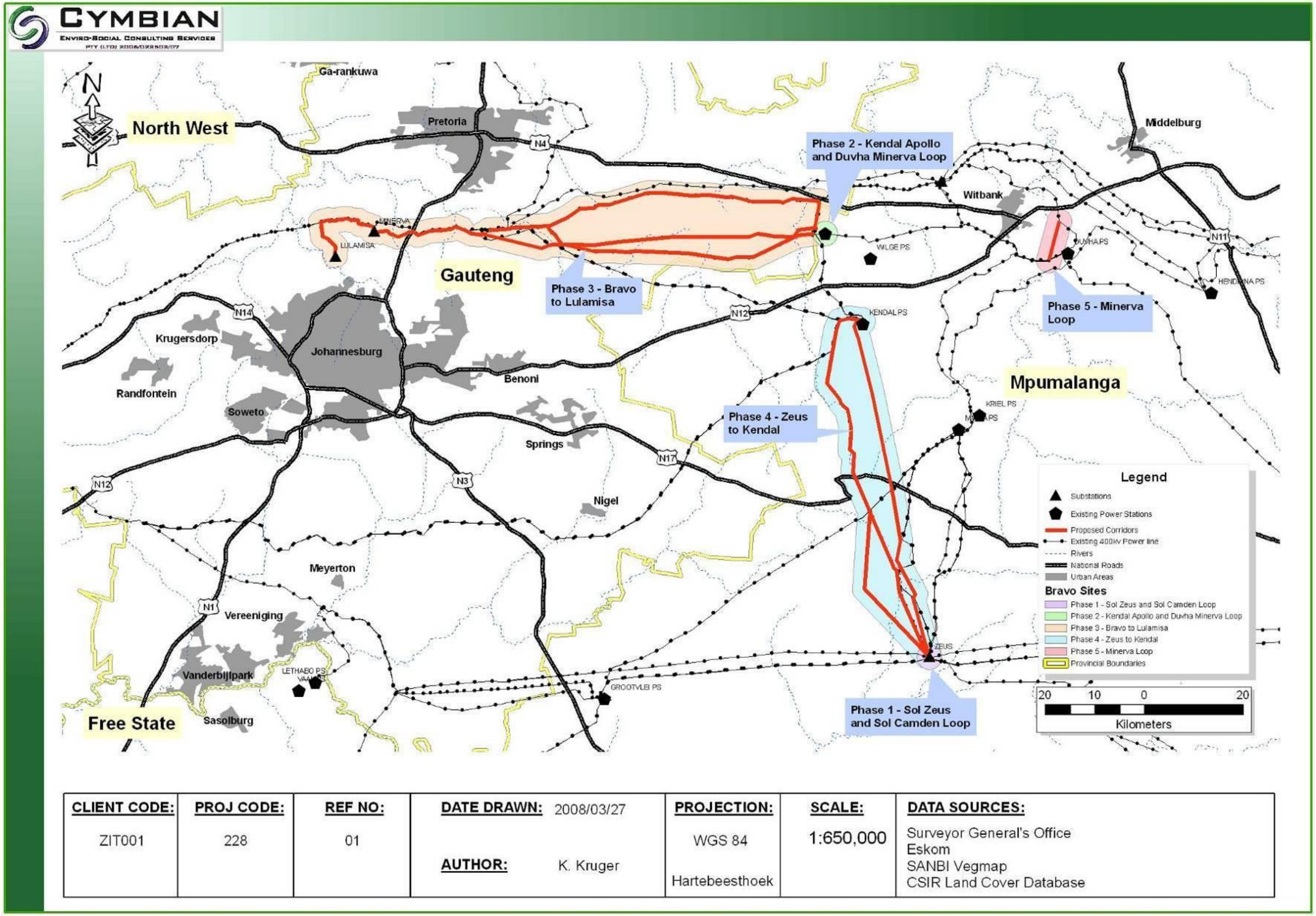

Figure 1: Site Location

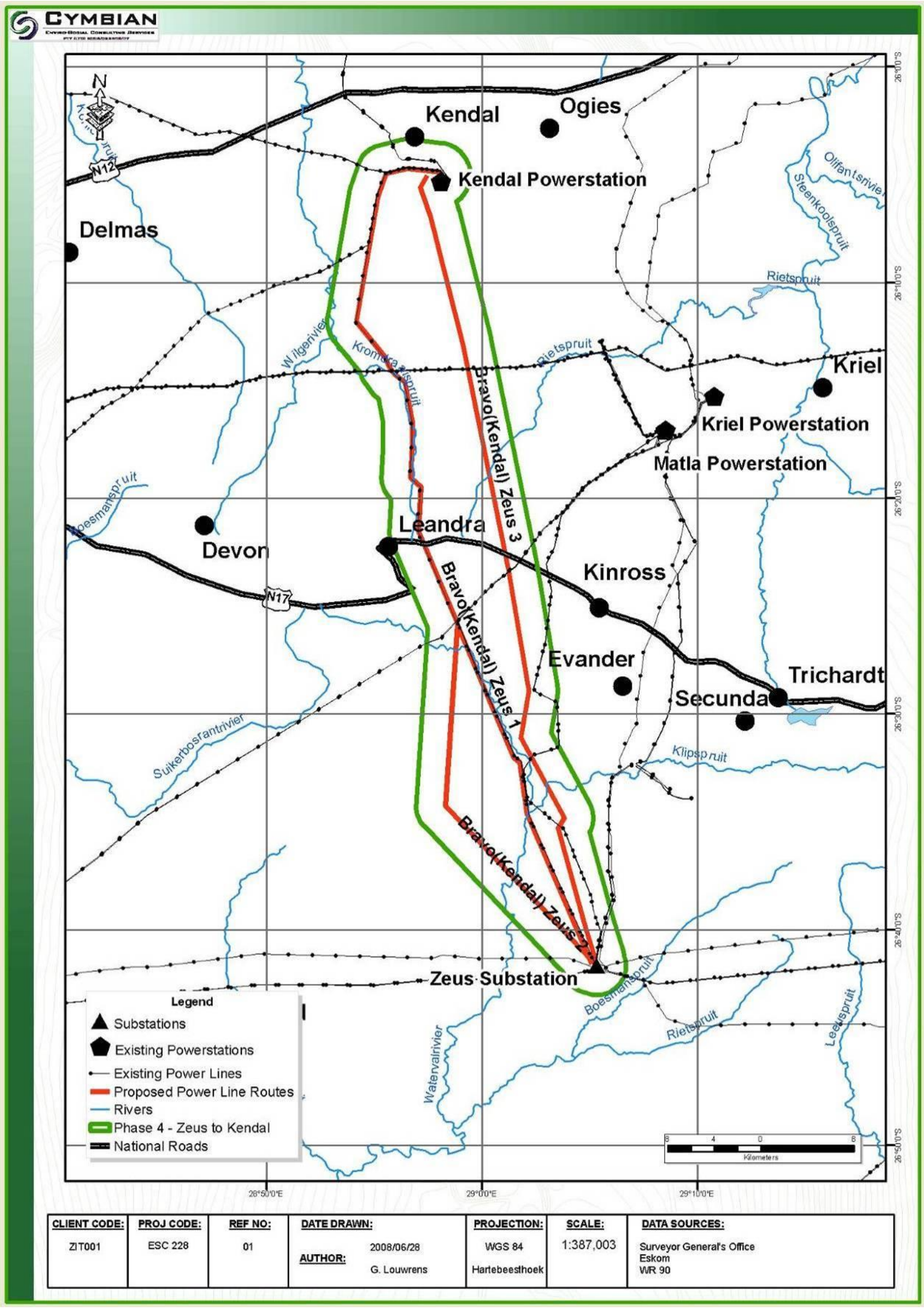

Figure 2: Site Map

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 regarding the routes 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 alternative corridors of approximately 5 km were analysed and will be assessed during this EIA. These three alternative corridors have been selected considering existing environmental information; engineering feasibilities as well as existing Eskom servitudes power lines. The following 3 alternatives were identified (Figure 2). The 3 alternative routes merge into 2 corridors 30 km from the Zeus substation, since there is and existing 400 kV Eskom servitude present.

Alternative 1:

Alternative 1 is to construct the two proposed 400 kV power lines, running parallel, approximately 76 km from Zeus Substation to Kendal Power Station. This proposed line will run furthest to the west as illustrated in Figure 2. This alternative is the longest alternative, and will be along an existing power line servitude. This alternative is currently the preferred alternative.

Alternative 2:

Alternative 2 is to construct the two proposed 400 kV power lines, running parallel, approximately 70 km from Zeus Substation to Kendal Power Station. The line will follow the same corridor as alternative 1 for the first 60 km's and later divert south before heading east towards the Zeus substation for 30 kms.

Alternative 3:

Alternative 3 is to construct the two proposed 400 kV power lines, running parallel, approximately 63 km from Zeus Substation to Kendal Power Station. This alternative will lead to a shorter power line length and is the alternative furthest to the east of the area as illustrated in Figure 2.

The 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.

2.4 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 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.

2.5 Project Timeframes

The primary project milestones are represented in Table 1 below.

Table 1: Primary Project Milestones for Bravo 4

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.

It should be noted that during the site visit, the Bravo Power Station site clearance and construction has already begun and large sections of the site was inaccessible and already disturbed.

3.1 Geology

3.1.1 Data Collection

The geological analysis was undertaken through the desktop evaluation using a Geographic Information System (GIS) and the relevant data sources. The geological data was taken from the Environmental Potential Atlas Data from the Department of Environmental Affairs and Tourism. Data was supplemented with on site observation during site visits conducted on the 8th – 12th September 2008 and the 3rd – 7th November 2008.

3.1.2 Regional Description

The lithology of the area comprises several geological sequences as illustrated in Figure 4. From the Figure it is clear that the study area is dominated by Dolerite flows along with Arenite. These main two geologies are prevalent for more than 80% of the study area. Several small sections of Granite, Shale and Tillite also occur within the study area.

The Arenite (sandstone) overlies the majority of the Mpumalanga coal fields and has been extensively disturbed by opencast mining operations all over the study area. This geology weathers to form the main agricultural red and brown soils of the province.

The Dolerite originates from lave intrusions throughout the area and can be distinguished by the "dinosaur egg" weathering of the rock. The Dolerite in the region weathers to a dark clayey soil that is not ideal for cultivation and is mostly used for grazing.

Figure 3: Dolerite (left) and sandstone (right) are the two main geologies found on site

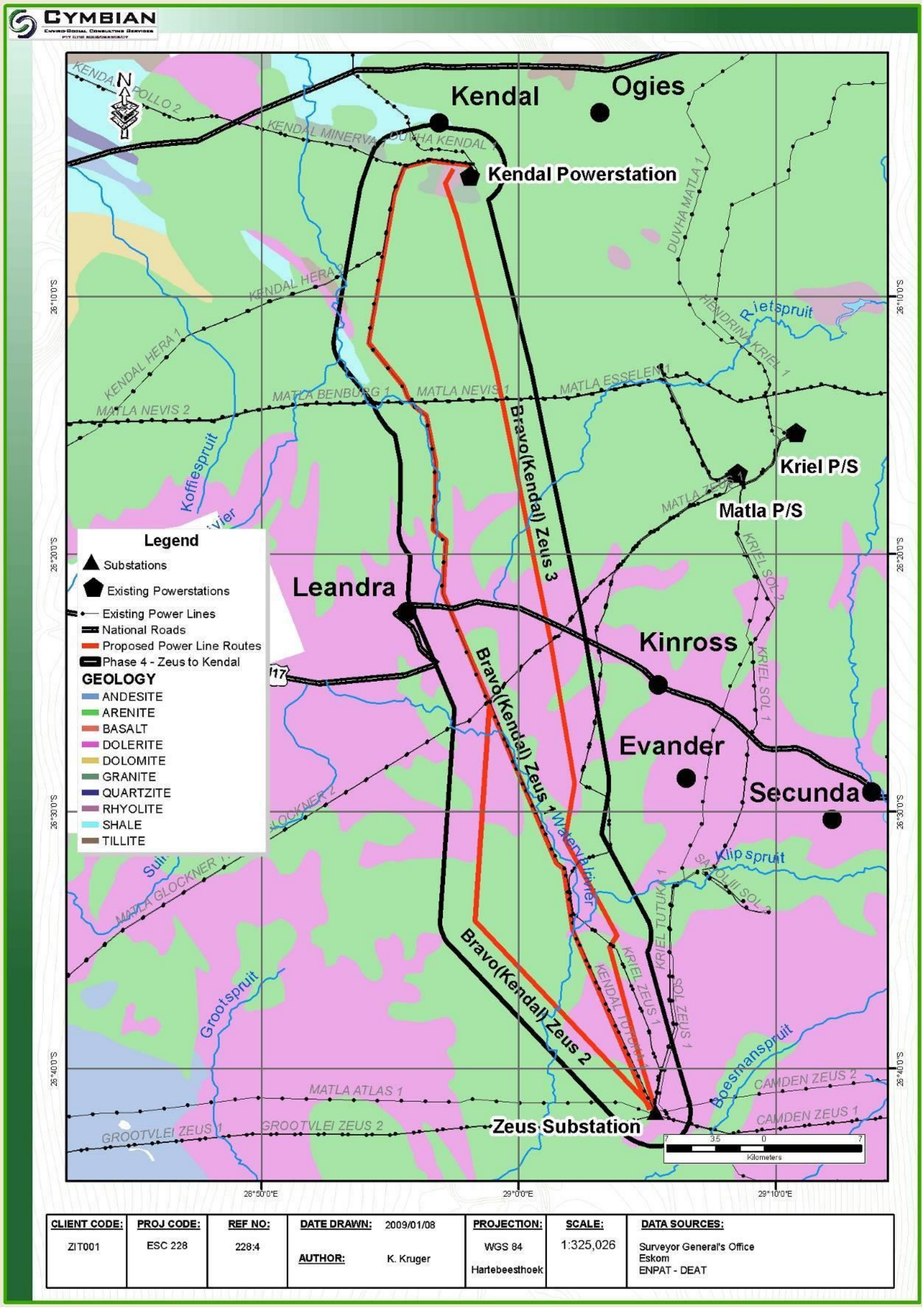

Figure 4: Regional Geology

3.2 Climate

3.2.1 Data Collection

Climate information was attained using the climate of South Africa database, as well as from Air Quality Impact Assessment for the Proposed New Coal-Fired Power Station (Kendal North) in the Witbank Area undertaken by Airshed Planning Professionals[1].

3.2.2 Regional Description

The study area displays warm summers and cold winters typical of the Highveld climate. The region falls within the summer rainfall region of South Africa, rainfall occurs mainly as thunderstorms (Mean Annual Precipitation 662 mm) and drought conditions occur in approximately 12% of all years. Mean annual potential evaporation of 2 060 mm indicates a loss of water out of the system.

The region experiences frequent frosts, with mean frost days of 41 days, winds are usually light to moderate, with the prevailing wind direction north-westerly during the summer and easterly during winter. In addition to frost the area is prone to hail storms during the summer time. Such a storm was experienced during the site visits and the hail stones are illustrated in Figure 5 below.

Figure 5: Hail stones from a storm event in November 2008 (Secunda)

[1] Air Quality Impact Assessment for the Proposed New Coal-fired Power Station (Kendal North) in the Witbank Area. Report No.: APP/06/NMS-01 Rev 0.2, 2006.

Ambient Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers. Long-term average (2003) maximum, mean and minimum temperatures for Kendal 2 is given in Table 2.

Table 2: Long Term Temperature Data for Kendal (Airshed, 2006)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Maximum	31	32	32	29	24	20	22	24	29	30	30	32
Mean	21	22	20	18	13	10	10	12	18	20	21	22
Minimum	15	15	12	11	6	4	3	4	10	13	14	15

Annual maximum, minimum and mean temperatures for Kendal 2 are given as 32°C, 3°C and 17°C, respectively, based on the 2003 record. Average daily maximum temperatures range from 32°C in December to 20°C in July, with daily minima ranging from 15°C in January to 3°C in July.

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.

3.3.2 Site Description

The study area falls within the Olifants River (Catchment B) and Vaal River (Catchment C) Primary Catchments as shown in Figure 6 (Northern section) and Figure 7 (Southern section).

The main river in the northern section of the site is the Wilge River along with the Kromdraai Spruit and the Riet Spruit. All these watercourses drain primarily northwards towards the Olifants River. Several non-perennial streams and drainage lines also occur throughout the area, draining towards the main rivers.

The southern section of the site drains towards the Vaal River and the main tributaries are the Waterval River, The Klip Spruit and the Boesman Spruit. The main drainage direction is southeast towards the Vaal River.

The streams and their associated dams 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.

As illustrated in the Figures below, it is evident that the Alternative 1 route is aligned along several streams, while Alternative 2 crosses very close to Leeupan. Alternative 3 does not traverse along any streams, but it does cross several. It should be noted that a large number of the existing power lines in the area are aligned along streams and drainage lines. The reasoning behind this was not to interfere with the farming activities that take place in all the surrounding areas. The recent emphasis on environmental impact limitation has however changed this perception, and it is now preferred that power lines avoid water courses. The streams support sensitive fauna and flora species which are described in more detail in the sections below. On the basis of the above it would be best to utilise Alternative 3, as this alternative avoids the most of the streams.

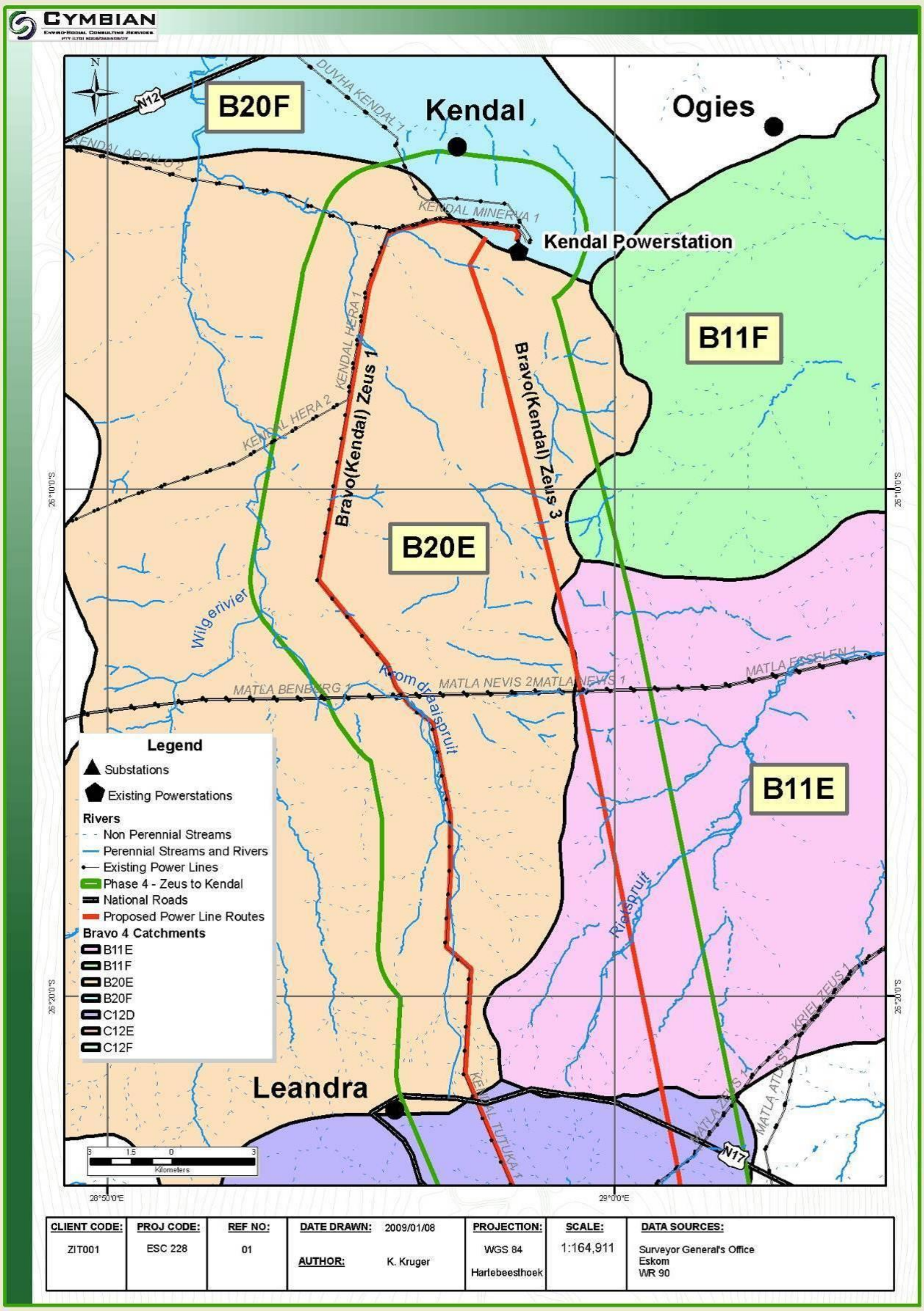

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Figure 6: Surface water and drainage features of the northern section of the site

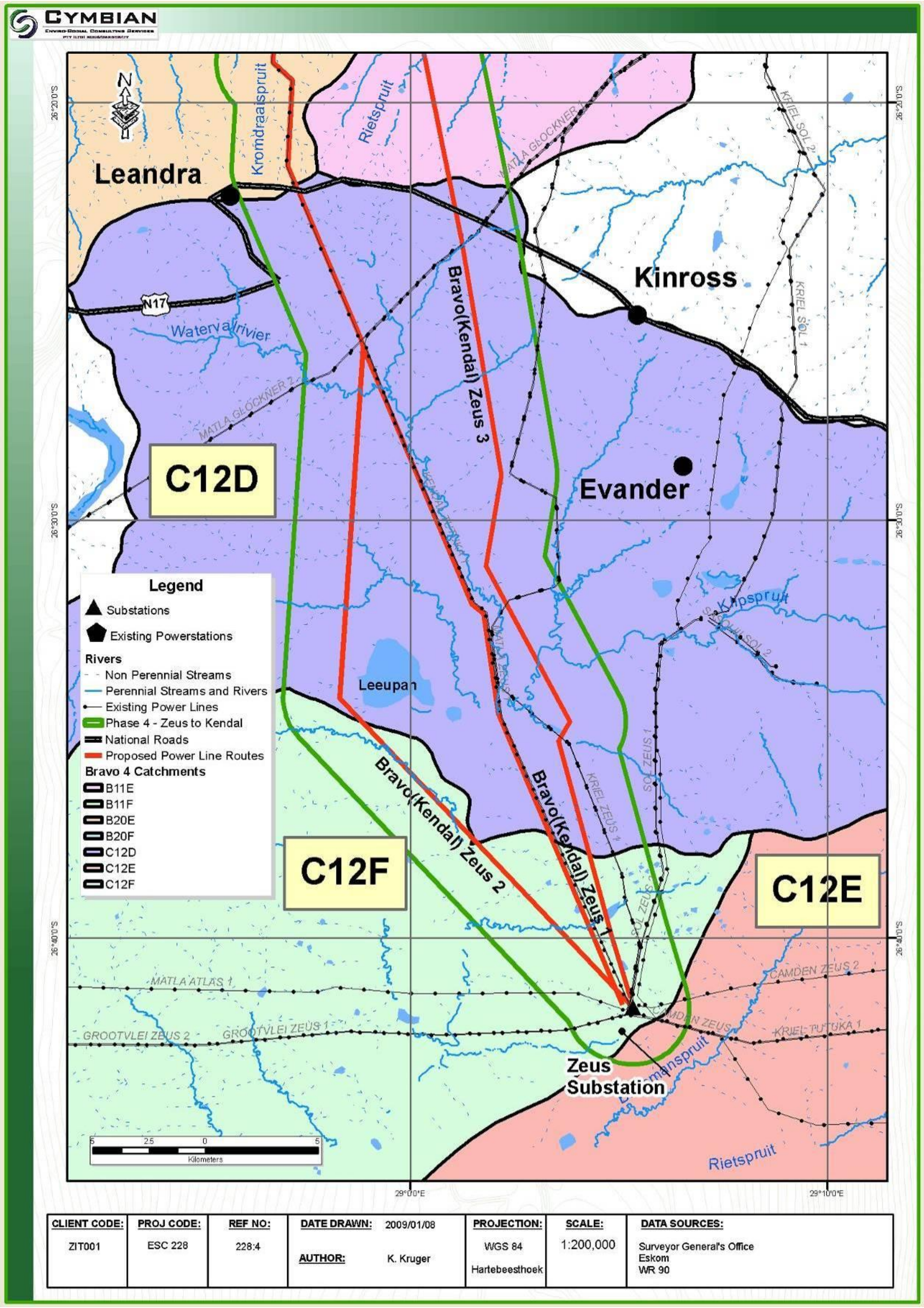


Figure 7: Surface water and drainage features of the southern section of the site

	
The Waterval River along which a significant section of Alternative 1 is aligned.	
	
Leeupan, a significant water body found along the Alternative 2 alignment. Note Secunda in the background (left) and the angling club (right).	
	
Waterval River showing existing power line crossings	Kromdraai Spruit, another stream that is traversed by the Alternative 1 alignment for a considerable distance.

Figure 8: Photographs of the surface water resources encountered on site

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 2628 BB, BD, DB and 2629 AA, AC and CA. Contours were combined from the topo mapsheets to form a combined contour layer. Using the Arcview GIS software the contour information was used to develop a digital elevation model of the region as shown in Figure 9 below.

3.4.2 Regional Description

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

3.4.3 Site Description

The study area's topography is representative of the region, that being gently undulating 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 1480 metres above mean sea level (mamsl) in the north to 1760 mamsl in the central parts of the site.

Figure 9 below illustrates the digital elevation model created from the contours of the region. The low lying areas are clearly visible in light blue while the higher areas are shown in brown. The watershed along the N17 highway is clearly visible in the centre of the site, from which the water drains either northwards or southwards.

Although the height difference is clear on the map, the higher lying areas in this region are not classified as ridges.

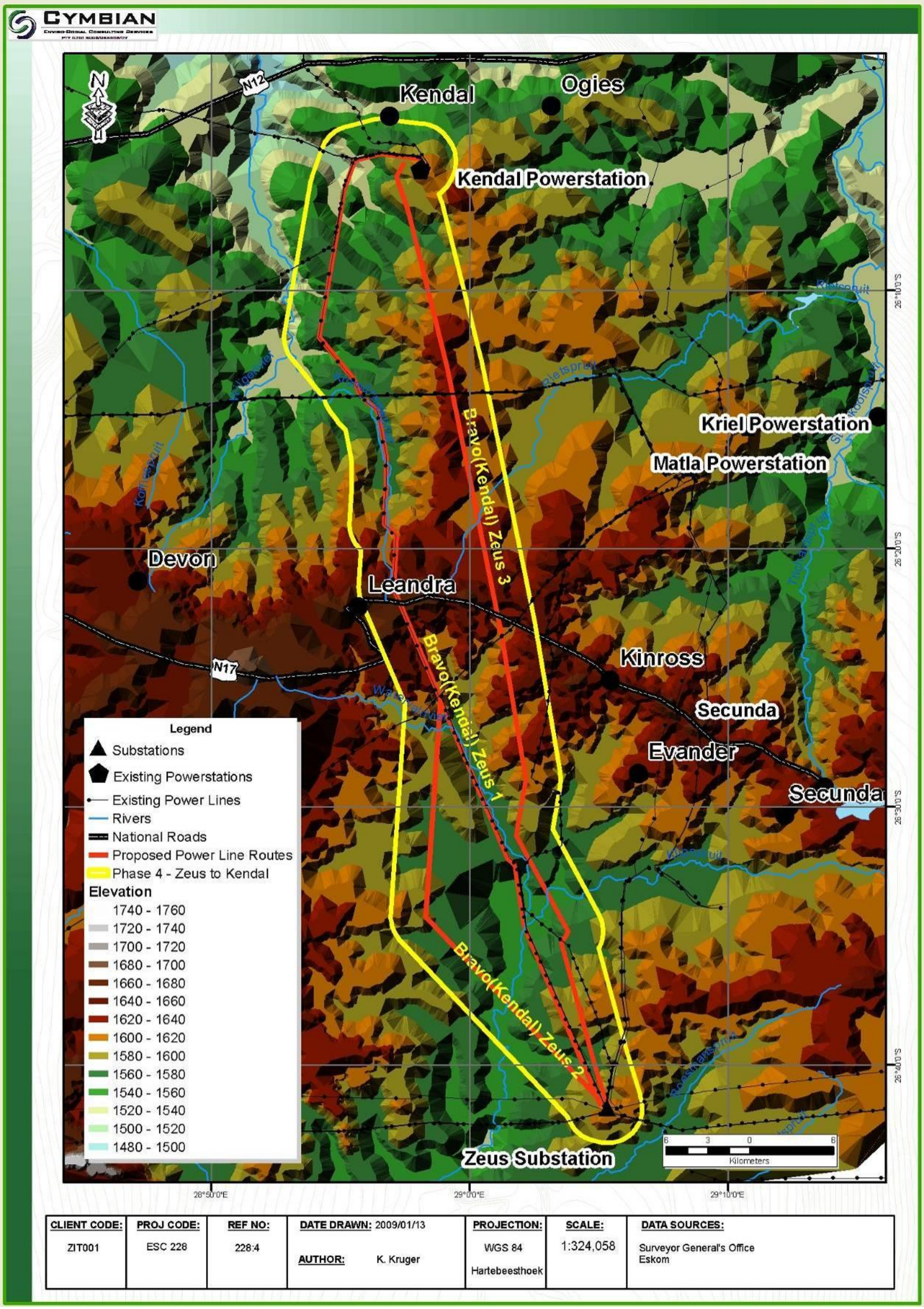


Figure 9: Topography of Site

3.5 Soils

3.5.1 Data Collection

The site visits were conducted on the 8th – 12th September 2008 and the 3rd – 7th November 2008. Soils were augered at 300 m 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:

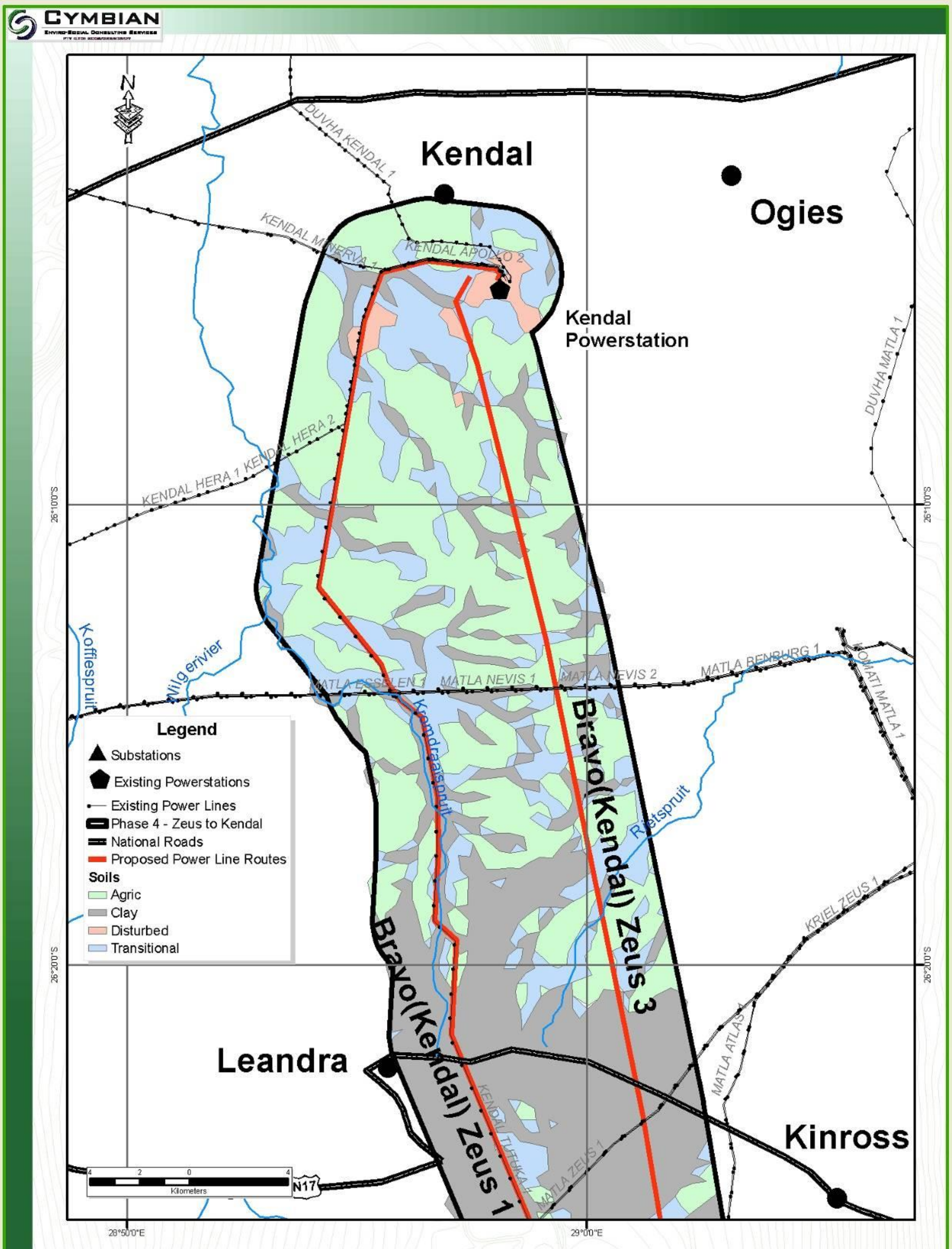
- Soil horizons;
- Soil colour;
- Soil depth;
- Soil texture (Field determination)
- Wetness;
- Occurrence of concretions or rocks; and
- Underlying material (if possible).

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), or the intrusive Karoo Suite dolerites which feature prominently in the area. The soils on the sandstones are generally deep with a brown colour, while the dolerites generally form dark clay soils.

3.5.3 Site Description

During the site visit several soil forms were identified including Mispah, Avalon, Clovelly, Katspruit, Longlands, Wasbank, Rensburg, Arcadia, Willowbrook, Steendal, Milkwood, Inhoek, Kroonstad, Westleigh, Dresden, Glencoe, Bainsvlei, Shortlands, Sterkspruit and Witbank. In order to simplify the assessment, the soil forms have been grouped into management units that have similar characteristics, and therefore would require similar management. These units are agricultural soils, disturbed soils, rocky soils, wetlands soils and transitional soils. Each of the soil management units are described in detail in the sections below and Figure 10 and Figure 11 illustrates the location of the soil units. The land capability (agricultural potential) of the abovementioned soils are described in more detail in Section 3.6.



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ZIT001	ESC 228	228.4	AUTHOR: K. Kruger	WGS 84 Hartebeesthoek	1:187,581	Surveyor General's Office Eskom ENPAT - DEAT

Figure 10: Soil Type Map of the northern section of the site

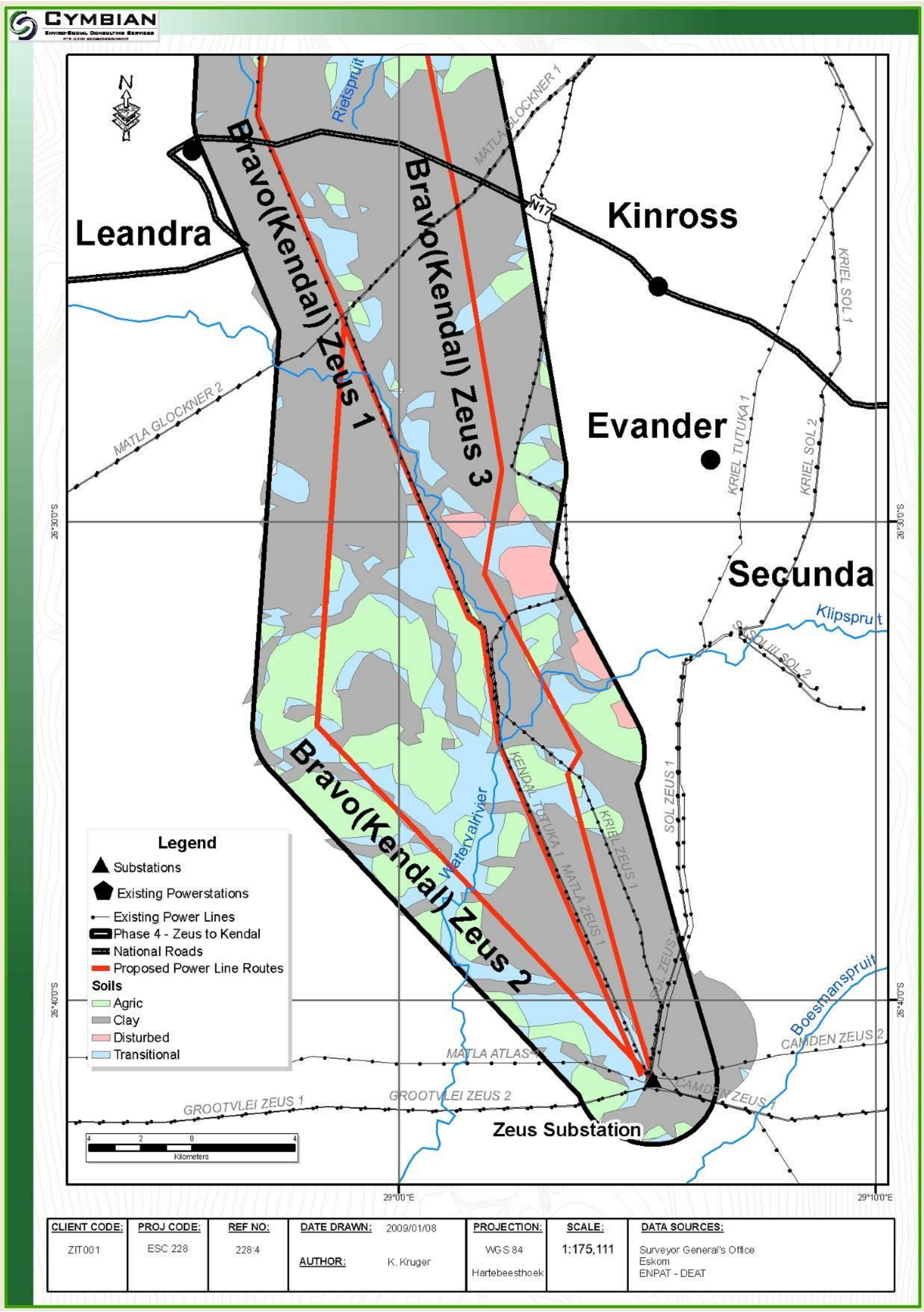


Figure 11: Soil Type Map of the southern section of the site

Agricultural Soils

The agricultural soils found on site support an industry of commercial maize production. These soils include Hutton, Clovelly, Avalon, Bainsvlei, Glencoe and Shortlands. These soils have deep red or yellow-brown B-horizons with minimal structure, but in the case of Shortlands soils the B-horizon has some degree of structure. These soils drain well and provide excellent to moderate cultivation opportunities. Each of the soils is described in detail below.

Hutton and Clovelly Soil Forms

Hutton's are identified based on the presence of an apedal (structureless) "red" B-horizon and Clovelly's with an apedal "yellow" B-horizon as indicated in Figure 12 below. These soils are the main agricultural soil in the country due to the deep, well-drained nature of these soils.

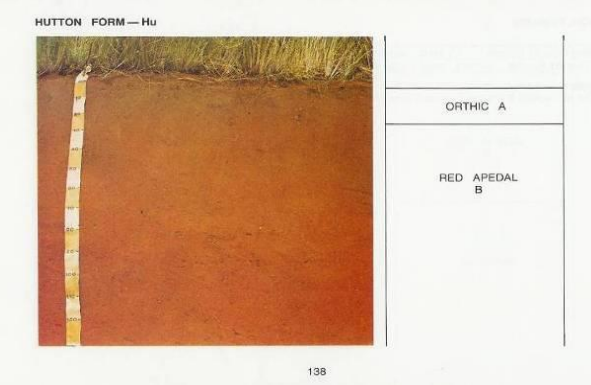


Figure 12: Hutton and Clovelly soil forms (Soil Classification, 1991)

Avalon and Bainsvlei Soil Forms

The Avalon and Bainsvlei soil forms are characterised by the occurrence of a soft plinthic B – horizon (See Figure 14). The Avalon has a yellow-brown B-horizon while the Bainsvlei has a red apedal B-horizon. These horizons are the same as described for the Hutton and Clovelly soils above. The plinthic horizon has the following characteristics:

- Has undergone localised accumulation of iron and manganese oxides under conditions of a fluctuating water table with clear red-brown, yellow-brown or black strains in more than 10% of the horizon;
- Has grey colours of gleying in or directly underneath the horizon; and
- Does not qualify as a diagnostic soft carbonate horizon.

These soils are found lower down the slopes than the Clovelly and Hutton soils and indicate the start of the soils with clay accumulation.

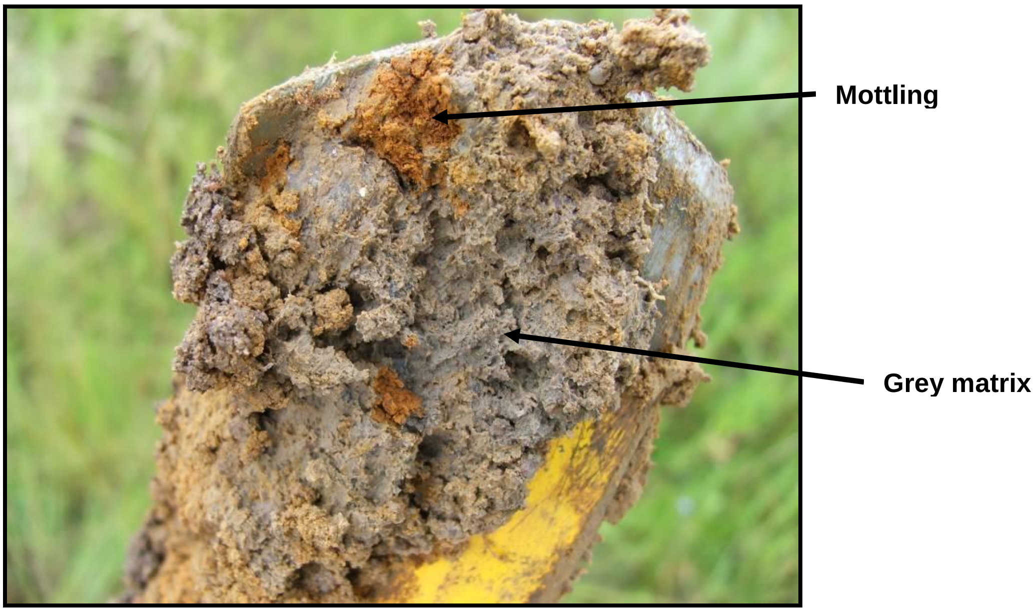


Figure 13: Soft plinthic B-horizon.

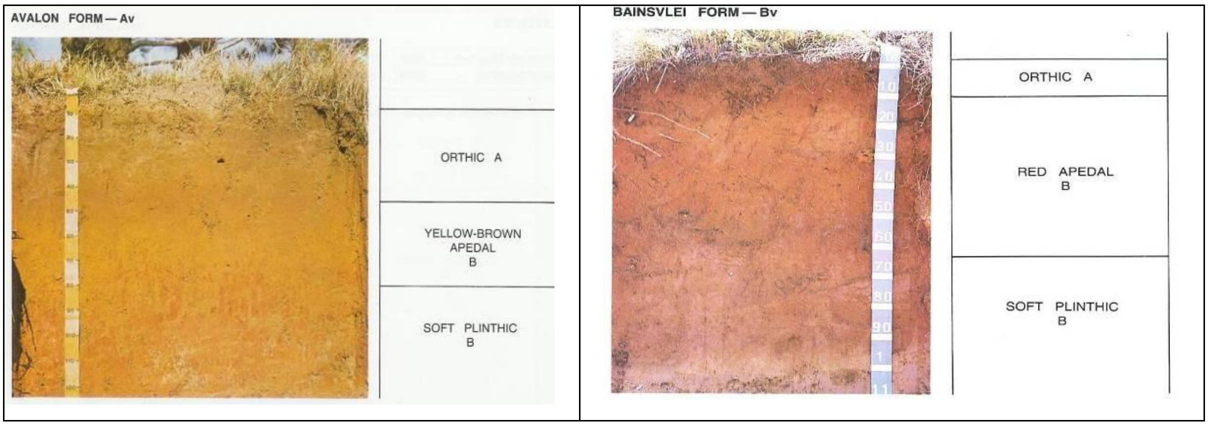


Figure 14: Avalon and Bainsvlei Soil Forms (Soil Classification, 1991)

Glencoe:

The Glencoe soil form is found in areas where the soft plinthic B-horizon of an Avalon has hardened irreversibly into Hard Plinthite (Ferricrete). Refer to Figure 15 for an illustration of this soil form.

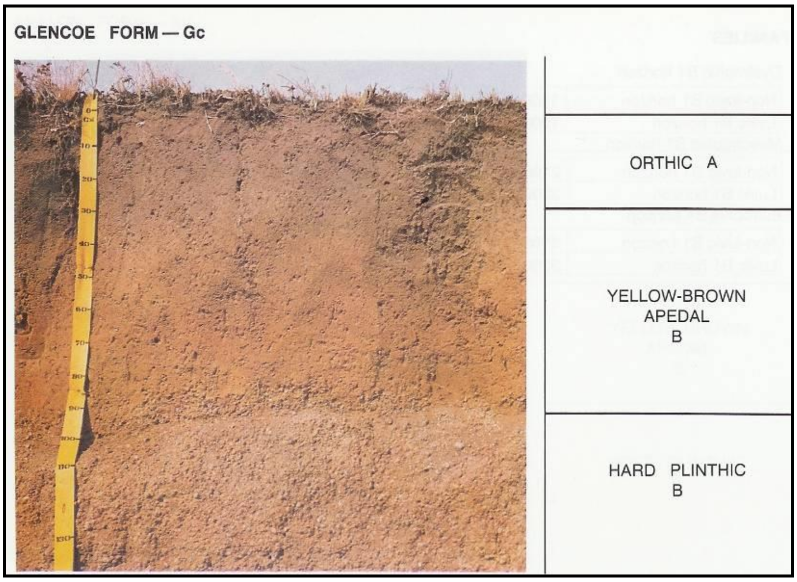


Figure 15: Glencoe Soil Form (Soil Classification, 1991)

Shortlands:

The Shortlands soil form has an Orthic A Horizon over a Red structured B Horizon as illustrated in Figure 16. These soils are very similar to the Hutton soils, the only difference being the formation of a structure in the B-horizon.

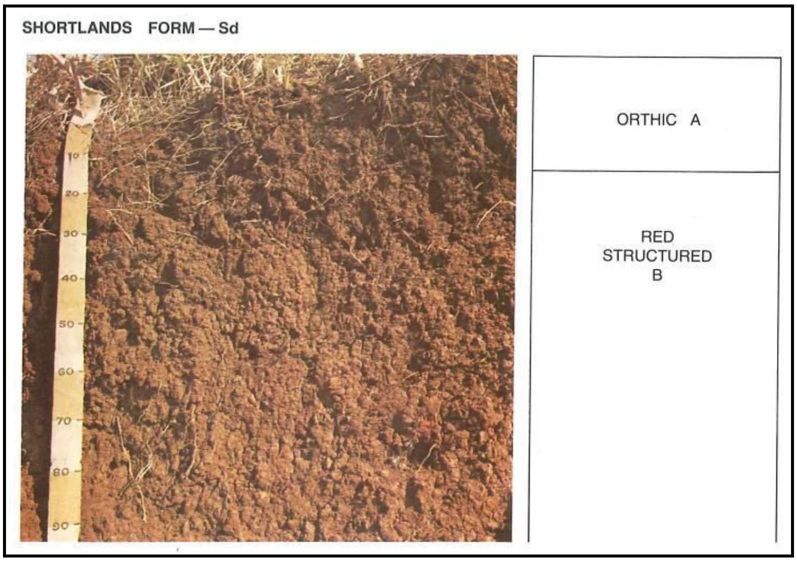


Figure 16: Shortlands Soil Form (Soil Classification, 1991)

Rocky Soils

The rocky soil management unit is made up of soils that are generally shallow and that overlie an impeding layer such as hard rock or plinthite. These soils are not suitable for cultivation and in most cases are only usable as light grazing. The unit comprises the following soil forms:

- Mispah (Orthic A horizon over hard rock);
- Milkwood (Melanic A horizon over hard rock);
- Dresden (Orthic over hard plinthic);

Mispah

The Mispah soil form is characterised by an Orthic A – horizon overlying hard rock. These soils are especially prevalent in the northern and central parts of the site and are commonly found on rocky ridges our outcrops. Please refer to Figure 17 for an illustration of a typical Mispah soil form.

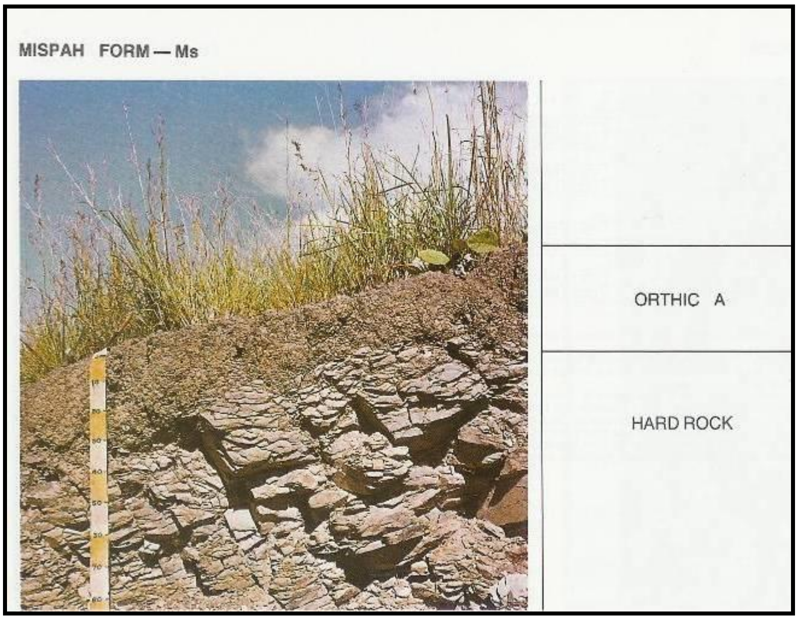


Figure 17: Mispah soil form (Memoirs on the Natural Resources of South Africa, no. 15, 1991).

Milkwood

The Milkwood soil form is characterised by a Melanic A horizon overlying hard rock. These soils dominate the southern parts of the site as they predominantly form from the Dolerite geology. Due to the underlying hard rock, these soils have limited cultivation potential and are most often used for grazing.

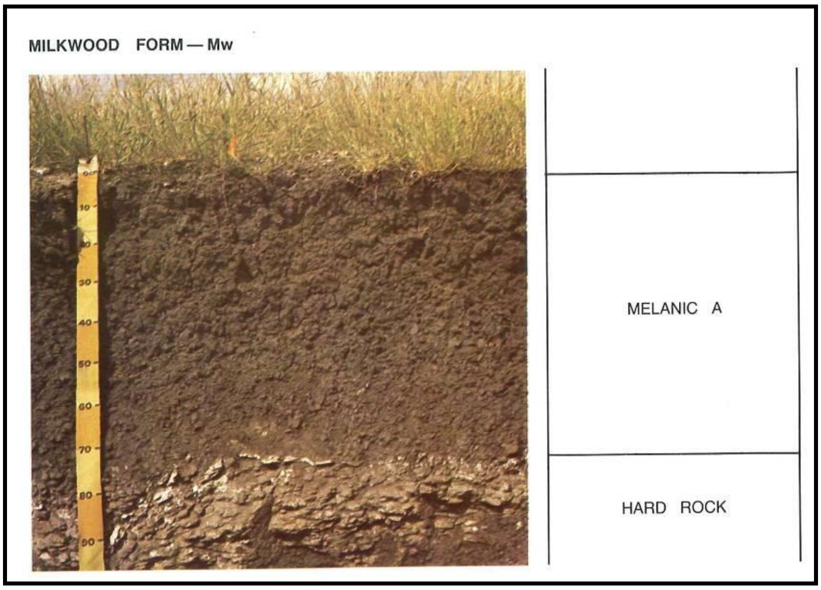


Figure 18: Milkwood soil form (Soil Classification, 1991)

Dresden

The Dresden soil form is characterised by a hard plinthic B-horizon (aka Ferricrete). This horizon develops when a soft plinthic horizon dries out and hardens irreversibly. These shallow soils have very limited potential and are mostly used for light grazing or wildlife.

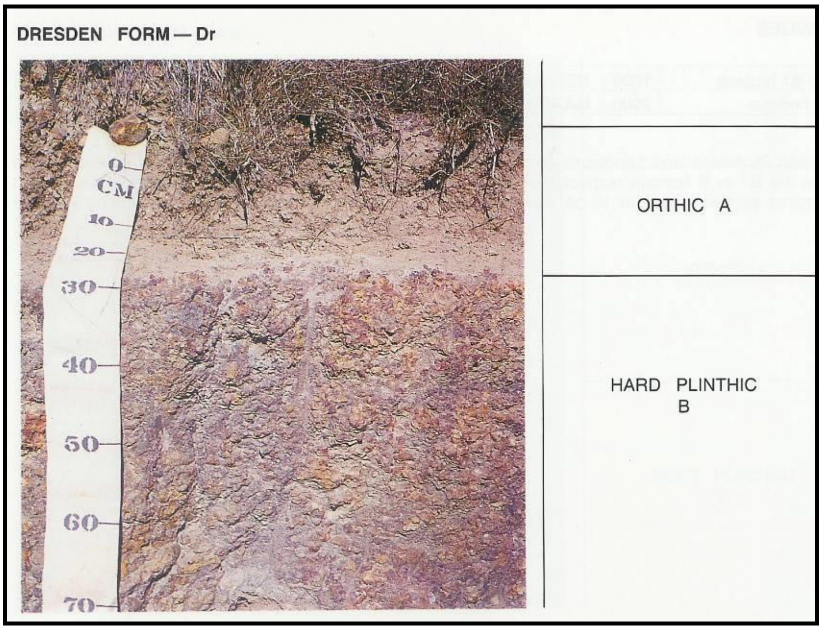


Figure 19: Dresden Soil Form

Transitional Soils

The transitional soil management unit comprises the soils found between clay soils and the agricultural soils. These soils often have signs of clay accumulation or water movement in the lower horizons. These soils are usually indicative of seasonal or temporary wetland conditions. Soil forms in this unit include:

- Longlands;
- Wasbank;
- Kroonstad; and
- Westleigh;

Wasbank, Kroonstad, Longlands and Westleigh Soil Forms

The Wasbank, Kroonstad and Longlands soil forms are all typified by an eluvial horizon, while the Westleigh soil form has a shallow soft plinthic horizon. These are also recognized as potential wetland soils. The E-horizon is a horizon that has been washed clean by excessive water movement through the horizon, while the soft plinthic horizon is formed by the accumulation of clays moving through the soil medium. These soils occur adjacent to the drainage channels found on site. Refer to Figure 7 for an illustration of these soil types.

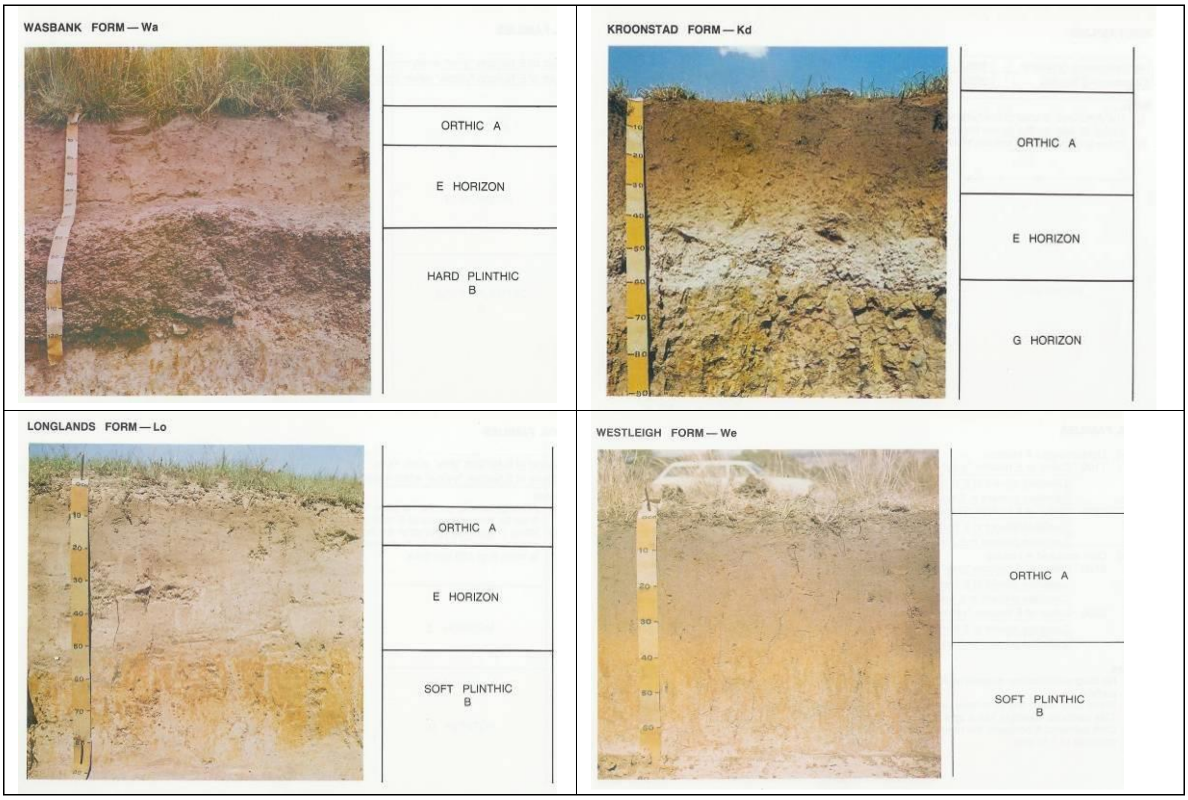


Figure 20: Wasbank, Kroonstad, Longlands and Westleigh Soil Forms (Soil Classification)

Clay Soils

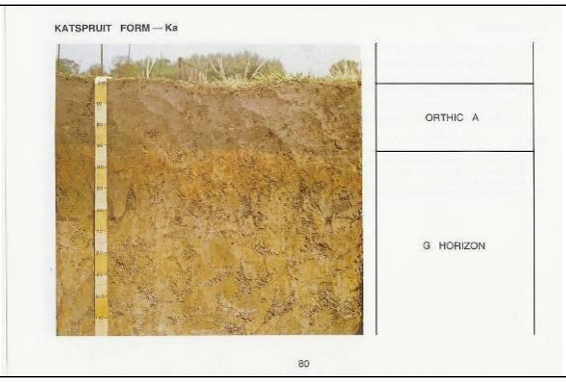
The clay soil management unit is found in areas where clays have accumulated to such an extent that the majority of the soil matrix is clays. These soils are usually indicative of seasonal or permanent wetland conditions. Soil forms in this unit include:

- Rensburg;
- Arcadia;
- Inhoek;
- Katspruit;
- Willowbrook;
- Sterkspruit ; and
- Steendal;

Katspruit and Willowbrook Soil Forms

The Katspruit and Willowbrook soil forms are found in areas of semi-permanent wetness. These soils are typified by an Orthic A horizon (Katspruit) or a Melanic A horizon (Willowbrook) over a diagnostic G horizon, as indicated in Figure 21. The G horizon has several unique diagnostic criteria as a horizon, including:

- 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.



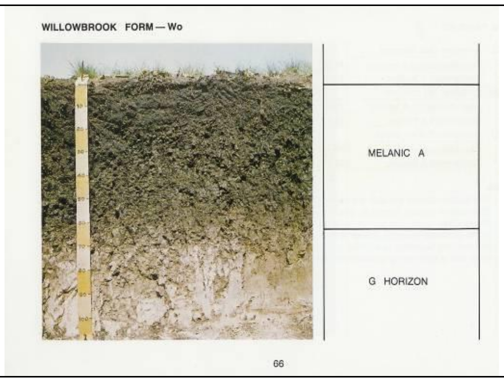


Figure 21: Katspruit and Willowbrook Soil forms (Soil Classification, 1991)

Rensburg and Arcadia soil forms

Arcadia and Rensburg soils are characterised by a vertic A-horizon. In the Rensburg the Vertic A is underlain by a G-horizon as described above, while the Arcadia is a pure vertic horizon. The Vertic horizon has several unique diagnostic criteria as a horizon, namely:

- Has strong developed structure
- Has at least one of the following:
  - Clearly visible, regularly occurring slicken sides in some part of the horizon or in the transition to an underlying layer
  - A plasticity index greater than 32 (using the SA Standard Casagrande cup to determine liquid limit), or greater than 36 (using the British Standard cone to determine liquid limit).

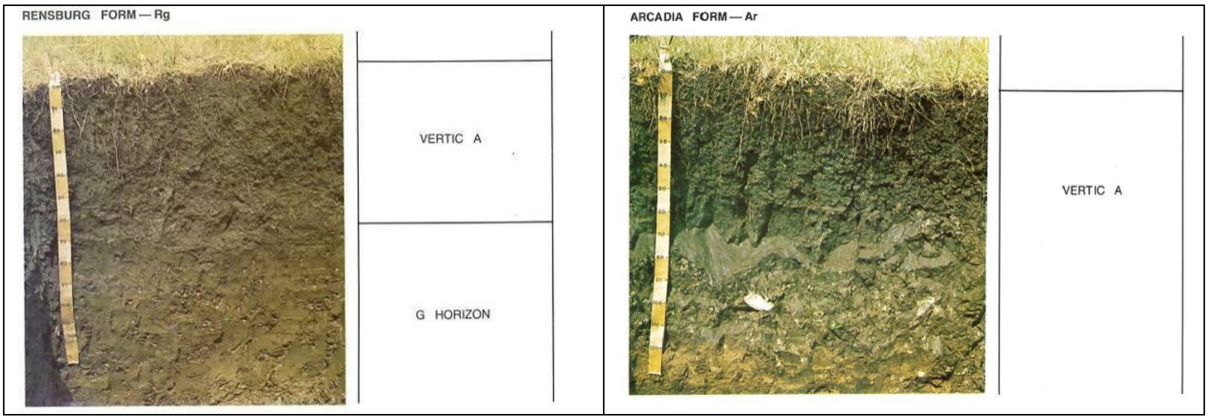


Figure 22: Rensburg and Arcadia soil forms (Soil Classification, 1991)

Inhoek and Steendal Soil Forms

The Inhoek and Steendal soil forms are typified by a Melanic A horizon. The Melanic horizon is characterised by the following:

- Dark colours in the dry sate with a value and chroma of 3 or less with the exception of 10YR 3/3 and colours redder than 5YR;
- No slickensides present as in the vertic clays;

In the case of the Steendal soil form the Melanic A horizon is underlain by a soft carbonate B horizon. This horizon is formed by the accumulation of carbonates in the horizon to such an extent that it dominates the morphology of the soil form. Please refer to Figure 23 for an illustration of the soil types.

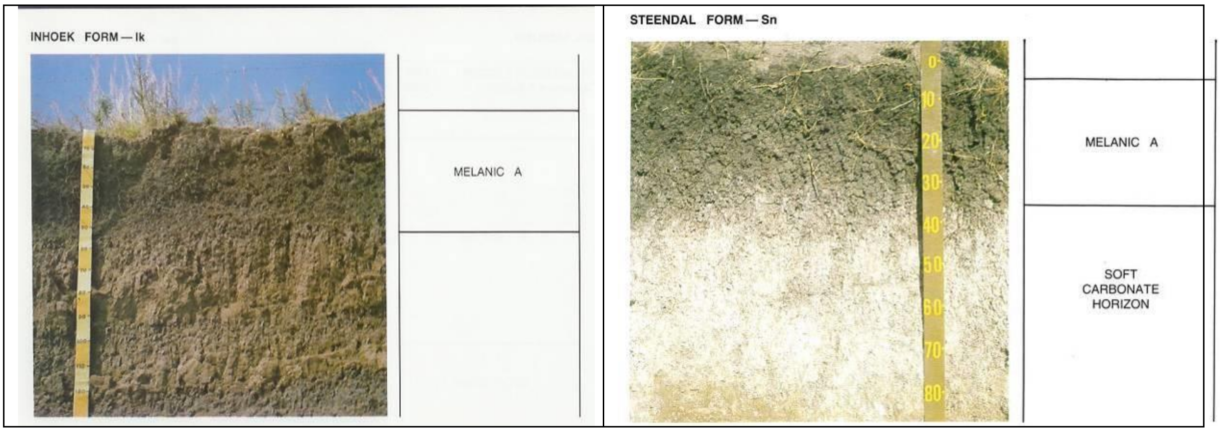


Figure 23: Inhoek and Steendal soil forms (Soil Classification, 1991)

Sterkspruit:

The Sterkspruit soil form has an Orthic A Horizon over a Prismacutanic B Horizon over Saprolite with calcareous characteristics as illustrated in Figure 24 below. The effective depth is less then 40cm due to the strong clay accumulations. These soils are marginal and suitable only for grazing. These soils were predominantly found along a stream in the central part of the site.

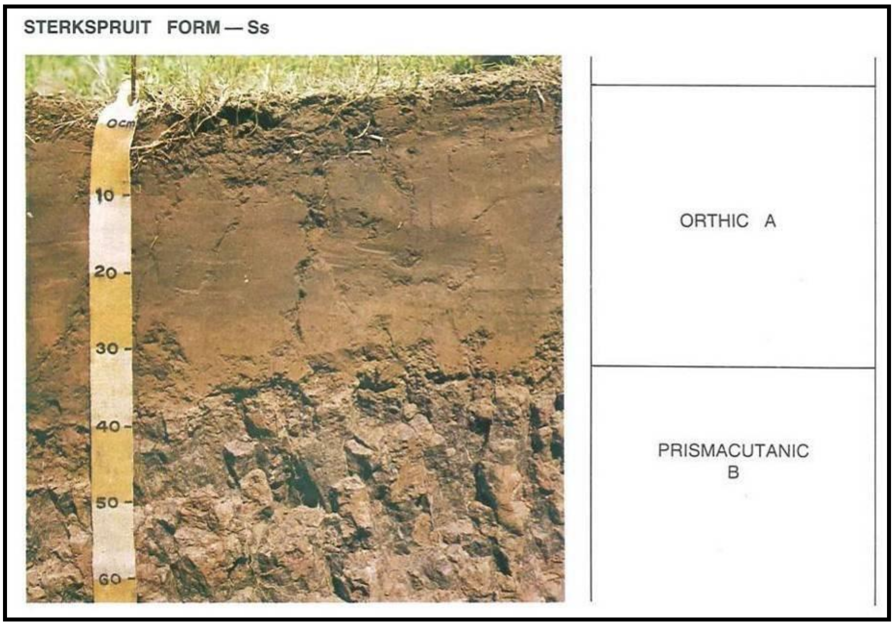


Figure 24: Sterkspruit Soil Form (Soil Classification, 1991)

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 II soils with few limitations. This is evident in 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 II – cultivation and class V and VII – grazing. The class II soils are suitable for cultivation and can be used for a wide range of agricultural applications. The class *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. Figure 25 illustrates the various land capability units on site.

Table 3: Land Capability of the soils on site for agricultural use

Management unit	Agricultural	Transitional	Disturbed	Clay
Area (ha)	20 810	114 212	1 220	30 555
% of site	12.5	68.5	0.7	18.3
Rock Complex		Yes – hard plinthic	Possible	
Flooding Risk	F1 – None	F2 – Rare	F2 – Rare	F4 - Common
Erosion Risk	E2 – Low to Moderate	E5 – Moderate to High	E5 – Moderate to High	E1 - Low
Slope %	2 – 10 %	2 – 10 %	2 – 20 %	0 – 5 %
Texture	T1 – 15 – 45% Clay	T1 – 15 – 45% Clay	T1 – 15 – 45% Clay	T3 - >55% Clay
Depth	D1 - > 70 cm	D2 – 60 – 80 cm	D2 – 60 – 80 cm	D3 – 40 – 60 cm
Drainage	W2-3 Well – Imperfectly drained	W4 – Somewhat poorly drained	W4 – Somewhat poorly drained	W5 – Poorly drained
Mechanical Limitations	MB0 - None	MB3 – Shallow soils on rock	MB3 – Shallow soils on rock	MB0 - None
pH	pH > 5	pH > 5	pH > 5	pH > 5
Soil Capability	II -	VII	VII	V
Climate Class	C2	C2	C2	C2
Land Capability	**II – Arable Land**	**VII – Light Grazing**	**VII – Light Grazing**	**V - Grazing**

No limitation	Low to Moderate	Moderate	High	Very Limiting

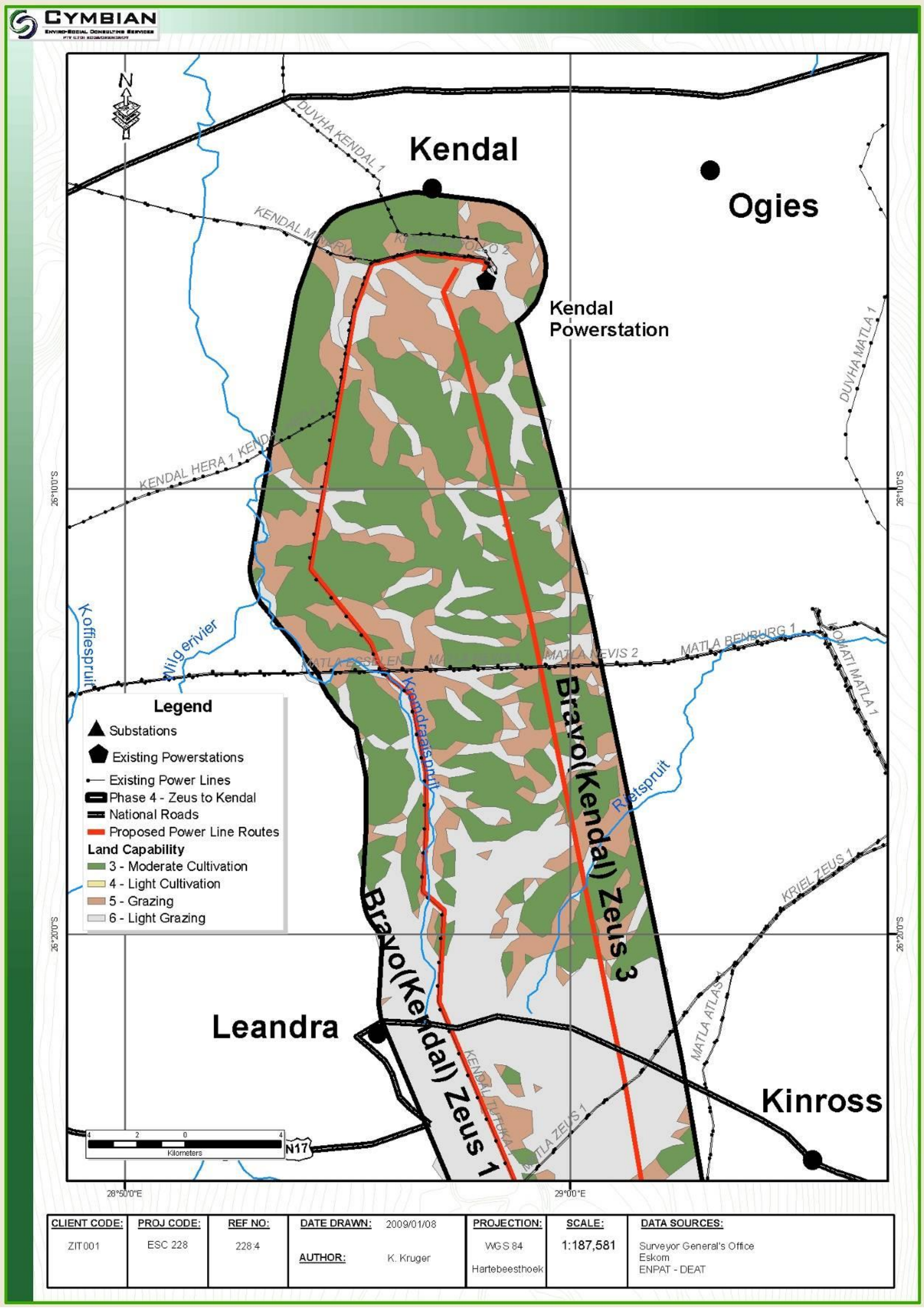


Figure 25: Land Capability Map of the northern section

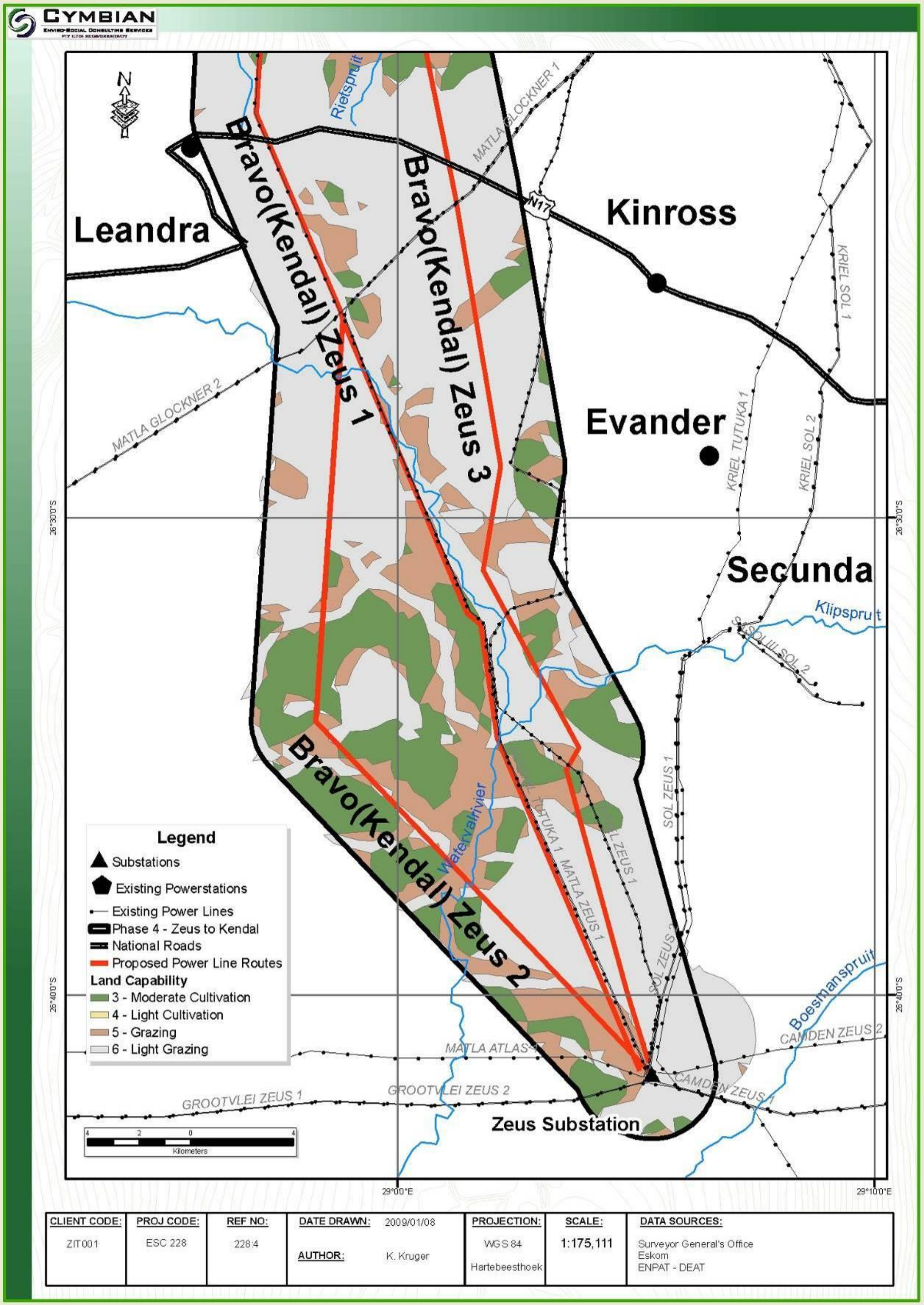


Figure 26: Land Capability Map of the southern section

3.7 Land Use

3.7.1 Data Collection

The Land Use data was obtained from the CSIR Land Cover database and supplemented with visual observations on site.

3.7.2 Site Description

The Land-Use is dominated by cultivated fields (maize), grazed grasslands, urban centres, coal mines and power stations. From the pictures (Figure 27) and map below (Figure 28 and Figure 29) it can be seen that the proposed routes traverses the entire spectrum of land uses found. Water bodies are the only land use regarded as sensitive and as such certain mitigatory measures will be outlined in Section 8.

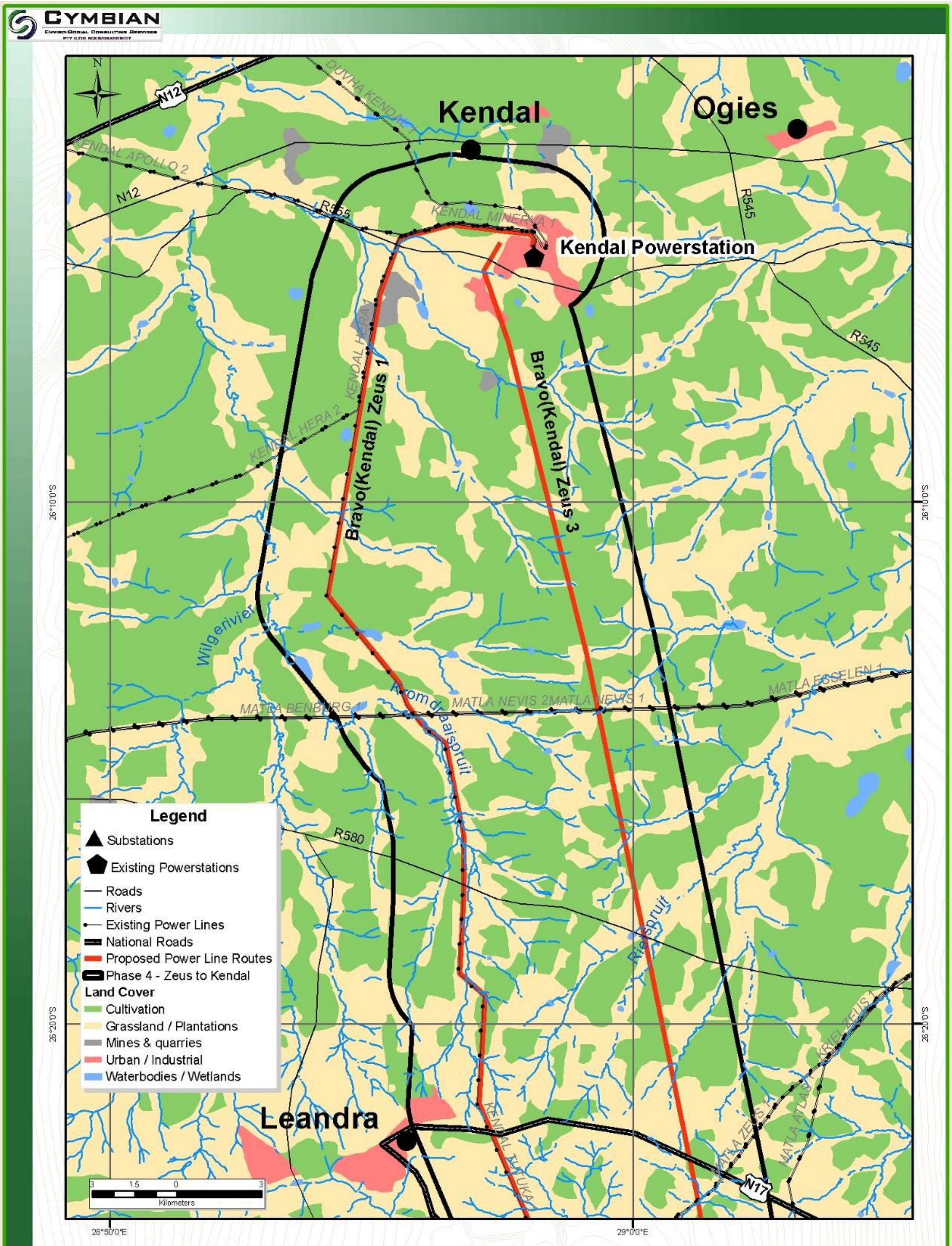
Ploughed fields in the foreground with the Kendal power station in the background.

Commercial centre at Roodebank.

Grazing land found on grasslands.

Old gold mine dump.

Figure 27: Land Uses encountered in the study site



CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2009/01/08	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	ESC 228	228:4	AUTHOR: K. Kruger	WGS 84 Hartebeesthoek	1:164,911	Surveyor General's Office Eskom WR 90

Figure 28: Land Use Map of the northern section of the site

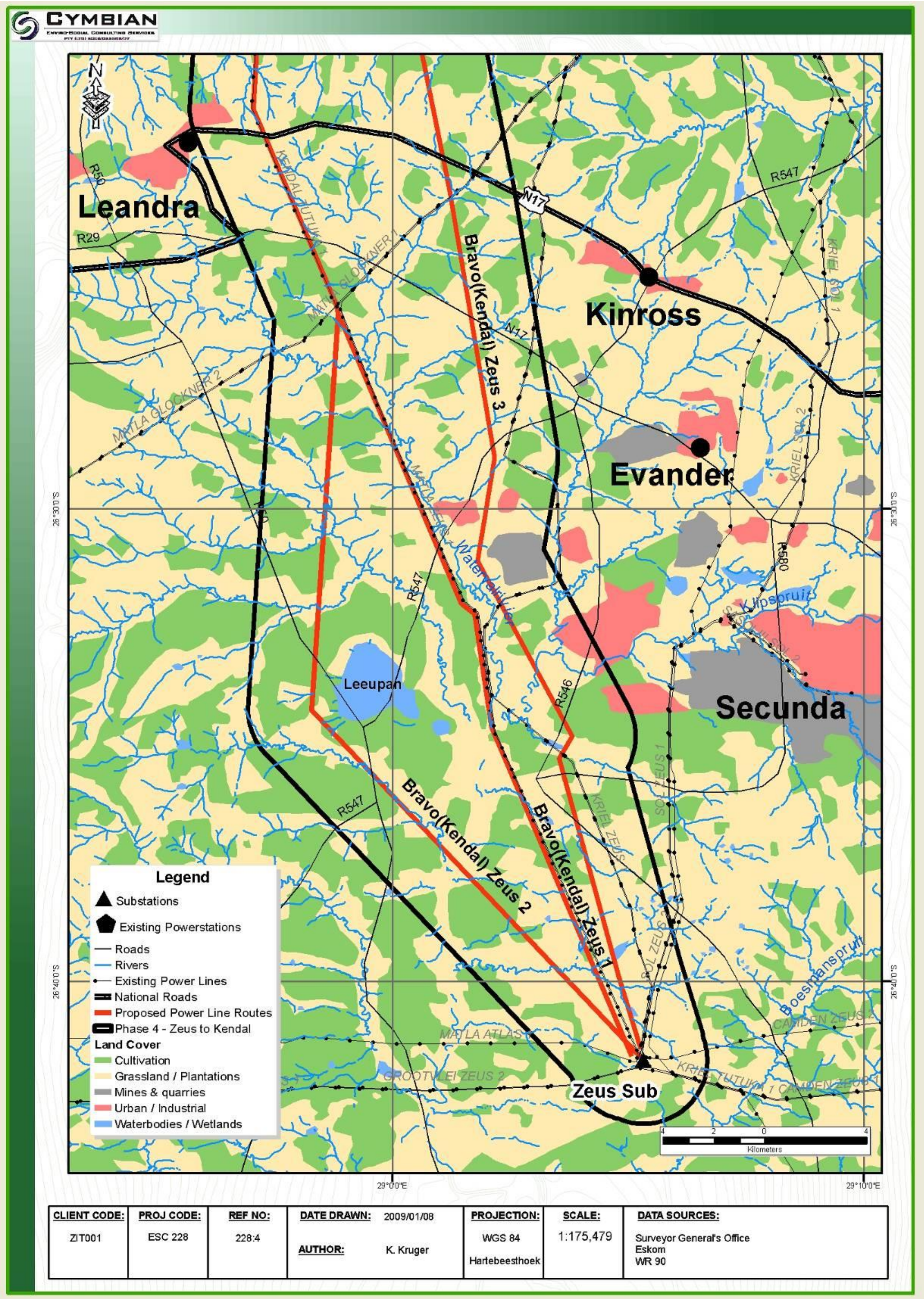


Figure 29: Land Use Map of the southern section of the site

From Figure 28 and Figure 29 above in can be seen that Alternatives 1 and 2 avoid agricultural land by following the drainage lines found in the area. Alternative 3 crosses over agricultural land but in so doing, avoids extensive periods of traversing in drainage lines. As wetlands, rivers and streams are seen as sensitive, it is suggested that the Alternative 3 alignment be utilised from a land use perspective.

3.8 Flora

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 two site visits conducted on the 8th – 12th September 2008 and the 3rd – 7th November 2008. 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 main vegetation types found in the region are the Soweto Highveld Grassland, Rand Highveld Grassland, Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands vegetation units as classified by Mucina and Rutherford[2]. Each of these vegetation units are described in more detail below.

Soweto Highveld Grassland

The Soweto Highveld Grassland is found in the Mpumalanga and Gauteng Provinces in a broad band roughly delineated by the N17 Highway in the north, Perdekop in the southeast and the Vaal River in the south. The landscape is typical of the gently undulating Highveld plateau which supports dense tufted grassland dominated by *Themeda triandra, Elionurus muticus, Eragrostis racemosa, Heteropogon contortus and Tristachya leucothrix.* This grassland is only interrupted by wetlands, occasional ridges and agricultural activities.

This vegetation type is endangered as almost no conservation of the vegetation type occurs. An estimated 45% of the vegetation type has already been transformed by cultivation, urban sprawl and mining.

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 Witbank, 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.*

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

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 (most prominently *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*. Once again 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.

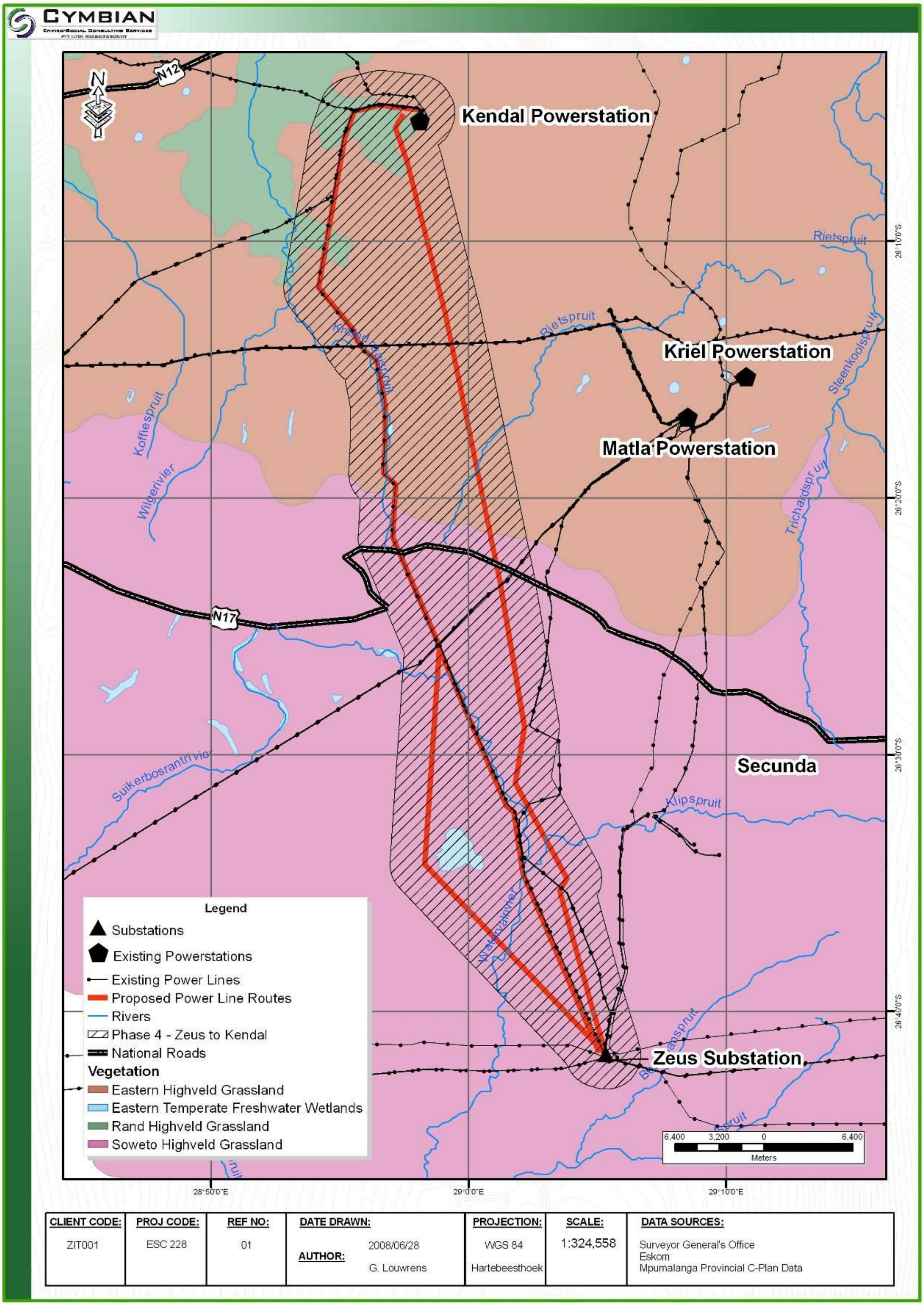


Figure 30: Main Vegetation types of the region

3.8.3 Site Description

Four main vegetation types were identified, namely anthropogenic grassland, moist grassland, riparian vegetation and grazed grassland. Each of these vegetation types are described in more detail below and illustrated in Figure 35 below. The species list for the site is attached in Appendix 1. The species that could occur in the quarter degree grids 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 198 species have been documented in the area with 103 confirmed species under the proposed routes.

***Hyparrhenia hirta* Anthropogenic Grassland (Grazed and Cultivated Fields)**

This tall grassland occurs over vast areas throughout Gauteng and the surrounding highveld. Disturbed grassland or other disturbed areas such as road reserves or fallow fields, not cultivated for some years, are also usually *Hyparrhenia* dominated (Coetzee et al. 1995; Bredenkamp & Brown 2003).

This *Hyparrhenia* – dominated grassland may appear to be quite natural, but they are mostly associated with an anthropogenic influence from recent or even iron-age times. This grassland is characterised by the tall growing dominant Thatch grass (*Hyparrhenia hirta*), and Bankrupt Bush (*Stoebe vulgaris*), an invader dwarf shrub which usually indicates grassland's degraded condition (Bredenkamp & Brown 2003).

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 Aristida congesta*. Forbs are rarely encountered, though a few individuals of species such as *Anthospermum rigidum, Conyza podocephala, Crabbea angustifolia and Helichrysum rugulosum* are often present (Bredenkamp & Brown 2003).

Figure 31 below provides an illustration of the *Hyparrhenia* grassland unit found among the ploughed fields in this case. In Figure 35 and Figure 36 this vegetation unit is illustrated by the cultivated fields.

Figure 31: ***Hyparrhenia*** **grassland**

Invaded grassland

The invaded grassland unit has arisen from the inherent susceptibility of the natural grassland of the region to be invaded by alien plants. In several places along the route the natural grassland has been invaded to such an extent that the vegetation is dominated by the alien invasive species. The most common aliens are *Acacia mearnsii (Black Wattle), Populus x canescens (Poplar), Tagetes minuta (Khaki bush), Bidens pilosa (Blackjack), Eucalyptus (Blue Gum) and Salix babylonica (Wattle).* This vegetation type is found in small pockets throughout the study site.

Figure 32: Invaded Grassland

Moist Grassland

The *Eragrostis plana* Grassland is well represented occurring mainly in high rainfall parts. This grassland type is a moist grassland, usually restricted to flat plains or bottomlands, mostly on moist, deep, clayey and poorly drained, seasonally wet soils, adjacent to wetlands , seasonal as well as perennial rivers. These habitats are often fairly unstable due to seasonal flooding and drying, which, together with frequent overgrazing, cause degradation of the vegetation (Bezuidenhout & Bredenkamp 1990).

Figure 33: Eragrostis Plana Moist Grassland

Eragrostis plana is conspicuous, often dominant member of this grassland type (Figure 33). *Paspalum dilatatum*, and the rhizomatous *Cynodon dactylon*, often presents in degraded sites, are also diagnostic, as well as the forbs *Crabbea acaulis, Berkheya radula, B. pinnatifida and Trifolium africanum.* Grass species such as *Eragrostis curvula, Themeda triandra, Setaria sphacelata and Digitaria eriantha* are often abundantly present, and may be locally dominant, while forbs are generally quite rare (Coetzee et al. 1995; Bredenkamp & Brown 2003).

Drainage areas and wetland communities

Drainage areas are seasonally wet areas that occur in low-lying 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. Here hydrophytes can be found. 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 34).

Figure 34: Seepage Area

Grazed Grasslands

In addition to the above vegetation types found on site, a few remaining patches of Soweto Highveld Grassland, Rand Highveld Grassland and Eastern Highveld Grassland are also found in between the cultivated fields and the streams. These grasslands are often used for grazing but the species composition remains as described in Section 3.8.2 above.

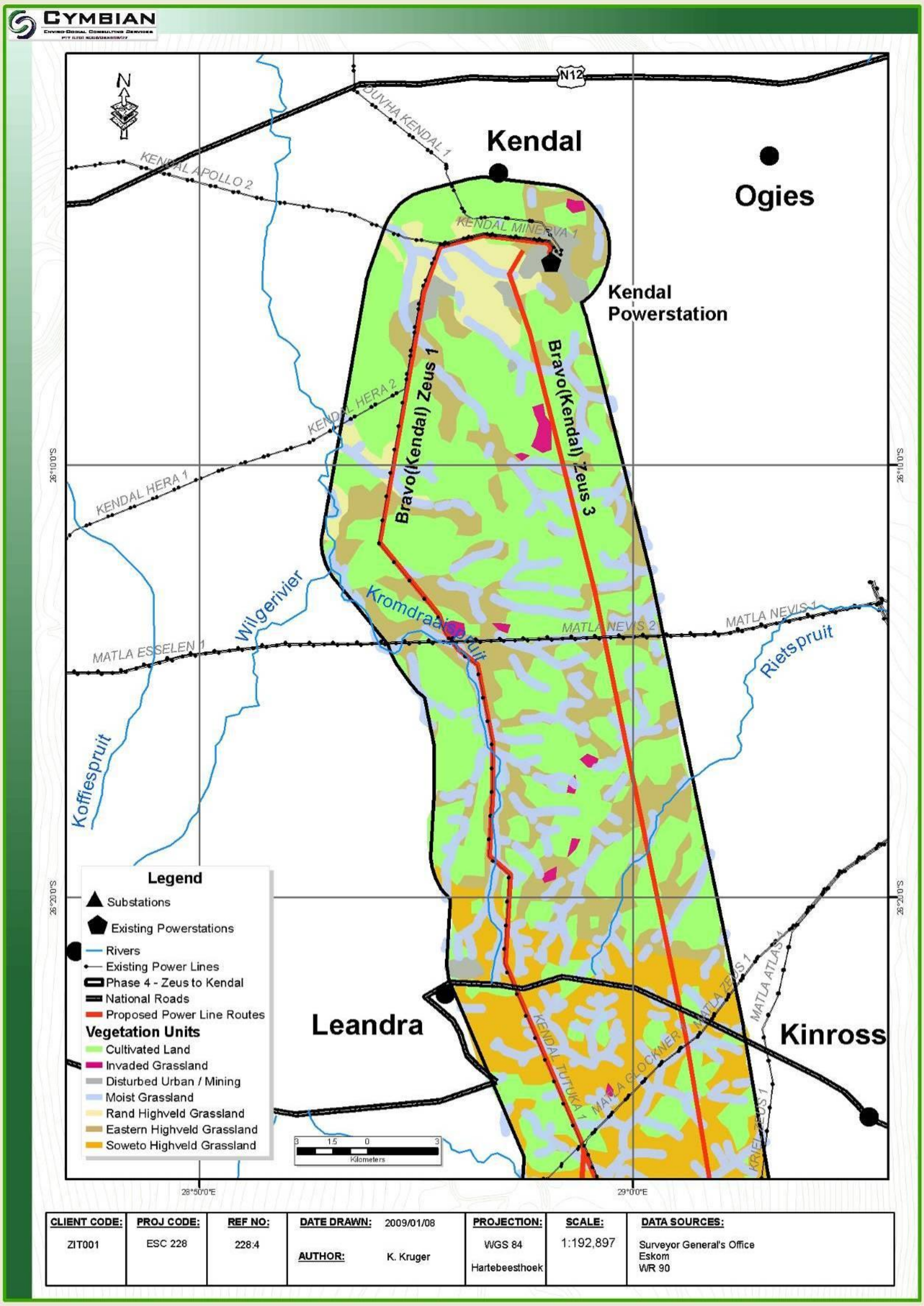


Figure 35: Vegetation units of the northern section of the site.

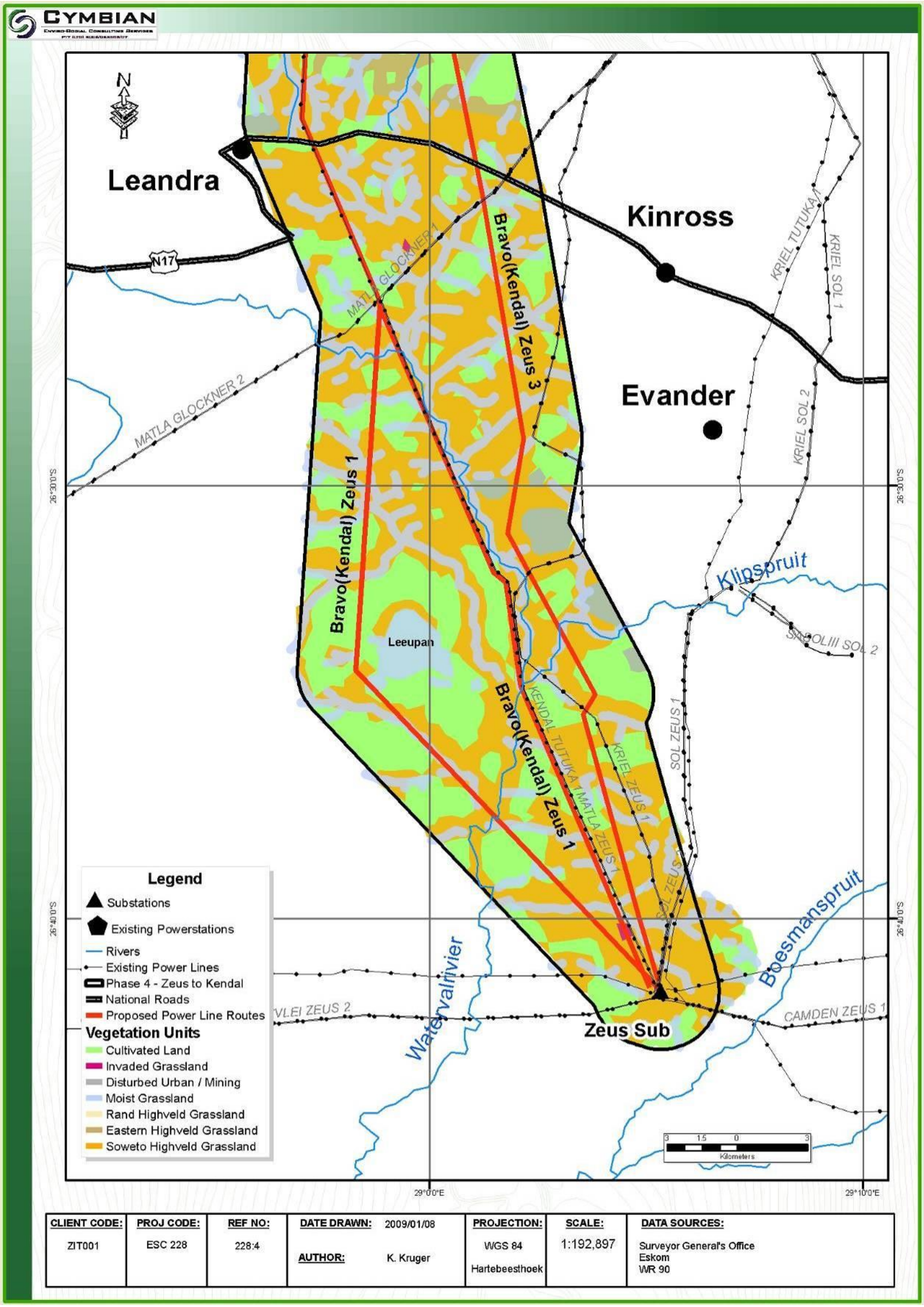


Figure 36: Vegetation units of the southern section of the site.

3.8.4 Sensitive Flora

During the site assessment, special efforts were made to identify sensitive or endangered vegetation along the routes. No red data species were found along the routes but that does not exclude the potential for such species to occur. The nature of the vegetation in the area is such that the bulk of the sensitive species are associated with wetlands and streams. Therefore it is suggested that all stream and wetlands be buffered by 100m. This figure is the standard buffer zone required by the Department of Water Affairs and Forestry (DWAF) for areas outside of the urban edge.

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 visits conducted on the 8^{th} – 12^{th} September 2008 and the 3^{rd} – 7^{th} November 2008. In addition and specialist avifauna report was compiled by Mr. Chris van Rooyen[3].

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, mongoose, 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 study area 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] Bird Impact Assessment Study, Bravo Integration Project: Phase 4, December 2008.

3.9.3 Site Description

The scope of work indicated that an avifauna assessment was required. This section details the avifauna assessment as well as the herpetofauna and mammals observed on site.

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 dryland cultivation of grazing of livestock. The largest portion of the site is comprised of disturbed grassland, totalling approximately 61.7 % of the study site. The remainder of the site comprises rocky and moist grassland as well as seepage zones and wetlands. All of these are suitable habitat to a number of protected species found in the region.

Species observed on site

A detailed list of the species observed on site is attached in **Error! Reference source not found.**.

Herpetofauna

Herptofauna could potentially occur in all four habitat types. The seepage zones and wetlands could potentially support amphibians representative of the region. The quarter degree squares are known to contain *Agama atra (*Southern Rock Agama*), Bitens arietans* (Puff Adder)*, Hemachatus haemachatus* (Rinkhals), *Causus rhombeatus* (Common Night Adder)*, Lycodonomorphus rufulus* (Common Brown Water Snake), *Aparallactus capensis* (Cape Centipede Eater), *Cordylus vittifer* (Transvaal Girdled Lizard)*, C. vandami* (Van Dam's Girdled Lizard), *Varanus niloticus (*Water Monitor), *Pachydactylus capensis (*Cape Thick-toed Gecko), *Leptotyphlops conjunctus conjunctus* (Cape Thread Snake) and *Mabuya capensis* (Cape Skink). *Hemachatus haemachatus* (Rinkhals) and *Leptotyphlops conjunctus conjunctus* (Cape Thread Snake) are endemic to Southern Africa. During the site visit the only one of the species above that was observed was a *Hemachatus haemachatus* (Rinkhals).

Avifauna

Avifauna on site was identified during the site visits. Table 4 below provides a list of the species observed as well as their occurrence. In addition to the site observations, a detailed specialist study was undertaken and is attached in Appendix 2.

Table 4: Avifauna Species List

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

In total 32 bird species were identified during the site investigations, including some sensitive species which are discussed in more detail in Section 3.9.4. The species 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.

Mammals

Several mammal species were observed on site, and it was notable that most of the species were limited to a game farm just north of the Zeus substation. Smaller mammals such as mongoose were found throughout the site. The species identified are listed below.

Table 5: Mammal Species List

Species	Common name	Occurrence
Antidorcas marsupialis	Springbok	Herd
Damaliscus dorcas phillipsi	Blesbok	Herd
Cynictis pencillata	Yellow Mongoose	Individuals
Orycteropus afer	Aardvark / Antbear	Individuals
Connochaetes taurinus	Blue wildebeest	Herd
Hystrix africaeaustralis	Porcupine	Individual
Ceraottherium simum	White Rhinoceros	Individuals

Figure 37: Fauna including springbok (left) and Blue wildebeest (right)

3.9.4 Sensitivities and power line interactions

The impacts to fauna are experienced in a number of ways, but due to the placement of the power lines on pylons the impacts are largely limited to avifauna. The construction and erection of the pylons could impact on habitat for ground dwelling fauna, but due to the large number of existing power lines in the area, this is a low possibility. Therefore the focus will be on the avifauna component.

The Red Data bird species that occur within the study area were recorded by the Bird Atlas project and are listed in Table 6 below. The species that could potentially be impacted on by the power lines are shaded in grey.

Table 6: Red data bird species

Species	Reporting rate %	Conservation status (Barnes 2000)	Habitat requirements (Barnes 2000; Hockey *et al* 2005; Harrison *et al* 1997; Young *et al* 2003; personal observations)
YELLOW-BILLED STORK *Mycteria ibis*	2628BB:7.4 2628BD:2.7 2628DB:8.7 2629AC:4.1 2629CA:4.0	near threatened	Always associated with water – dams, wetlands, rivers, marshes, even small pools. Could be present at larger water bodies e.g. Leeuwpan. Vulnerable to collisions.
PINK-BACKED PELICAN	2628BB:- 2628BD:- 2628DB:- 2629AC:- 2629CA:1.3	vulnerable	Always associated with large water bodies. Could be present at larger water bodies e.g. Leeuwpan. Vulnerable to collisions.
LANNER FALCON *Falco biarmicus*	2628BB:- 2628BD:1.8 2628DB:1.1 2629AC:1.4 2629CA:0.7	near threatened	Generally prefers open habitat, but exploits a wide range of habitats. Will nest in wooded areas if suitable cliffs are present. No negative interaction expected, except possible breeding on crow nests on the proposed lines.
WATTLED CRANE *Bugeranus carunculatus*	2628BB:- 2628BD:- 2628DB:1.1 2629AC:- 2629CA:-	critically endangered	Shallow wetlands with extensive short emergent vegetation. To a lesser degree in natural grassland and croplands. No suitable habitat along the alignment. Vagrant to the area.
BLUE KORHAAN *Eupodotis caerulescens*	2628BB:1.9 2628BD:10.8 2628DB:14.1 2629AC:- 2629CA:12.7	near threatened	Grasslands, pastures and cultivated fields. Vulnerable to collisions.
GREATER PAINTED SNIPE *Rostratula benghalensis*	Not recorded by Bird Atlas but recorded by CWAC	near threatened	Various aquatic habitats, preferring exposed mud adjacent to cover. Recorded at Leeuwpan. No interactions expected.
BLACK-WINGED PRATINCOLE *Glareola nordmanni*	2628BB:3.7 2628BD:3.6 2628DB:1.1 2629AC:2.0 2629CA:3.3	near threatened	Agricultural landscapes, ploughed lands. No interactions expected.
MELODIOUS LARK Mirafra cheniana	2628BB:- 2628BD:- 2628DB:1.1 2629AC:- 2629CA:-	near threatened	Open climax Themeda grassland, pastures and fallow lands. Vulnerable to habitat destruction and disturbance.

Species	Reporting rate %	Conservation status (Barnes 2000)	Habitat requirements (Barnes 2000; Hockey *et al* 2005; Harrison *et al* 1997; Young *et al* 2003; personal observations)
BLACK STORK Ciconia nigra	2628BB:- 2628BD:- 2628DB:- 2629AC:- 2629CA:1.3	near threatened	Associated with rivers, dams and cliffs. Could be present at larger water bodies e.g. Leeuwpan. Vulnerable to collisions.
SECRETARYBIRD Sagittarius serpentarius	2628BB:5.6 2628BD:6.3 2628DB:10.9 2629AC:6.1 2629CA:7.3	near threatened	Prefer open grassland, densities low in maize growing areas. Was recorded during field visits in the study area. Vulnerable to collisions.
WHITE-BELLIED KORHAAN Eupodotis senegalensis	2628BB:3.7 2628BD:1.8 2628DB:5.4 2629AC:- 2629CA:0.7	vulnerable	Often in the interface between grassland and savanna. Avoids severely grazed and recently burnt sites. Vulnerable to collisions.
LESSER FLAMINGO Phoenicopterus minor	2628BB:0.9 2628BD:0.9 2628DB:5.4 2629AC:0.7 2629CA:7.3	near threatened	Moves extensively between water bodies. May be found in small numbers on any suitable dam. Vulnerable to collisions.
GREATER FLAMINGO Phoenicopterus ruber	2628BB:2.8 2628BD:2.7 2628DB:21.7 2629AC:5.4 2629CA:17.3	near threatened	Moves extensively between water bodies. May be found in small numbers on any suitable dam. Vulnerable to collisions.
LESSER KESTREL Falco naumanni	2628BB:11.1 2628BD:9.9 2628DB:8.7 2629AC:10.2 2629CA:10.0	vulnerable	No negative impacts expected from power line. Small and nimble species, likely to use the power line as hunting perch.
AFRICAN GRASS-OWL Tyto capensis	2628BB:- 2628BD:1.8 2628DB:1.1 2629AC:- 2629CA:2.0	vulnerable	Likely to be found in rank grass adjacent to wetlands. Could be vulnerable to collisions with power line as potentially suitable habitat could exist in wetlands. Also vulnerable to habitat destruction.
BLUE CRANE Anthropoides paradiseus	2628BB:0.9 2628BD:14.4 2628DB:39.1 2629AC:- 2629CA:3.3	vulnerable	Low reporting rate but can be present in the pockets of remaining grassland and wetlands. Vulnerable to collisions.

Species	Reporting rate %	Conservation status (Barnes 2000)	Habitat requirements (Barnes 2000; Hockey *et al* 2005; Harrison *et al* 1997; Young *et al* 2003; personal observations)
CASPIAN TERN Sterna caspia	2628BB:- 2628BD:- 2628DB:3.3 2629AC:1.4 2629CA:1.3	near threatened	Estuaries and large inland water bodies. No negative interactions expected.
AFRICAN MARSH-HARRIER Circus ranivorus	2628BB:0.9 2628BD:9.9 2628DB:- 2629AC:2.7 2629CA:1.3	vulnerable	Large permanent wetlands with dense reed beds. Sometimes forages in smaller wetlands and adjacent grassland. Could be vulnerable to collisions with power line as potentially suitable habitat could exist in wetlands. Also vulnerable to habitat destruction.
BLACK HARRIER Circus maurus	2628BB:- 2628BD:- 2628DB:- 2629AC:4.1 2629CA:4.0	near threatened	Dry grassland and rarely in agricultural fields. Vulnerable to collisions with power lines.
PALLID HARRIER Circus macrourus	2628BB:- 2628BD:- 2628DB:1.1 2629AC:0.7 2629CA:-	near threatened	Grasslands associated with open pans and floodplains. Vulnerable to collisions with power lines.
BOTHA'S LARK Spizocorys fringillaris	2628BB:- 2628BD:- 2628DB:- 2629AC:2.0 2629CA:0.7	endangered	Prefers short grass, such as heavily grazed grassland in upland areas. No negative interactions expected. Vulnerable to habitat destruction and disturbance.
CHESTNUT-BANDED PLOVER Charadrius pallidus	2628BB:2.8 2628BD:- 2628DB:- 2629AC:- 2629CA:-	near threatened	Found primarily in salt pans. No negative interactions expected.
DENHAM'S BUSTARD Neotis denhami	2628BB:- 2628BD:0.9 2628DB:- 2629AC:- 2629CA:-	vulnerable	In the grassland biome it favours sour grassland in high rainfall areas. Vagrant to the area, no negative interactions expected.
SOUTHERN BALD IBIS Geronticus calvus	2628BB:- 2628BD:1.8 2628DB:- 2629AC:2.0 2629CA:-	vulnerable	Likely to be found on recently burnt ground and unburnt, short-grazed grassland, cultivated pastures, reaped maize fields and ploughed lands. Vulnerable to collision with power lines.

Species	Reporting rate %	Conservation status (Barnes 2000)	Habitat requirements (Barnes 2000; Hockey *et al* 2005; Harrison *et al* 1997; Young *et al* 2003; personal observations)
GREY CROWNED CRANE Balearica regulorum	2628BB:- 2628BD:- 2628DB:1.1 2629AC:- 2629CA:-	vulnerable	Breeds in marshes, pans, and dam margins with tall emergent vegetation. Feeds in adjacent short grasslands and croplands. Vulnerable to collision with power lines.

Power Line Interactions

According to the Avifauna assessment the following interactions are prevalent in South Africa. Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds and other animals and birds colliding with power lines. Other problems are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure, and disturbance and habitat destruction during construction and maintenance activities.

According to the specialist report the most severe potential impact that the proposed line will have is bird collisions with the overhead earth wire. This impact will most likely occur close to wetlands, where the line skirts a dam, where it crosses a drainage line and in areas of natural grassland.

Species at risk are water birds of several species where it skirts larger dams, particularly Leeuwpan, where flamingo collisions have been recorded. Collision hazards also exist where the line will cross pockets of natural grassland, as this is the preferred habitat of most of the remaining large terrestrial Red Data species, including the Blue Crane, Blue Korhaan, White-bellied Korhaan and Secretarybird in the Mpumalanga highveld. As mentioned earlier, the impacts on grassland and wetlands that are evident in the study area have been severe, reducing most Red Data, large terrestrial species to vagrants. The dense grid of existing power lines that covers the whole study area is a death trap for cranes, and the impact of these lines on the remaining Blue Cranes in the area can only be guessed at. Large areas of what seems to be suitable grassland remain the study area, yet they are devoid of any cranes. Given the extreme vulnerability of cranes to power lines, there is no question that the power lines must have effectively sterilized large areas for these birds. There are, however, substantial numbers of non Red Data power line sensitive species in the study area that have managed to survive and even thrive in some instances despite the habitat degradation that have occurred. In some instances, man-made developments such as the proliferation of artificial water bodies have benefited certain species. Examples are Red-knobbed Coot, Reed Cormorant *Phalacrocorax africanus*, Egyptian Goose, White-breasted Cormorant *Phalacrocorax lucidus*, Black-headed Heron *Ardea melanocephala*, Grey Heron *Ardea cinerea* and Yellow-billed Duck (Harrison *et.al* 1997). These species (and many other non Red Data ducks, herons and waders) run the risk of collision with the proposed power lines.

During the site investigations several dead birds were found underneath the existing power lines that traverse over the study area. The birds included Blue Crane, Lesser Flamingo, Marsh Owl, Secretary Bird, Sacred Ibis and Feral Pigeon (refer to Figure 38).

Figure 38: Dead birds found underneath the existing power lines on site, Lesser Flamingo (left) Marsh Owl (centre) and Secretary Bird (right).

Preferred Alternative

According to the specialist report, attached in Appendix 3, the most suitable power line alternative is Alternative 3. This is due to the avoidance of drainage areas and wetlands as well as the more developed nature of the route.

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 1480 mamsl to 1760 mamsl as illustrated in Figure 9. From Figure 9 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 soils on site follow a strong correlation with the underlying geology. The Sandstone soils are generally sandy, deep soils that are good for agriculture, while the Dolerite soils are dark in colour and have a high clay content. These soils are less suitable for agriculture and are mostly used for grazing.

The soils are located on the rolling landscape described above that slopes to the numerous streams and rivers in the area. Water enters the soils profile and then flows through the profile down-slope. This action of water movement through the slope typifies a small section of the site (eluvial and plinthic soils). Closer to the streams (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.

During the site visits the soils on site were identified (Refer to Section 3.5). Of the soils identified on site the Katspruit, Rensburg and Willowbrook soil forms are indicative of the permanent wetland zone, while the Kroonstad, Wasbank, Westleigh, Avalon, Inhoek and Longlands soil forms are indicative of the temporary or seasonal 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 soils mentioned above were classified accordingly and the results are visually represented in Figure 10 and Figure 11.

Vegetation Indicator

The vegetation units on site are described in Section 3.8.3 above and illustrated in Figure 35. The vegetation found in the moist grassland and the seepage 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, there are wetlands on site. It should however be noted that several of the so-called wetlands could also be classified as riparian zones as they follow drainage paths of the streams on site.

All the areas identified above perform critical ecosystem functions and also provide habitat for sensitive species. It is suggested that a 100 m buffer be placed from the edge of the wetland and riparian zones in order to sufficiently protect these zones. Figure 39 and Figure 40 below illustrates the various wetland zones including the buffers. From the figures it is once again clear that Alternative 3 is the best alignment, as it limits the interaction with the sensitive wetlands.

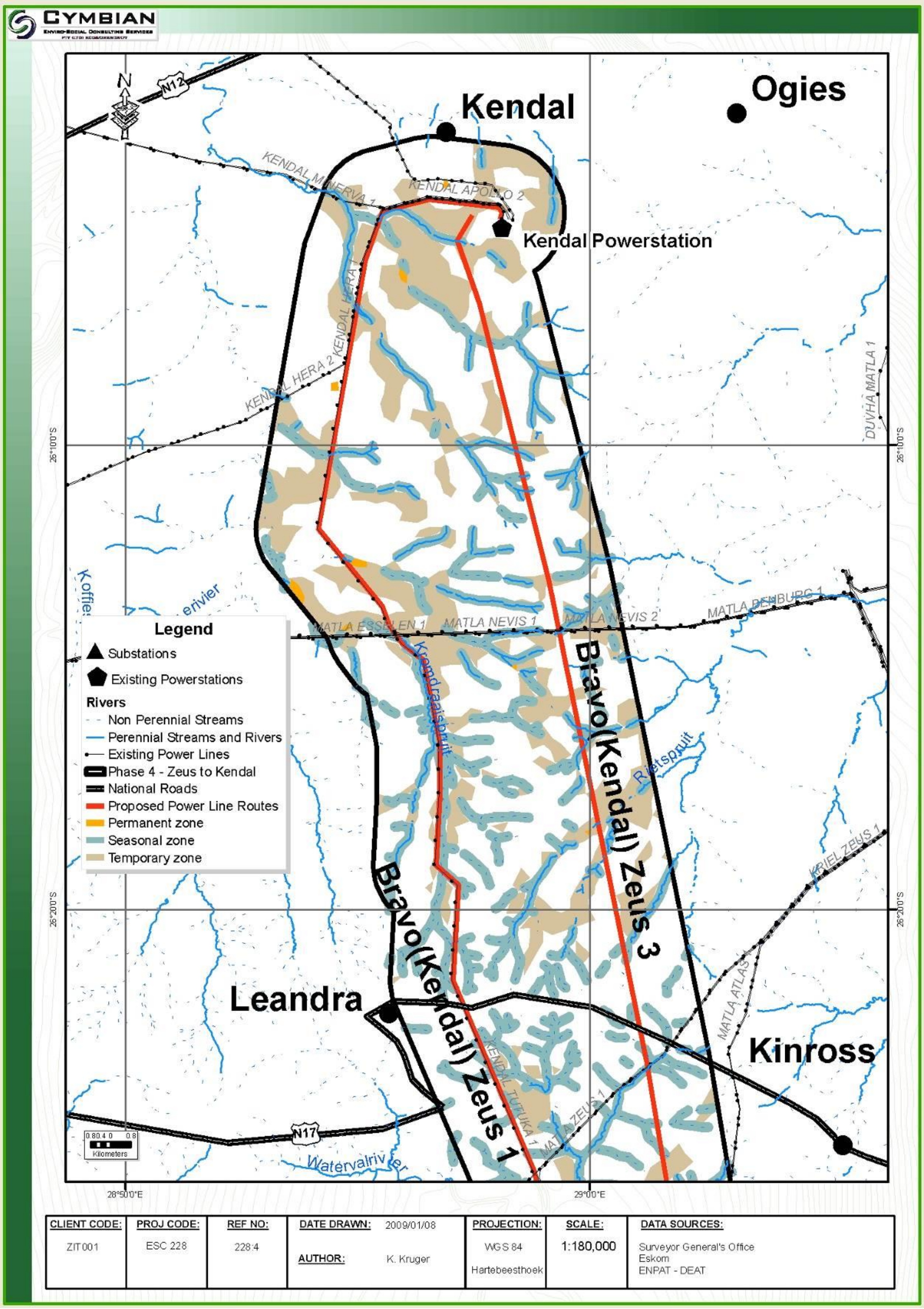


Figure 39: Wetland and Riparian Zone Map of the northern section of the site

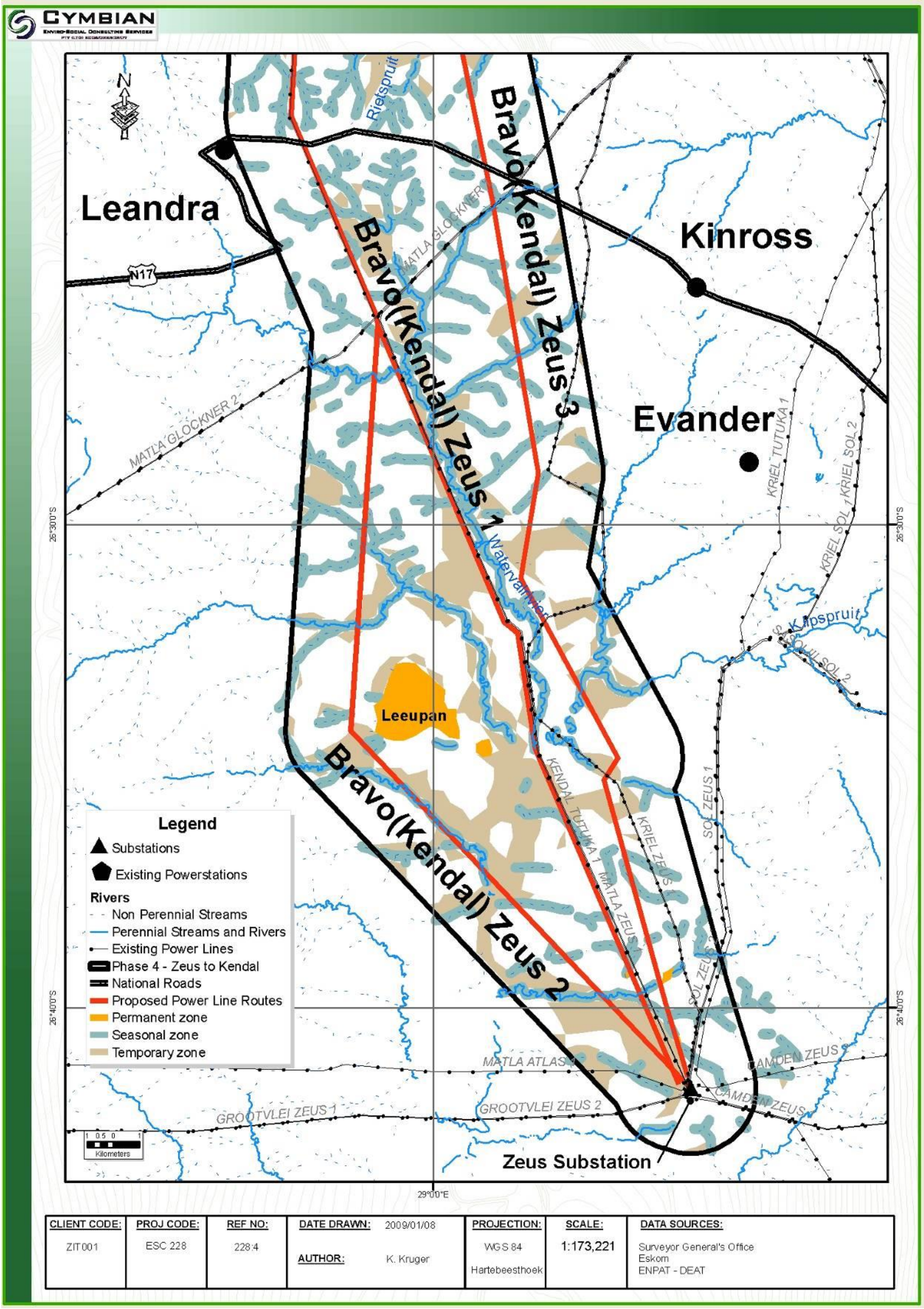


Figure 40: Wetland and Riparian Zone Map of the southern section of the site

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 7 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 7: 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 8:

Table 8: 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 9 below. A detailed rating of each habitat is given in Section 3.11.2 below.

Table 9: 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 10 below:

Table 10: 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 11 below.

Table 11: 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:

- Antropogenic grassland;
- Moist grassland;
- Grazed grassland; and

➲ Seepage areas and wetlands.

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

Grazed Grassland

This vegetation unit has a **moderate** biodiversity rating as indicated in Table 12 below. The **moderate** conservation value is attributed to the moderate grassland species diversity in the unit and the large area of rocky grassland remaining. The **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the rocky grassland.

Table 12: Biodiversity Rating for the 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	5 – Obvious	5 - High
Biodiversity Rating	Conservation status	Functional status	Biodiversity
	9 – Moderate	13 - High	Moderate

Moist Grassland

This vegetation unit has a **moderate** biodiversity rating as indicated in Table 13 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 **high** functional rating is attributed to the obvious ecological services and the high aesthetic value of the moist grassland.

Table 13: Biodiversity Rating for the *moist grassland* unit

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

Antropogenic Grassland

This vegetation unit has a **low** biodiversity rating as indicated in Table 14 below. The **low** conservation value is attributed to the low grassland species diversity in the unit and the large area of disturbed grassland remaining. The **low** functional rating is attributed to the lack of ecological services provided by the disturbed grassland.

Table 14: Biodiversity Rating for the *disturbed grassland* unit

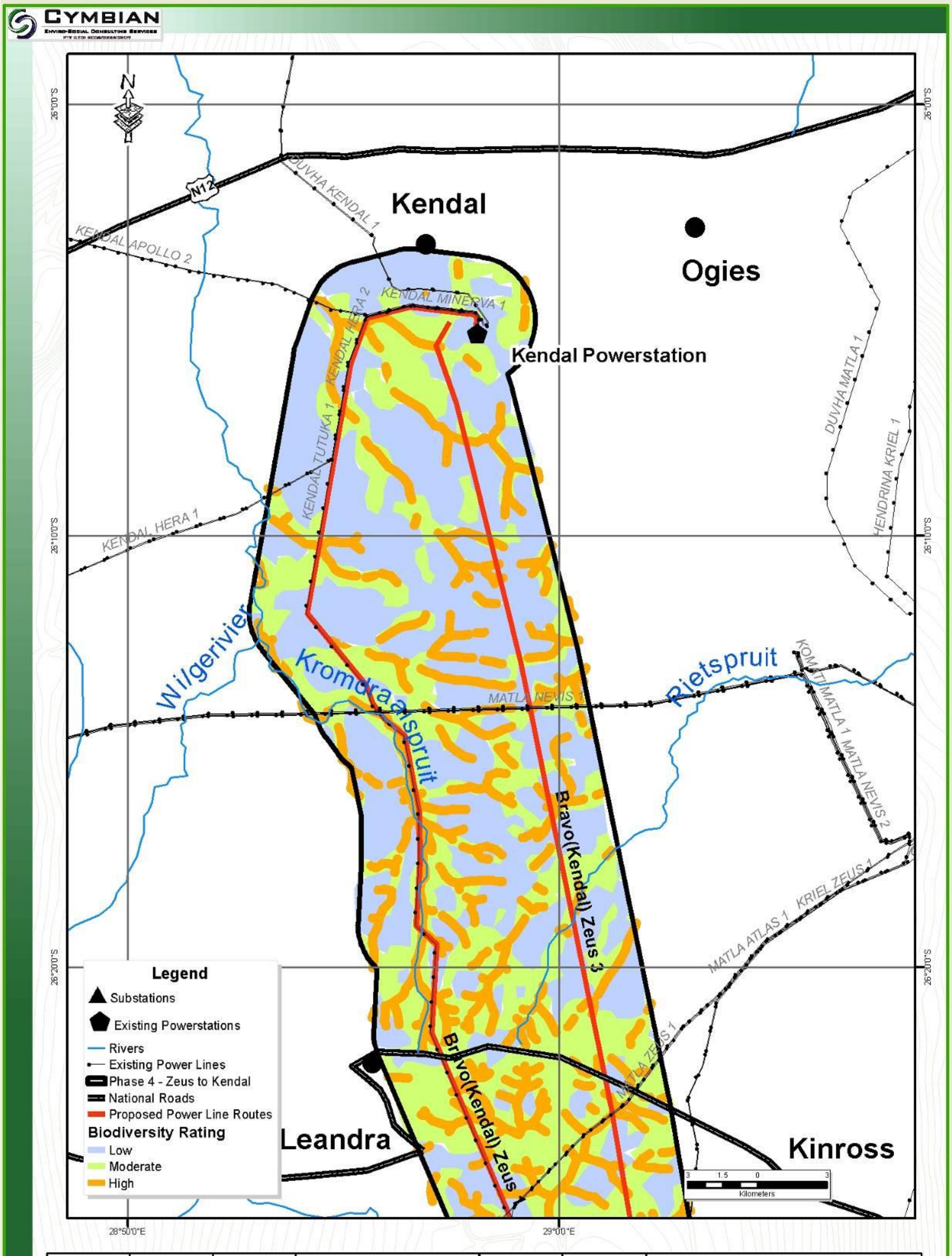
	Size of vegetation unit	Species diversity	Condition
Conservation status	1 - Large	1 - Low	1 - Disturbed
	Use	**Ecological service**	**Aesthetic value**
Functional status	1 - None	3 - Undetermined	1 - Low
	Conservation status	**Functional status**	**Biodiversity**
Biodiversity Rating	3 - Low	5 - Low	Low

Drainage Areas and Wetlands

This vegetation unit has a **high** biodiversity rating as indicated in Table 15 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 15: Biodiversity Rating for the *drainage 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**



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ZIT001	ESC 228	228:4	AUTHOR: K. Kruger	WGS 84 Hartebeesthoek	1:200,000	Surveyor General's Office Eskom WR 90

Figure 41: Biodiversity Rating Map of the northern part of the site

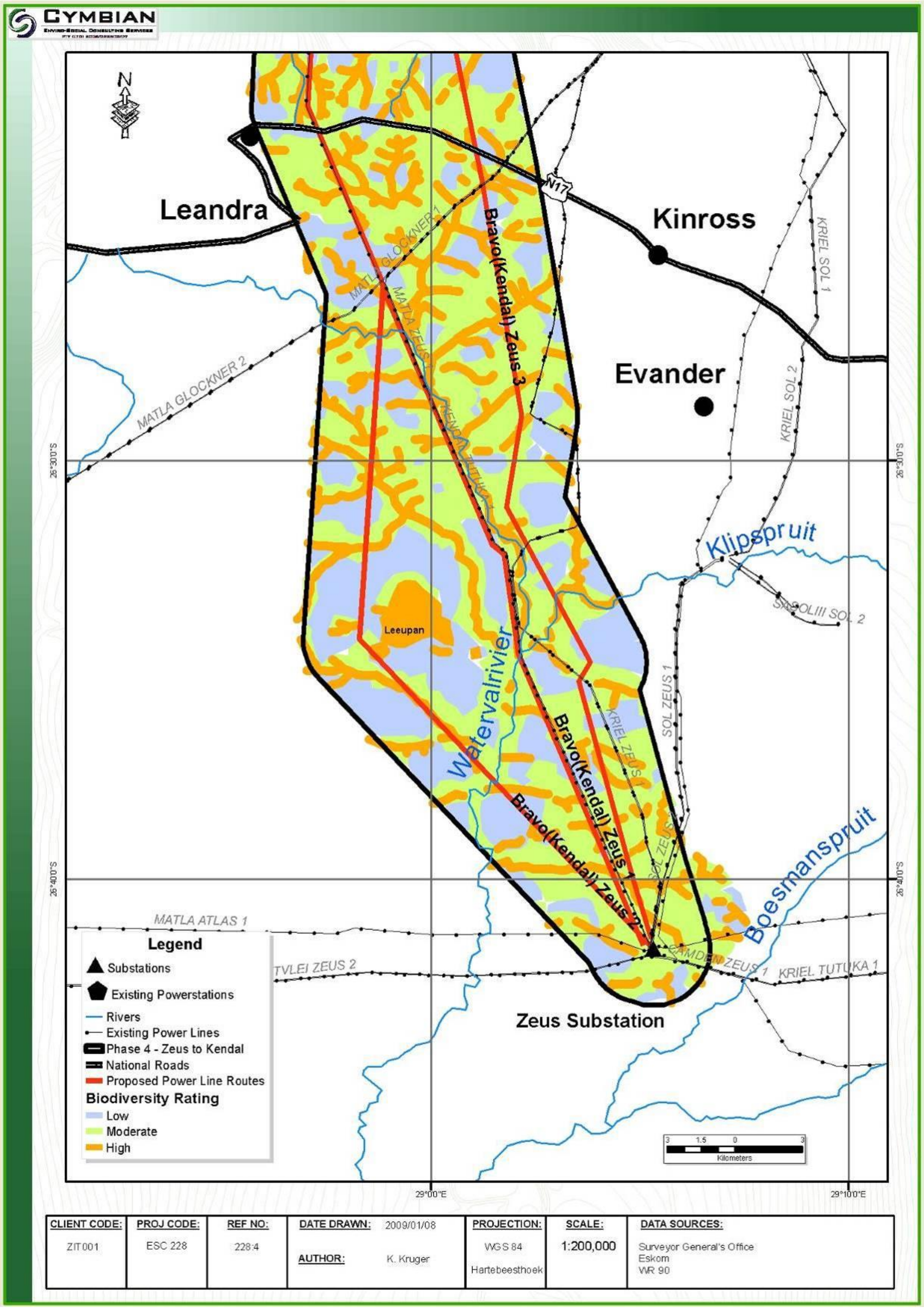


Figure 42: Biodiversity Rating Map of the southern part of the site

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 immediately adjacent to the Bravo Power Station with the power station construction site and other existing power lines featuring prominently 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
- Identify measures available to mitigate the potential impacts.

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 16 have been determined and used in the Visibility Assessment. The criteria are defined in more detail in the subsection following.

Table 16: Visual Impact Assessment Criteria

CRITERIA	DEFINITIONS
Category of Viewer	
Static	***Farms, homesteads or industries***
Dynamic	***Travelling along road***
View Elevation	
Above	***Higher elevation then 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 is 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. All the power line alternatives are located on rolling slopes with very little screening from topography or vegetation. Please refer to Figure 9 for the topography of the site.

The major rivers in the south of the site are the Klipspruit and the Waterval River, with several smaller tributaries. In the northern section the Wilge River is the main watercourse that drains northwards. Alternative 1 follows the Waterval River as well as the Kromdraaispruit, Alternative 2 crosses the Waterval River before joining the same alignment as Alternative 1, also following the Kromdraaispruit. Alternative 3 does not traverse along any major water courses but does cross over the Rietspruit and the Klipspruit.

The landscape surrounding the proposed power lines can be described as open grassland with numerous cultivated fields. The natural vegetation does not provide any substantial screening of the power lines. There are several existing power lines throughout the site, and in deed the intention of the project is to connect the existing power lines with the new power station. Figure 43 below provides a view of some of the existing power lines on site.

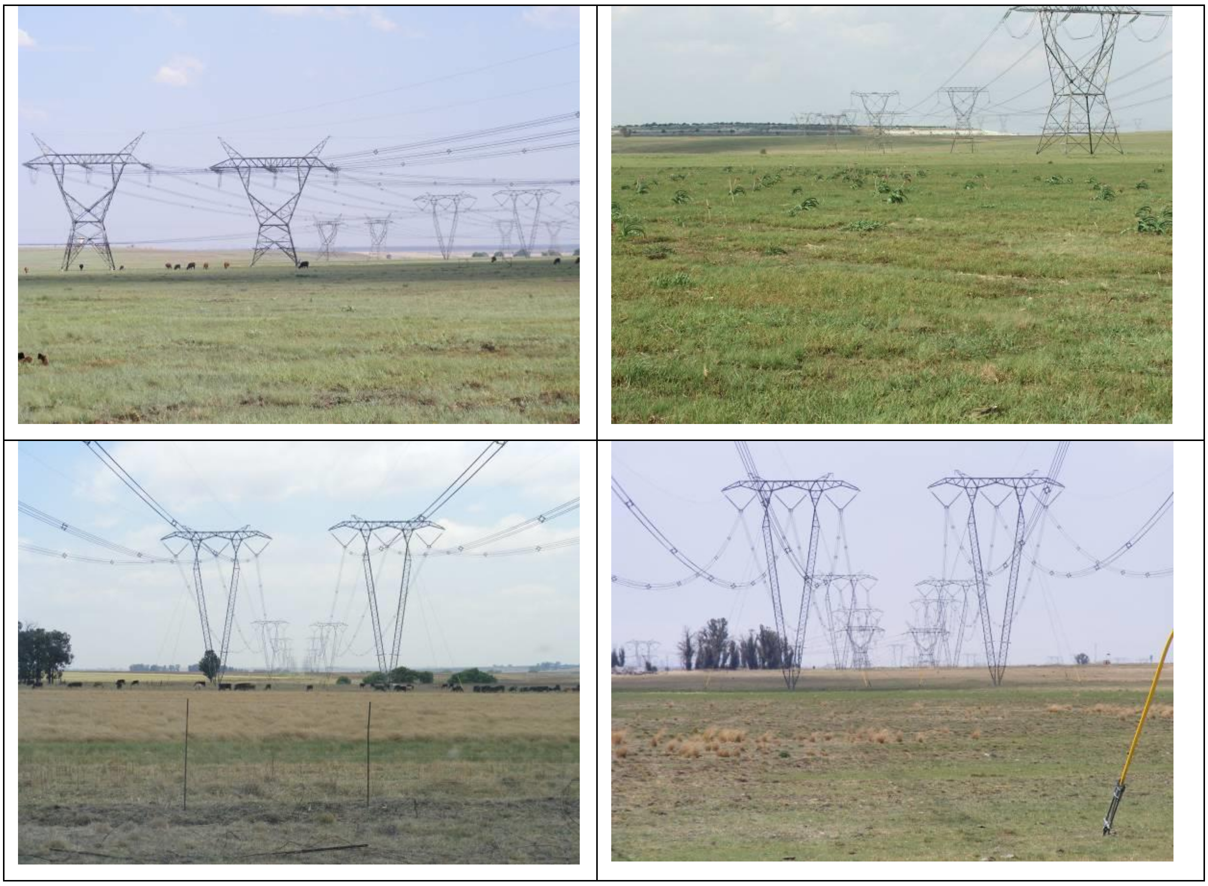


Figure 43: View of the existing power line on site

The study area is relatively devoid of any other infrastructure, with the exception of several farm houses, fences and roads. In a few isolated areas the power lines traverse close to areas used for mining, urban settlements and power generation.

4.3.2 Viewshed

It should be noted that the viewshed for each of the alternatives, which is plotted on Figure 44, Figure 45 and Figure 46, 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 available 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 blue having lower visibility. It should be noted that Alternatives 3 is more visible than Alternative 1 and 2 due to the fact that it is located along the higher altitudes and is not aligned along drainage lines like the other two alternatives.

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

- The viewshed extends approximately 50 km to the northwest of the proposed upgrade;
- In a easterly direction the viewshed is generally limited by a ridgelines approximately 40 km from the site at Bethal;
- To the west the viewshed extends approximately 70 km with isolated views on high outcrops; and
- Potential views from the south are blocked by the flowing ridges located south from the proposed site, and the viewshed extends about 5 km.

4.4 Impact Assessment

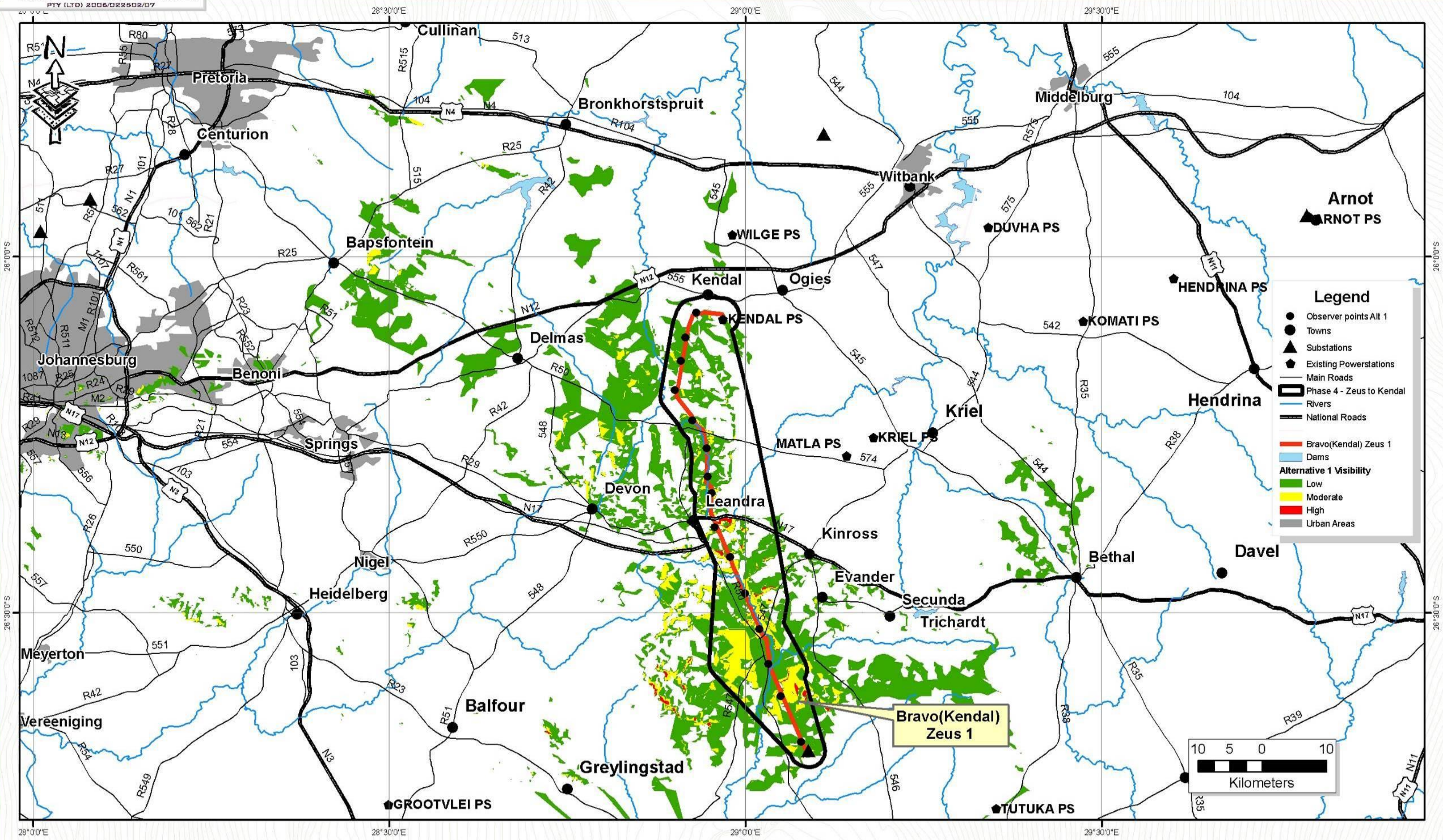
The visual simulations prepared by Cymbian illustrate the extent to which the upgrade will be visible from key observation points (static and dynamic views). The vertical form/dimensions of the buildings/structures would be hidden by their location among existing buildings and within a well vegetated 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 several towns in the region as listed in Table 17. The potential number of viewers from this area could vary as the farmlands are quite sparsely populated while the towns have denser populations. 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 to the proposed upgrade. It should be noted that a viewing distance of more than 5 km reduces the visibility as atmospheric effects reduce the contrast between the power lines and the surrounding landscape. In addition several existing power lines traverse the site, reducing the impact of an additional line.

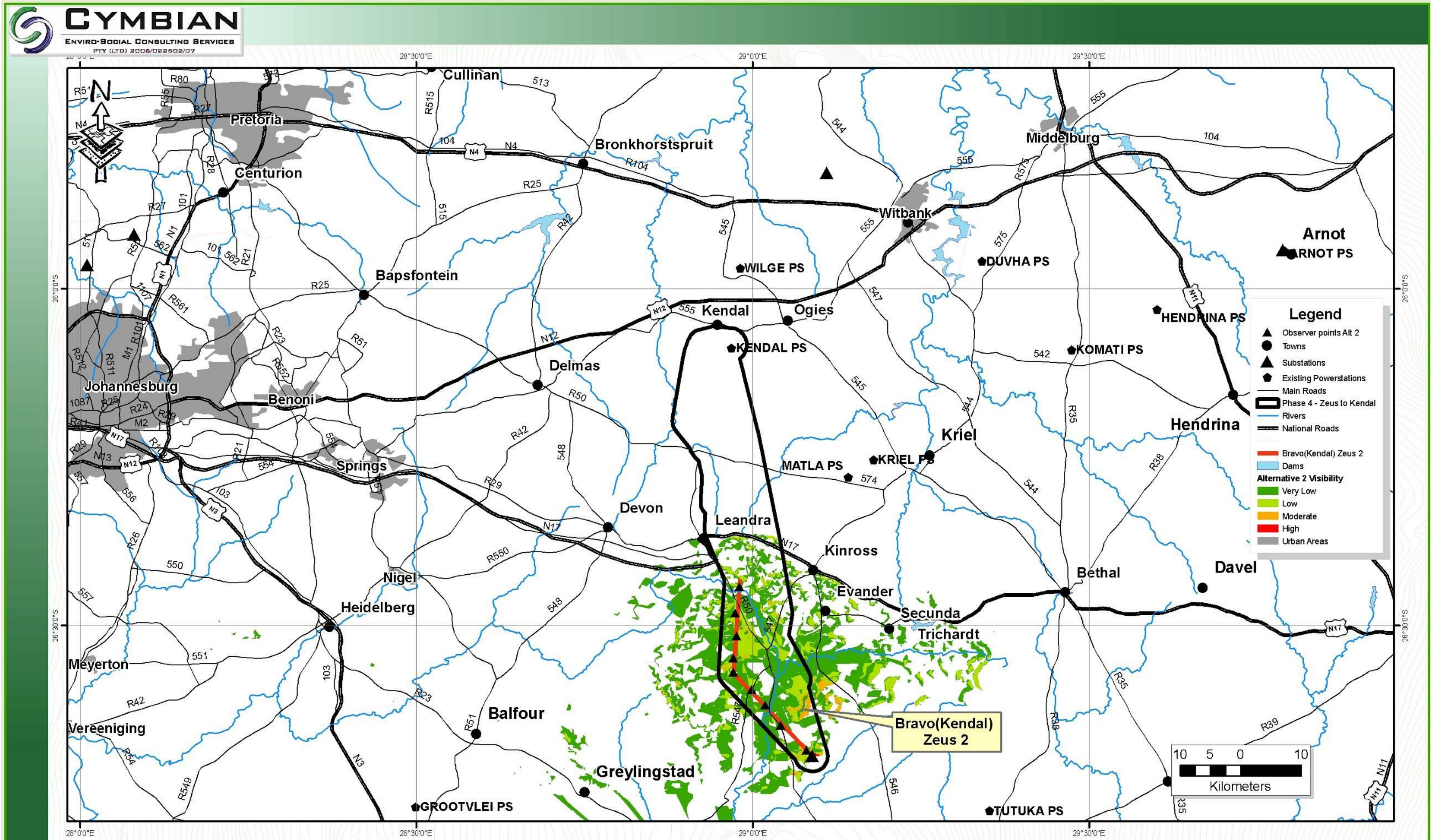
Table 17: Static views

Town	Alt 1 Distance (km)	Alt 2 Distance (km)	Alt 3 Distance (km)
Kendal	0	0	0
Leandra	2	2	10
Kinross	15	15	10
Evander	7.5	10	7.5
Devon	15	15	20
Secunda	15	20	15
Greylingstad	25	20	25
Delmas	20	20	30



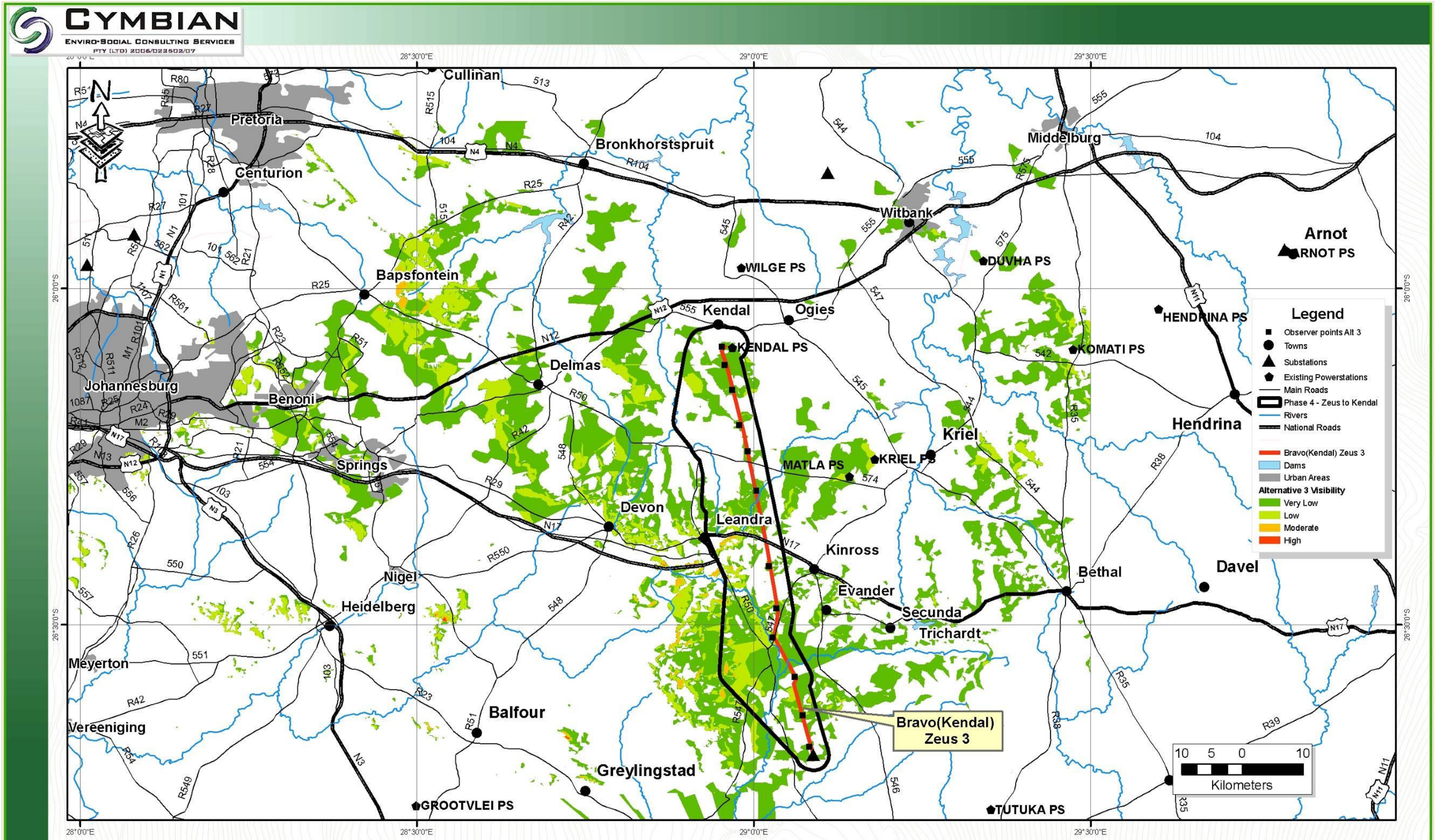
CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2009/01/15 AUTHOR: K. Kruger	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	228:4		WGS 84 Hartebeesthoek	1:580,000	Generated from Surveyor General Topo Data

Figure 44: Viewshed from the Alternative 1 alignment.



CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2009/01/15	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	228:4	AUTHOR: K. Kruger	WGS 84 Hartebeesthoek	1:580,000	Generated from Surveyor General Topo Data

Figure 45: Viewshed from the Alternative 2 alignment



CLIENT CODE:	PROJ CODE:	REF NO:	DATE DRAWN: 2009/01/15	PROJECTION:	SCALE:	DATA SOURCES:
ZIT001	228	228:4	AUTHOR: K. Kruger	WGS 84 Hartebeesthoek	1:580,000	Generated from Surveyor General Topo Data

Figure 46: Viewshed from the Alternative 3 alignment

Dynamic Views

The power lines will be visible to a moderate number of viewers, mainly those travelling along the highways and other main routes in the area. The level of visibility of the power lines reduces as a result of a view distance of more than 5 km and the resulting atmospheric effects that reduce the contrast between the power lines and the surrounding landscape. Please refer to Table 18 for a summary of the dynamic impacts of all three alternatives on the main roads in the study site. The power line upgrade would also be visible from several farm roads which are located around the proposed site.

As the table below illustrates, the power lines will be visible from a number of roads in the area, and exposures to the view will range from 40 seconds to 17 minutes. The R50 and the R547 runs through the study area and the power lines will be most visible along these roads. Although the lines will also be visible for ling periods along the N12 and N17 highways, these are from further away and hence the impact will not be as high.

Table 18: Dynamic Impact Table

Road	Speed limit	Length (km)	Visibility (min)	Distance from power line (km)
N12	120	31.53	15.77	5 – 30
N17	120	27.53	13.77	0 - 45
N3	120	1.29	0.64	50 – 60
N4	120	8.02	4.01	30 – 40
R547	100	25	15	0 – 10
R50	100	35	17.5	0 – 15

Conclusion

Table 19 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 44 and Figure 45.

Table 19: Visual Impact Matrix

Potential Observation Point	*Category of Potential Receptor*	*Context of View*	*Approximate View Distance*	*Period of View*	*Visibility Rating*
Surrounding Farmland	*Static*	*Above & below*	*0 – 50 km*	*Long Term*	*Medium*
Towns	*Static*	*Above & below*	*0 - 30 km*	*Long Term*	*Medium*
Gravel Roads	*Dynamic*	*Above & below*	*0 – 20 km*	*Medium*	*Medium*
Tar Roads	*Dynamic*	*Level - Above*	*0 – 40 km*	*Medium*	*Medium*

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 power line will not increase the impact significantly. In terms of the preferred alternative, there is very little to choose between the alternatives from a visual standpoint. But it should be noted that the impact along Alternatives 1 and for sections along Alternative 2 is existing, while the bulk of Alternative 3 will be a new visual impact.

5.0 ALTERNATIVE SENSITIVITY ANALYSIS

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

Table 20: Alternative Sensitivity Matrix

Sensitivity	Alternative 1	Alternative 2	Alternative 3
Geology	None	None	None
Climate	None	None	None
Topography	None	None	None
Surface Water	Most river crossings, traverses along several major streams.	Traverses along several major streams and in close proximity to Leeuwpan.	Avoids the bulk of the surface water bodies.
Soils & Land Capability	Clay soils dominate	Clay soils dominate	Agricultural soils dominate
Flora	Traverses through sensitive vegetation	Traverses through sensitive vegetation	Limits interaction with sensitive vegetation.
Fauna	Potential high impact on avifauna	Potential high impact on avifauna	Smallest impact to avifauna
Wetlands	Traverses along wetlands and streams	Traverses along wetlands and streams	Limits interaction with wetlands
Visual	Existing impact	Limited existing impact	New impact
Total Sensitivities	**5**	**6**	**2**

On the basis of the matrix presented above, it is suggested that the Bravo 4 Alternative 3 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 21.

Table 21: 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 22 below.

Table 22 : 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 23.

Table 23 : 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 24.

Table 24: 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 25 below.

Table 25 : 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 26. 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 26 : 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:

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

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

Table 27 : 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 28 : 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 lines 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

The additional impact resulting from the power line construction could occur on rocky ridges or places of shallow geology. The impact would be limited to the construction of the pylon footings, and should be a maximum of $8m^3$ of geological strata per footing. It should be noted that the erection of the pylons require a firm foundation, and this is achieved by casting a concrete slab under the soil surface. 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 29: 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

The topography throughout the site has been left relatively unimpacted. The only impacts to topography were the establishment of mine dumps at the gold mining activities south of Kinross and the coal mining activities throughout the site. Please refer to the figure below for an illustration of the mine dump. This impact is limited to a very small area of the site, and as such is too small to be rated. Therefore the initial impact is rated as **no impact.**

Figure 47: Mine dump on site

Additional Impact

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

Cumulative Impact

The cumulative impact is the same as assessed for the initial impact.

Mitigation Measures

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

Residual Impact

The residual impact remains **no impact** as assessed for the initial impact.

7.1.3 Soils, Land Capability and Land Use

Initial Impact

The bulk of the study area comprises agricultural and transitional soils. These soils can and in most cases are used for agricultural activities. The areas with existing power lines are usually on soils that are not suitable for agriculture, thereby ensuring that optimal land use is practised. The farming and especially ploughing of the soils breaks down the soil structure and increases the potential for erosion, which in turn could reduce the land capability.

The initial impact to soils and land capability is **probably** a LOW negative impact acting over the long term, and is *presently occurring* in the *study area*. As indicated in Table 30 below the impact rating class is a Moderate Impact.

Table 30: Soil and Land Capability Initial Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Soils	LOW	*Study Site*	Long Term	*Is occurring*	Moderate
	2	**2**	**4**	**5**	**2.67**

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. The route alternatives are approximately 70 km in length 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 467 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 31: Soil Impact

Soil Type	Alternative 1 (km)	Alternative 2 (km)	Alternative 3 (km)
Clay	35.2	40.1	31.8
Transitional	21.7	18	11.9
Disturbed	1.5	1.5	0.5
Agricultural	12.2	13.6	19

As indicated in Table 31 above, Alternatives 1 and 2 crosses more sensitive soils than Alternative 3. That said, the impact rating class between the two alternatives differ and is therefore rated separately.

For Alternative 3 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 32 below the impact rating class is a Moderate Impact.

Table 32: 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 1 and 2 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 33 below the impact rating class is a Moderate Impact.

Table 33: 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

Due to the fact that the two impacts (power station and the power lines) are in adjacent locations, the cumulative impact remains as rated for the initial impact i.e. a High impact class.

Mitigation Measures

- Take land use into consideration when choosing pylon types, it is recommended that smaller footprint pylons be used in cultivated areas;
- Avoid placement of pylon footings in the clay soils;
- 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 Moderate Impact, as the mitigation measures will not reduce the overall impact of the power station construction.

7.1.4 Surface Water

Initial Impact

Due to the size of the site and the numerous drainage lines and streams on site, the estimation of the potential initial impact to surface water is almost impossible. That said, all the watercourses observed on site was in good health. The largest potential impact in the area is the industrial complex of Secunda as well as the open cast coal mines near Kendal. The impact to surface water would be limited to contaminated storm water runoff and sediment entering the streams. This is also the case for the various towns in the district, that discharge their stormwater runoff into the natural systems. The impact is assessed in Table 34 below.

Table 34: Surface Water Initial Impact Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Surface water	LOW	*Study Site*	Medium Term	*Could happen*	Low
	2	***2***	**3**	**3**	**1.4**

The initial impact to surface water is 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 1.4 or a Low impact class.

Additional Impact

During the construction phase there should be limited impacts to surface water features as the placement of the pylons will be done in such a way as to avoid the surface water features on site.

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 35.

Table 35: 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 of wastes (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 100 m of any of the streams or wetlands on site.
- If possible utilise Alternative 3 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 within the mines and towns, large areas of vegetation have also been cleared. Of the total area on site only an estimated 30 % of natural vegetation remains. The initial impact to flora is **probably** a HIGH negative impact acting over the long term, and is *presently occurring* in the *study area*. As indicated in Table 36 below the impact rating class is a High Impact.

Table 36: Flora Initial Impact Assessment

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

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 37 below illustrates the length that each route alternative will cross the vegetation types identified. Alternatives 1 and 2 traverse a much longer section of the sensitive moist grassland and seepage area vegetation units when compared to Alternative 3.

Table 37: Flora Impact

Soil Type	Alt 1 (km)	Alt 2 (km)	Alt 3 (km)
Cultivated Fields	22.4	29.2	27.2
Moist Grassland and Drainage areas*	22	24.7	13.5
Eastern Highveld Grassland	7.3	7.3	4.7
Rand Highveld Grassland	3.3	3.3	1.5
Soweto Highveld Grassland	19.5	14.8	18.9
Disturbed Grassland	2	1.5	0.5

* Indicates sensitive vegetation types

The additional impact from the Alternative 3 alignment to flora is **probably** a MODERATE negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 38 below the impact rating class is a Low Impact.

Table 38: Flora Additional Impact Assessment – Alternative 3

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Flora	Moderate	*Isolated Site*	Short Term	*Will occur*	Low
	3	**1**	**2**	**5**	**2**

Due to the alignment of Alternatives 1 and 2 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 1 and 2 to flora is **probably** a HIGH negative impact acting over the long term, and *will occur* in *isolated sites*. As indicated in Table 39 below the impact rating class is a Moderate Impact.

Table 39: Flora Additional Impact Assessment – Alternatives 1 and 2

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
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 High 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 100 m from the edge of the wetlands and streams;
- Alternative 3 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 3 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 40 below the impact rating class is a Moderate Impact.

Table 40: 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 Soweto, Rand and Eastern Highveld grasslands, the moist grassland and the drainage areas the main habitat still available for fauna. The site is 61.7 % disturbed and the habitat available for fauna is limited. The suitable habitats did show low species diversity, indicating that the impact of cultivation has limited faunal activity throughout the site. The bulk of the faunal species observed were limited to a game farm to the north of the Zeus Sub Station.

The study area is criss crossed with existing high voltage power lines that could potentially impact on the faunal life. 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. As shown in Figure 38 above, several birds have been found dead under the exisitng power lines.

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 41: 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 1 and 2 are significantly closer to the habitat for the sensitive species and therefore the impacts are assessed separately.

The additional impact from the Alternative 3 alignment to fauna is **probably** a MODERATE negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 42 below the impact rating class is a Low Impact.

Table 42: 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 1 and 2 alignments to fauna is **probably** a HIGH negative impact acting over the short term, and *will occur* in *isolated sites*. As indicated in Table 42 below the impact rating class is a Moderate Impact.

Table 43: 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 3 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.
- Demarcate the sections of line that need to be mitigated once the alignment has been finalized
    - only through a combination of physical inspection of the entire length of the final alignment, and
    - detailed analysis of high resolution satellite imagery.
    - It is standard procedure by the Eskom Transmission Group to perform this procedure with the help of a suitably experienced ornithologist once the line has been pegged.
- All construction and maintenance activities should be undertaken in accordance with Eskom Transmission's environmental best practice standards.
- Care should be taken not to unnecessarily disturb any birds along the servitude.
- The Environmental Control Officer should identify any breeding birds along the servitude, particularly large terrestrial species such as cranes, korhaans or Secretary birds and notify

the avifauna specialist of these so that advice can be given on how to best deal with the situation.

- The construction of new access roads in particular should be limited to a minimum.
- All vehicle and pedestrian movement should be restricted to the actual construction site and, in the case of maintenance patrols, to the actual servitude.

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 Zeus Sub Station, Kendal Power Station, coal mines and cultivated fields. In addition to the abovementioned impacts 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 44: 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 44 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 45: 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 45 above it is clear that the additional impact from the construction of the power lines will be a Moderate impact. It should be noted that Alternative 3 has the least number of existing lines in the vicinity and therefore could be perceived as a higher impact by a observer.

Cumulative Impact

There are a high number of existing industrial and agricultural activities present on site as well as a high number of power lines on site. 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)[4] 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 7.1.1 above.

7.2.2 Topography

The impact assessment does not change from that of the construction phase, refer to Section 7.1.2 above.

7.2.3 Soils, Land Capability and Land Use

The impact assessment does not change from that of the construction phase, refer to Section 7.1.3 above.

7.2.4 Surface water

The impact assessment does not change from that of the construction phase, refer to section 7.1.4 above.

7.2.5 Vegetation

The impact assessment does not change from that of the construction phase, refer to section 7.1.5 above.

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

7.2.6 Fauna

Initial impact

The initial impact remains as assessed in Section 7.1.6, a High impact.

Additional impact

During the operational phase the proposed development will add approximately 70 km of high voltage power lines to the existing network of power lines in the area. Sensitive avifauna were identified right under the potential alignments 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 46 below.

Table 46: 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 70 km of high voltage power lines to the existing network of power lines in the area. The addition is moderate in comparison with the approximately 300 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;
- Adhere to the construction phase mitigation measures;
- Alternative 3 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 70 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 47: 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 47 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 7.1.7 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 7.1.1 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 7.2.2 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 7.2.3 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 7.2.4 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 7.2.5 above.

7.3.6 Fauna

Even though the removal of the 70 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 7.2.6 above due to the remaining network if high voltage power lines.

7.3.7 Visual

Even though the removal of the 70 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 7.2.7 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

Management Component	Rivers and streams
Primary Objective	
To ensure that the rivers and streams are protected and incur minimal negative impact from the development as possible.	

Core Criteria:	Monitoring Criteria
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.	*Storm water Management Plan, Site Development Plan, EMP monitoring and Intermittent observations*
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.	
No construction vehicles or activities will be allowed to work within 50 m of any of the streams or wetlands on site	
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	
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	

9.0 CONCLUSION

In conclusion the proponent in proposing the construction and operation of two high voltage power lines in order to connect the Kendal Power Station to the existing Zeus Sub Station as part of the Bravo integration project.

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 seepage 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 seepage zones could be reduced by utilising the Alternative 3 route alignment, thereby limiting the contact with the wetlands and seepage zones.

The area provides habitat to a number of sensitive avifauna species and potential impacts to these are rated as a High impact. Serious consideration should be made to install collision preventative measures. Furthermore the utilisation of Alternative 3 will reduce the potential impact as the route traverses to less suitable habitat.

The visual impact was found to be moderate, when considering the high number of existing power lines in the area.

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 3 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: 2528DD					
Family	**Species**	**Common name**	**Present**	**Occurrence**	**Habitat**
Acanthaceae	Hermbstaedtia odorata	Rooiaarbossie	x	Individuals	Distirbed/Grassland
Acanthaceae	Ruellia cordata (Thunb)		x	Individuals	
Amaryllidaceae	Cyrthanthus breviflorus	Yellow Fire lily	x	Individuals	
Amaryllidaceae	Cyrthanthus breviflorus	Fire lily	x	Individuals	Disturbed areas /Ripirain zones
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				
Asclepiadaceae	Asclepias eminens (Harv.) Schltr		x	Individuals	Disturbed/Grassland
Asclepiadaceae	Asclepias fruticosa	Milkweed	x	Individuals	Disturbed Areas
Asteraceae	Tagetes minuta	Khaki weed	x	Common	Disturbed Areas
Asteraceae	Bidens pilosa	Blackjack	x	Common	Disturbed Areas
Asteraceae	Bidens formosa	Cosmos	x	Individuals	
Asteraceae	Crassocephalum x picridifolium (DC.) S.Moore				
Asteraceae	Dicoma macrocephala DC.				
Asteraceae	Denika capensis Thunb.		x	Individuals	Ripirain zones
Asteraceae	Gerbera piloselloides	Swartteebossie	x	Individuals	Disturbed Areas/Grassland
Asteraceae	Haplocarpha scaposa	Tonteldoosbossie	x	Individuals	Disturbed Areas/Grassland
Asteraceae	Helichrysum aureonitens Sch.Bip.		x	Individuals	
Asteraceae	Helichrysum nudifolium (L.) Less. var. nudifolium	Hottentot's Tea			
Asteraceae	Helichrysum pilosellum (L.f) Less.		x	Sparse	Disturbed Areas/Grassland
Asteraceae	Helichrysum setosum Harv.	Yellow Everlasting			
Asteraceae	Helichrysum splendidum (Thunb.) Less.				
Asteraceae	Helichrysum cephaloideum DC		x	Individuals	Grassland
Asteraceae	Nidorella hottentotica DC.				
Asteraceae	Stoebe vulgaris	Bankrupt Bush	x	Sparse	Higly Disturbed Areas

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Family	Species	Common name	Present	Occurrence	Habitat
Asteraceae	Cirsium vulgare	Scotish Thistle	x	Sparse	Disturbed Areas
Asteraceae	Tagetes minuta	Khaki weed	x	Common	Disturbed Areas
Asteraceae	Vernonia poskeana Vatke & Hildebr. subsp. botswanica G.V.Pope				
Asteraceae	Vernonia oligocephala	Bitterbossie	x	Sparse	Disturbed Areas
Asteraceae	Senecio inaequidens DC. (=s. burchellii DC. p.p)	Canary Weed	x	Sparse	Disturbed Areas
Asteraceae	Senecio erubescens Ait. Var. crepidifolius DC		x	Individuals	Grasslans/Riparian Zone
Asteraceae	Sonchus oleraceus	Sow Thistle	x	Individuals	Grassland/Ripiran Zone
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		x	Individuals	Disturbed Areas/Grassland
Convolvulaceae	Ipomoea bolusiana Schinz subsp bolusiana		x	Individuals	
Convolvulaceae	Merremia palmata Hallier f.		x	Individuals	Grassland
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	Common	Riparian zone
Cyperaceae	Coleochloa setifera Ridley) Gilly		x	Sparse	Riparian zone
Cyperaceae	Lipocarpha nana (A.Rich.) Cherm.				
Cyperaceae	Mariscus congestus (Vahl) C.B.Cl.		x	Individuals	Grassland/Riparian Zones
Cyperaceae	Pycreus pumilus (L.) Domin				
Cyperaceae	Schoenoplectus corymbosus (Roth. Ex Roem. & Schult.) J. Raynal		x	Individuals	Wetland
Dicranaceae	Campylopus savannarum (Müll.Hal.) Mitt.				
Dipsacaceae	Scabiosa columbaria	Wild scabious	x	Individuals	
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.				

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Family	**Species**	**Common name**	**Present**	**Occurrence**	**Habitat**
Fabaceae	Indigofera zeyheri Spreng. ex Eckl. & Zeyh.				
Fabaceae	Indigofera hilaris Eckl. & Zeyh		x	Individuals	Grassland
Fabaceae	Lotononis foliosa Bolus		x	Individuals	
Fabaceae	Rhynchosia monophylla Schltr.		x	Individuals	
Fabaceae	Rhynchosia nervosa Benth. ex Harv. var. nervosa				
Fabaceae	Rhynchosia totta (Thunb.) DC.		x	Individuals	
Fabaceae	Virgilia divaricata Adamson				
Fabaceae	Zornia milneana Mohlenbr.		x	Individuals	
Fabaceae	Erythrina zeyheri ex Harv		x	Sparse	Disturbed Areas (Grazzed Areas)
Fossombroniaceae	Fossombronia gemmifera Perold				
Geraniaceae	Monsonia angustifolia	Crane's Bill	x	Individuals	Disturbed Areas/Grassland
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	
Hypoxidaceae	Hypoxis interjecta		x	Individuals-Sparse	Disturbed Areas (Grazzed Areas)
Hypoxidaceae	Hypoxis argentea Harv. Ex Bak		x	Individuals	Disturbed
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.				
Lamiaceae	Acrotome hispida Benth		x	Sparse	Grassland
Lentibulariaceae	Utricularia arenaria		x	Individuals	
Lentibulariaceae	Utricularia stellaris L.f.				
Liliaceae	Ledebouria ovatifolia (Bal.)Jessop		x	Sparse	Grassland
Liliaceae	Ledebouria cooperi		x	Individuals	Disturbed Areas/Grassland
Liliceae	Protasparagus setaceus	Asparagus Fern	x	Individuals	
Liliaceae	Urginea depressa Bak		x	Individuals	Grassland
Liliaceae	Anthericum cooperi Bak		x	Sparse	Grassland
Liliaceae	Anthericum fasciculatum Bak.		x	Individuals	Grassland
Liliaceae	Monopsis decipiens		x	Individuals	Grassland
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			

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Family	**Species**	**Common name**	**Present**	**Occurrence**	**Habitat**
Menyanthaceae	Nymphoides thunbergiana (Griseb.) Kuntze				
Mesembryanthemaceae	Delosperma leendertziae N.E.Br.				
Mesembryanthemaceae	Frithia humilis Burgoyne				
Mesembryanthemaceae	Mossia intervallaris (L.Bolus) N.E.Br.				
Mimosaceae	Elephantorrhiza elephantia (Burch.) Skeels	Elephant root	x	Individuals	Grassland
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.				
Onagraceae	Oenothera rosea	Rose Evening Primrose	x	Sparse	Disturbed areas/Ripirain Zone
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	Aristida adscensionis	Annaul Tree-awn	x	Individuals	
Poaceae	Brachiaria serrata	Velvet Grass	x	Sparse	Grassland
Poaceae	Calamagrostis epigejos (L.) Roth var. capensis Stapf				
Poaceae	Cymbopogon excavatus	Broad-leaved Turpentine Grass	x	Individuals	
Poaceae	Cymbopogon plurinodes	Trutpentine Grass		Sparse	
Poaceae	Cynodon dactylon	Coch Grass	x	Common	Grassland
Poaceae	Echinochloa jubata Stapf				
Poaceae	Elionurus muticus	Wire Grass	x	Individuals	Disturbed Areas/Grassland
Poaceae	Eragrostis capensis (Thunb.) Trin.	Heart-seed Love Grass	x	Individuals	
Poaceae	Eragrostis chloromelas Steud.	Narrow Curly leaf	x	Common	Grassland
Poaceae	Eragrostis hierniana Rendle				
Poaceae	Eragrostis inamoena K.Schum.				
Poaceae	Eragrostis plana	Tough Love Grass	x	Common	Grassland
Poaceae	Eragrostis racemosa (Thunb.)	Narow Heart Love	x	Sparse	

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Family	**Species**	**Common name**	**Present**	**Occurrence**	**Habitat**
	Steud.	Grass			
Poaceae	Eragrostis tef (Zuccagni) Trotter	Tef	x	Sparse	
Poaceae	Eragrostis lehmannia	Lehmann's Love Grass	x	Sparse	Disturbed Areas/Grassland
Poaceae	Eragrostis pseudosclerantha	Foopath Love Grass	x	Individuals	Disturbed Areas/Grassland
Poaceae	Eragrostis curvula	Weeping Love Grass	x	Common	Disturbed Areas/Grassland
Poaceae	Harpochloa Falx	Carerpillar Grass		Individuals	Grassland
Poaceae	Heteropogon contortus	Spear Grass	x	Sparse	Grassland
Poaceae	Helictotrichon tugidulum	Small Oats Grass	x	Sparse	Grassland/Riparian Zone
Poaceae	Hyparrhenia hirta (L.) Stapf	Common Thatching Grass	x	Sparse-Common	
Poaceae	Hyparrhenia quarrei Robyns				
Poaceae	Hyparrhenia tamba (Steud.) Stapf	Blue Thatching Grass	x	Common	Disturbed Area/Roadside
Poaceae	Imperata Cylindrica	Cottonwool Grass	x	Sparse	Riparian zone
Poaceae	Hyperthelia dissoluta (Nees ex Steud.) Clayton				
Poaceae	Loudetia simplex	Russet Grass	x	Sparse	
Poaceae	Melinis repens	Natal Red Top	x	Individuals	Grassland
Poaceae	Miscanthus junceus (Stapf) Pilg.	Wireleaf Daba Grass			
Poaceae	Panicum maximum	Guinea Grass	x	Sparse	Riparian zone
Poaceae	Panicum schinzii	Sweet grass	x	Sparse	Grassland
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	Setaria sphacelata var. torta	Greeping bristle grass	x	Individuals	Disturbed Areas/Grassland
Poaceae	Sporobolus fimbriatus	Dropseed Grass	x	Sparse	
Poaceae	Themeda triandra	Red Grass	x	Individuals	Disturbed Areas/Grassland
Poaceae	Tristachya leucothrix	Hairy Trident Grass	x	Individuals	Grassland
Poaceae	Urochloa Oligothricha	Perrennial Signal Grass	x	Individuals	Disturbed Areas Grassland
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	
Ranunculaceae	Ranunculus multifdus	Buttercup	x	Sparse	Disturbed Areas

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Family	**Species**	**Common name**	**Present**	**Occurrence**	**Habitat**
Ricciaceae	Riccia atropurpurea Sim				
Ricciaceae	Riccia okahandjana S.W.Arnell				
Ricciaceae	Riccia volkii S.W.Arnell				
Rubiaceae	Kohautai caespitosa Eckl. & Zeyh		x	Individuals	Disturbed areas/Grassland
Rubiaceae	Richardia scabra L.				
Rubiaceae	Rubia horrida (Thunb.) Puff	Kleefgras	x	Individuals	
Salicaceae	Salix babylonica (Introduced)	Weepiing Willow	x	individual	Ripirain Zone
Scrophulariaceae	Chaenostoma leve (Hiern) Kornhall				
Scrophulariaceae	Diclis reptans Benth		x	Individuals	Ripirain Zone
Scrophulariaceae	Jamesbrritenai aurantiaca	Cape saffron	x	Individuals	Grassland
Selaginellaceae	Hebenstretia angolensis Rolfe	Katstert	x	Individuals	
Selaginellaceae	Selaginella dregei (C.Presl) Hieron.				
Solanaceae	Solanum mauritianum	Poison apple	x	Individuals	Disturbed areas
Solanaceae	Solanum sisymbrifolium	Wild tomato	x	Individuals	
Solanaceae	Solanum pseudocapsicum	Jerusalem cherry	x	Individuals	Disturbed Areas
Thelypteridaceae	Thelypteris confluens (Thunb.) C.V.Morton				
Thymelaeaceae	Gnidia sericocephala (Meisn.) Gilg ex Engl.				
Verbenaceace	Vebena sp		x	Common	Disturbed Areas
Xyridaceae	Xyris capensis Thunb.				

Appendix 2: Avifauna assessment

Appendix 3: Bird Collision Prevention Guidelines

Appendix 4: Vegetation Management Guideline

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