ESKOM DISTRIBUTION

Mookodi Integration Project

Draft Environmental Impact Report

DEA Reference: 12/12/20/1929

Issue Date: 24 October 2012
Revision No.: 1
Project Number: 10466

Date:	24 October 2012
Document Title:	Mookodi Integration Project.
Author:	Shaun Taylor
Revision Number:	1
Checked by:	Rebecca Thomas
Approved:	Rebecca Thomas
Signature:	
For:	SiVEST Environmental Division

The Independent Environmental Assessment Practitioner:
We, SiVEST Environmental, declare that we –

- act as the Independent Environmental Assessment Practitioners in this application for the proposed construction and operation of the distribution power lines and substations in the Vryburg and Stella area;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

ESKOM DISTRIBUTION

MOOKODI INTEGRATION PROJECT

DRAFT ENVIRONMENTAL IMPACT REPORT

Executive Summary

Eskom plans to install electricity distribution infrastructure in order to increase the electricity supply in the Vryburg and Stella areas of South Africa. The proposed 132kV power lines and substations are regarded as a listed activity in terms of the Environmental Impact Assessment Regulations (2006) published under the National Environmental Management Act, 1998 (Act 107 of 1998) and thus require an Environmental Impact Assessment (EIA). SiVEST Environmental Division has been appointed as independent Environmental Assessment Practitioner (EAP) to undertake the EIA on Eskom's behalf.

The proposed project is required to improve electricity supply for future developments which are planned by the Naledi Local Municipality as well as to provide electricity for proposed developments to the north of Stella.

The proposed project involves the construction of five 132kV distribution power lines and two substations. Alternative routes and substation sites have been proposed. Each power line route has a 300m-wide corridor to allow for some flexibility during construction should an unforeseen obstruction be encountered, and to take account of site-specific environmental sensitivities. The main component of the proposed power line route connects two proposed substations (Bophirima and Kalplats), running from Vryburg to the north of Stella in the North West Province (Bophirima-Kalplats 132kV power line) via a ±130km 132kV power line. Shorter power line route components will connect the proposed Bophirima Substation on the outskirts of Vryburg with the Mookodi Transmission Substation Site and with the existing Vryburg Substation. The third route component is proposed to link the proposed Kalplats Substation with the existing Edwards Dam Substation located to the north-west. The Kalplats-Edwards Dam Ring Extension will consist of an additional ±35km 132kV power line, to be stepped down to 88kV at Edwards Dam existing distribution substation. The existing Edwards Dam distribution substation will inject into Edwards Dam rural substation.

The specialist assessments listed below were conducted during the EIR phase as stipulated in the Plan of Study (PoS) for EIA. These parameters were identified to be important at the onset of the study and the following studies were thus undertaken:

- Biodiversity (Flora and Fauna)
- Avi-fauna (Birds)
- Surface Water

- Geotechnical
- Geohydrology
- Heritage
- Visual
- Social

These assessments were largely undertaken at a desktop level, with field verification, where necessary.

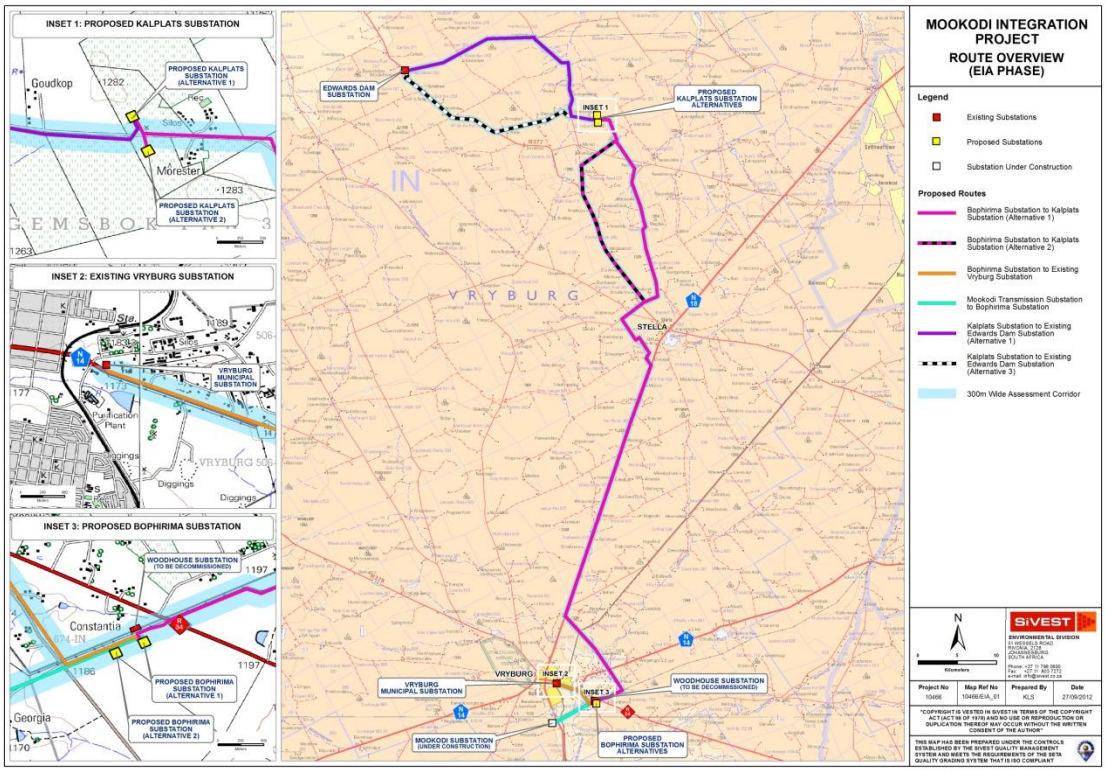


Figure i: Map of the Study Area showing proposed power line alignments and proposed substation locations.

Table i: Summary of findings

Environmental Parameter	Summary of major findings	Recommendations
Biodiversity (Flora and Fauna)	▪ Several sensitivities relating to both the faunal and floral environment have been identified within the corridors. ▪ The proposed project could result in detrimental effects on these environments as discussed. However, power lines do not result in large scale	▪ A biodiversity walk-down is to be conducted to ensure that tower locations are strategically positioned and access to these locations is appropriately planned. ▪ It is essential that

Environmental Parameter	Summary of major findings	Recommendations
	clearing and suitable mitigation measures can be implemented to reduce the identified impacts.	biodiversity specialists are on the project team during construction to ensure that the issues identified in this report are prioritised.
Avi-fauna	▪ The large study area was found to be moderately sensitive for avifauna. ▪ Electrocution of birds such as African White-backed Vulture is of particular concern in the north, while collision of heavy flying birds such as Flamingos is possible throughout the site. ▪ Collisions are expected to be the largest impact of this project. ▪ Provided that the high risk sections of line are mitigated in the form of marking, the impact should be contained and an acceptable level of mitigation for this project can be reached using available devices such as bird-friendly steel lattice structures.	▪ Line marking is required to mitigate for collision impacts. ▪ An avifaunal walk through is recommended in order to identify the spans of line for marking to mitigate for bird collisions.
Surface Water	▪ The predominant surface water features in the study area are small pans, with much of the area being characterised by endorheic drainage. A number of morphologically poorly-defined valley bottom wetland systems also occur in the study area, particularly in the northern parts. ▪ A typical feature of the vast majority of surface features in the study area is the presence of a riparian zone that is distinct from the surrounding non-wetland shrubveld vegetation in terms of its structure and species composition. These riparian zones are ecologically very important, and play an important role in terms of the morphological state of the watercourse.	▪ Alternative 3 of the Kalplats-Edwards dam line component and Alternative 2 of the Bophirima-Kalplats alternative section are preferred, and should ideally be selected for development. ▪ Should Alternative 1 of the Kalplats-Edwards dam line component be selected for development, it is very important that the lines completely avoid the Mosita se Laagte wetland system and that they are aligned to the east of the district road.

Environmental Parameter	Summary of major findings	Recommendations
Geotechnical	▪ Foundation conditions considered not a suitable founding medium at Bophirima Substation Alternative 1 and will require a more costly foundation solution. ▪ Foundation conditions considered not a suitable founding medium at Kalplats Substation Alternative 2 and will require a more costly foundation solution. ▪ Impacts from a geotechnical perspective focus on removal of vegetation, topsoil and subsoils which can be acceptably mitigated.	▪ Bophirima Substation Alternative 2 is preferred from a geotechnical perspective. ▪ Kalplats Substation Alternative 1 is preferred from a geotechnical perspective.
Geohydrology	▪ Except for a short section in the northern part of the proposed new transmission line, the area traversed by the line is underlain by geologically old hard rock terrain comprising of diamictite, dolomite, chert, quartzites, lava, and granite-gneiss. Over the northern section the area is covered by recently deposited aeolian (wind-blown) sand. ▪ With the exception of the small area around Vryburg where dolomitic rocks are present, the groundwater yield from boreholes is in general low and the different rock types are not regarded to host high yielding aquifers. ▪ .All the identified potential impacts were rated as having a Negative Low impact score (8 - 20) and therefore, these are considered to have negligible negative effects that will require little to no mitigation.	▪ Due to the low significance rating of all impacts identified, no preference is given to any of the alternative power line routes and substation positions, and therefore no concerns and/or fatal flaws from a groundwater perspective have been identified.
Heritage	▪ The following categories of heritage sites were identified as occurring in the study area: Farming and farming related activities, such as farmsteads, stock pens, windmills, etc. Local and private cemeteries.	▪ As it is unlikely that the power line would have any other than a visual impact on the site, it is recommended that the site is retained in its current location.

Environmental Parameter	Summary of major findings	Recommendations
	Roadside memorials. ▪ Only one site, a small informal cemetery located on the farm Help Makaar 248, is located in what is perceived to be the corridor. ▪ Despite the occurrence of the cemetery, from a cultural heritage point of view, there are no sites, features or objects known to exist in the corridor or its alternatives that would prevent the proposed development from taking place.	▪ The cemetery site should be avoided at all times. During construction it should be clearly demarcated, e.g. by using danger tape. ▪ If retained, no permits are necessary.
Visual	▪ Due to the size of the study area, a relatively large number of sensitive visual receptors that could potentially be affected by the proposed power lines have been identified. Large parts of the study area are rural in visual character with a natural component to the landscape. The northern-most parts of the area are much more natural in character and are valued for their aesthetic quality. ▪ The result of the study shows relatively few sensitive receptor locations would be subject to a high degree of visual intrusion, with the majority of locations only subject to a low degree of visual intrusion. ▪ The potential visual impact on the lines would be reduced if preferred alternative alignments from a visual perspective for the lines were chosen.	▪ Choosing the visually preferred alignments would avoid the visually most-sensitive parts of the route and would significantly reduce the visual impact potential of the lines.
Social	The findings of the SIA can be summarised as follows: Pre-Construction Phase ▪ The main issue during the pre-construction phase is that of the relocation of households and other structures. A number of households and structures have been identified	▪ The recommendation with regards to relocation of households and other structures is that cognisance is taken of the sensitive and flagged areas marked in this report and to use this as a guideline in planning a final

Environmental Parameter	Summary of major findings	Recommendations
	that are either within or in very close proximity to the route corridors as they currently stand, which would place these households and structures at 'risk' for relocation. However, given the fact that an alignment still has to be found within the 300m wide corridor, relocation can be avoided as per Eskom's policy and that of the IFC. Construction Phase ▪ Geographical processes: A temporary loss of land will occur within the servitude and construction laydown areas, restricting the landowner access to these and leading to possible loss of crops within the 31m strip. The same would hold true for the substation sites, but in this regard the land loss is expected to be of a more permanent nature and would therefore be more applicable to the operations and maintenance phase. ▪ Demographical processes: The largest group faction of the construction team that will move into the area is estimated at around 470 people during the peak of construction, which will not have a significant bearing on the size of the population of the local municipal area as a whole. However, it is expected that the presence of construction workers in areas such as Huhudi and Thakwaneng (where construction workers are likely to spend their free time) can lead to an increase	route alignment. ▪ The alignment of the power line within the corridor must be done in consultation with the affected landowners to minimise the impact on the property and surrounding land use. ▪ Overall the SIA did not identify any areas that can be classified as fatal flaws.

Environmental Parameter	Summary of major findings	Recommendations
	in conflict situations, a rise in the HIV/AIDS rate, an increase in opportunistic crime, etc. Their presence also signals the presence of a project taking place in the area leading locals to believe that jobs might be available, which in turn might lead to the further conflict situations and the in-migration of jobseekers from elsewhere, which could intensify conflict points. The presence of unemployed jobseekers can lead to the expansion of the informal settlements at Huhudi, which would increase the housing backlog and place additional strain on the local municipality (cumulative effect). ▪ Economic Processes: Due to the skilled nature of constructing a distribution power line and a substation, it is unlikely that large numbers of local job opportunities will be created. Some informal opportunities might be created. ▪ Institutional and Legal Processes: The contractor will supply accommodation, normally in the form of a construction camp. Although the construction camp in itself does not pose a social impact, it can lead to a number of social ills, which in turn can then lead to social impacts. ▪ Socio-cultural processes: During the construction phase changes would mostly relate to possible conflict situations between local residents and newcomers to the area, most notably where there is a marked dissimilarity in social	

Environmental Parameter	Summary of major findings	Recommendations
	practices. In addition the presence of migrant workers in the form of a male-dominated construction team can fuel a 'macho-culture' with strong peer pressure, which often causes these individuals to engage in risky (sexual) behaviour. Operations and Maintenance Phase ▪ Geographical processes: During the operations and maintenance phase there will be a degree of long term loss of cultivated and grazing land, but this loss of land will mostly be centred on the distribution line towers. ▪ Economic processes: During the operations and maintenance phase some property owners might experience a negative impact on their property value. However, it is also expected that the proposed substations and the associated distribution power lines will enhance the electricity supply, which in turn will indirectly stimulate economic growth as the supply can meet the demand, allowing businesses and industries to expand. ▪ Socio-cultural processes: The issue of the physical presence of the line and how it affects people's sense of place can be expected to various degrees of subjectivity and different social groups.	

These specialist studies were conducted to address the potential impacts relating to the proposed development that were identified during the scoping phase. An impact assessment was conducted to ascertain the level of each identified impact, as well as mitigation measures which may be required. The potential positive and negative impacts associated within these studies

have been evaluated and rated accordingly. The results of the specialist studies have indicated that no fatal flaws exist as a result of the proposed substations and associated power lines.

Based on the findings of the specialist studies, the preferred alternative sections of the proposed power line route and substation are as follows:

- **Bophirima Substation to Kalplats Substation Alternative 2**
- **Kalplats Substation to Edwards Dam Substation Alternative 3**
- **Bophirima Substation Alternative 2**
- **Kalplats Substation Alternative 1**

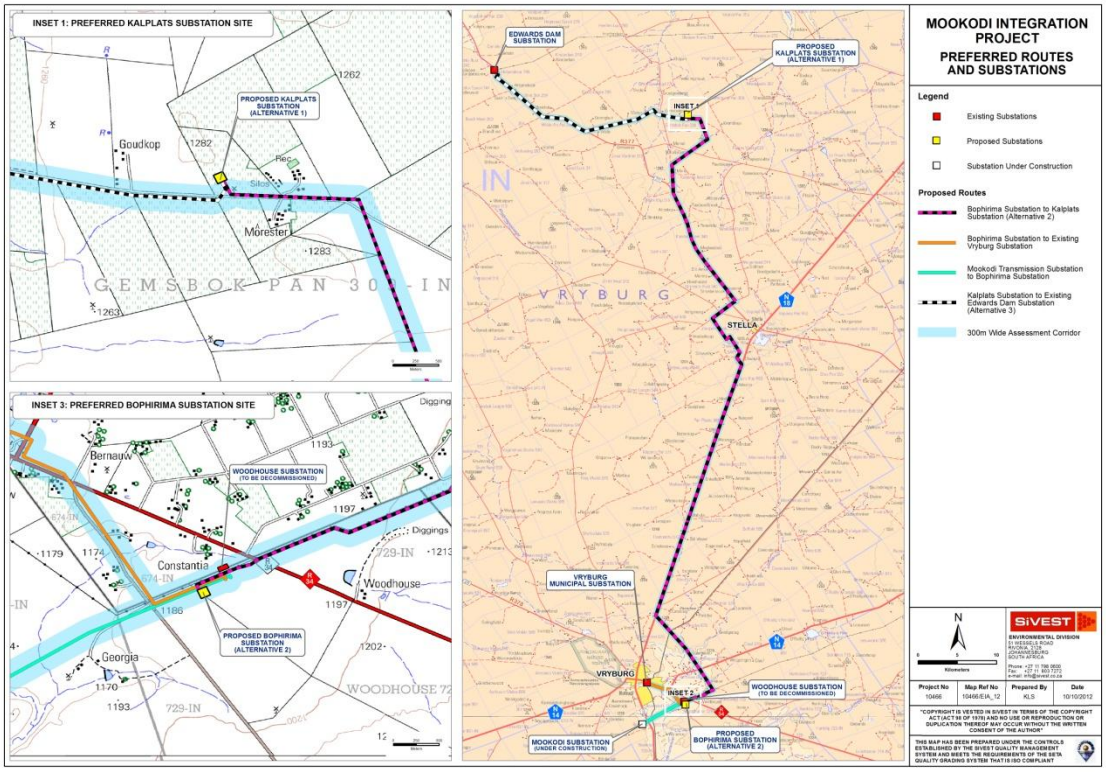


Figure ii: Preferred route and substations

It is the opinion of the EAP that the proposed project be allowed to proceed provided that the recommended mitigation measures are implemented, and provided the following conditions are adhered to:

- Social issues raised in this report are attended to;
- Landowners are constantly kept informed about the project;
- Loss of agricultural land is kept to the minimum;
- Relocation is implemented as a last resort;
- Regular maintenance of the servitude;
- An avifaunal, heritage and biodiversity walk down is conducted prior to the start of construction;

- Ensure that no boreholes are present within the final 31m servitude. ECO to conduct walk down;
- Sensitive wetlands and riparian habitats are to be spanned by the power lines;
- Mitigation measures for the avoidance of groundwater contamination at substation sites are strictly implemented;
- Final EMP needs to be approved by DEA prior to construction.

ESKOM DISTRIBUTION

MOOKODI INTEGRATION PROJECT

DRAFT ENVIRONMENTAL IMPACT REPORT

Contents Page

List of Tables

List of Figures

List of Maps

All maps are included in Appendix 5 in A3 format.

List of Appendices

Glossary of Terms

Alluvial: Resulting from the action of rivers, whereby sedimentary deposits are laid down in river channels, floodplains, lakes, depressions etc.

Biodiversity: The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

Catenal: Associated with a catena which is a repeated sequence of soil profiles that is geographically related to and associated with relief features. Different soil types and characteristics are often found to be linked together in the same sequence when traced down from a crest to a valley bottom.

Environmental Impact Assessment: In relation to an application to which Scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of the application.

Environmental Impact Report: In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

Environmental Management Plan: A legally binding working document, which stipulates environmental and socio-economic mitigation measures that must be implemented by several responsible parties throughout the duration of the proposed project.

Ephemeral: When referring to a stream or drainage line, it refers to the flow characteristics by which there are only periodic surface flows. Similarly when referring to a pan or depression, this would be characterised by only periods of time when surface water occurs within it, usually associated with the rainy season.

Episodic: A river / stream which only flows sporadically; i.e. at very irregular intervals. Flow in the river would typically be confined to a single episode (usually rainfall related) which would be a highly irregular occurrence

First Order Stream: A stream at the head of a catchment. Stream order is a classification of drainage system according to a hierarchy of orders of magnitude of channel segments. Within a single drainage basin the un-branched channel segments at the head of a catchment are designated as first order streams. Where two first order streams meet, a second order stream forms, and so forth.

Geophysics: The study of the physical characteristics and properties of the earth; including geodesy, seismology, meteorology, oceanography, atmospheric electricity, terrestrial magnetism, and tidal phenomena.

Hyrdomorphic / hydric soil: Soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring growth and regeneration of hydrophytic vegetation. These soils are found in wetlands.

Kilovolt (kV): a unit of potential equal to a thousand volts (a volt being the standard unit of electric potential. It is defined as the amount of electrical potential between two points on a conductor carrying a current of one ampere while one watt of power is dissipated between the two points).

Load profile analysis: Metering and monitoring which provides the information critical to managing energy.

Macro-geomorphological: Related to / on the scale of geomorphic provinces. A geomorphic province is a spatial entity with common geomorphic attributes.

Pastoral: of or relating to the country; country-like. rural

Precipitation: Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.

Red Data species: All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

Riparian: The area of land adjacent to a stream or river that is influence by stream induced or related processes.

Scoping Report: An “issues-based” report which forms the first phase of an Environmental Impact Assessment process

List of Abbreviations

API – Aerial Photographic Interpretations
BID – Background Information Document
CBD – Central Business District
CBO – Community Based Organisation
DEA – Department of Environmental Affairs
DSR – Draft Scoping Report
EIA – Environmental Impact Assessment
EIR – Environmental Impact Report
EMP – Environmental Management Plan
ENPAT – Environmental Potential Atlas
ESRI – GIS and Mapping software
EWT – Endangered Wildlife Trust
FGM – Focus Group Meeting
FSR – Final Scoping Report
GDP – Gross Domestic Product
GIS – Geographic Information System
HIA – Heritage Impact Assessment
HV – High Voltage
I&APs – Interested and Affected Parties
I&RR - Issues and Response Report
ICNIRP - International Commission for Non-Ionising Radiation Protection
IDP – Integrated Development Plan
ISEP – Integrated Strategic Electricity Planning
IUCN – International Union for the Conservation of Nature and Natural Resources
KLM - Kagisano Local Municipality
KSW – Key Stakeholder Workshop
kV – Kilo Volt
MLM - Molopo Local Municipality
NLM - Naledi Local Municipality
NEMA – National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA – National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NFA – National Forests Act, 1998 (Act No. 84 of 1998)
NHRA – National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NSBA – National Spatial Biodiversity Assessment
NWA – National Water Act, 1998 (Act No. 36 of 1998)
PM – Public Meeting
PPP – Public Participation Process
RSMDM – Dr Ruth Segomotsi Mompati District Municipality
SAHRA – South African Heritage Resources Agency
SANBI – South African National Biodiversity Institute

SANRAL – South African National Roads Agency
SDF – Spatial Development Framework

ESKOM DISTRIBUTION

MOOKODI INTEGRATION PROJECT

DRAFT ENVIRONMENTAL IMPACT REPORT

1 INTRODUCTION

1.1 Background

Eskom Holdings SOC Limited (Eskom) is responsible for the provision of reliable and affordable power to its consumers in South Africa. If Eskom is to meet its mandate and commitment to supply the ever-increasing needs of end-users, it has to plan, establish and expand its generation capacity and associated distribution power line infrastructure on an on-going basis.

To this end, Eskom has commissioned an Environmental Impact Assessment (EIA) for the proposed Mookodi Integration Project (hereafter referred to as the "proposed project"). Accordingly, SiVEST have been appointed by Eskom as the independent Environmental Assessment Practitioners (EAP) to undertake an EIA for the proposed project. This project includes the construction of two (2) substations and four (4) separate 132 KV power lines, with a total length of approximately 130km. The primary power line runs from the proposed Bophirima Substation to Kalplats substation in the North West Province and is approximately 89 km. The Kalplats-Edwards Dam Ring Extension will consist of additional ±35km 132kV power line, to be stepped down to 88kV at Edwards Dam existing Distribution Substation.

The National Department of Environmental Affairs (DEA) is the competent authority on this application. As such, an application for the proposed project was submitted to the DEA on the 18th May 2010. The application was approved on the 1st June 2010 and allocated the following reference number: DEA Ref No: 12/12/20/1929.

The Environmental Scoping Report and Plan of Study (PoS) for EIA were subsequently submitted to DEA in the Scoping phase of the EIA, on the 19th January 2011. SiVEST received acceptance of the Environmental Scoping Report and PoS for EIA from DEA on the 29th March 2011.
The proposed project is now in the Impact phase of the EIA. The Draft Environmental Impact Report (DEIR) has been made available for public review from between October and November 2012.

All authority consultation, correspondence and acceptance letters are included within Appendix 1.

1.2 Legal Context

In terms of Government Notice No. R. 387 of the Environmental Impact Assessment Regulations 2006, a full Environmental Impact Assessment is required for the proposed development based on triggered activities as stipulated in Table **1** below. However, several activities which trigger a basic assessment in terms of Government Notice No. R. 386 were also identified and need also be specified. Ultimately, these activities will not form a separate assessment, but will fall into the greater EIA.

Table 1: Listed activities in terms of the NEMA Regulations

Number and date of the relevant notice:	**Activity No (s)**	**Description of listed activity**
Government Notice R387 (21 April 2006)	1(l)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the transmission and distribution of above ground electricity with a capacity of 120 kilovolts or more.
Government Notice R387 (21 April 2006)	2	Any development activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be, 20 hectares or more.
Government Notice R387 (21 April 2006)	12	The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
Government Notice R386 (21 April 2006)	4	The dredging, excavation, infilling, removal or moving of soil, sand or rock exceeding 5 cubic metres from a river, tidal lagoon, tidal river, lake, in-stream dam, floodplain or wetland.
Government Notice R386 (21 April 2006)	7	The above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres at any one location or site.
Government Notice R386 (21 April 2006)	14	The construction of masts of any material of type and of any height, including those used for telecommunications broadcasting and radio transmission, but excluding (a) masts

		of 15m and lower exclusively used by (i) radio amateurs; or (ii) for lightening purposes (b) flagpoles; and (c) lightening conductor poles
Government Notice R386 (21 April 2006)	15	The construction of a road that is wider than 4 metres or that has a reserve wider than 6 metres, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 metres long.

1.3 Expertise of Environmental Assessment Practitioner

SiVEST has considerable experience in the undertaking of linear power line EIAs. Staff and specialists who have worked on this project and contributed to the compilation of this draft Environmental Impact Report are detailed in **Table 2** below.

Table 2: Environmental and specialist consultants

Name and Organisation	Role
Rebecca Thomas – SiVEST	Project Leader
Shaun Taylor – SiVEST	Report Compilation, Public Participation Assistance
Faith Kalibbala – SiVEST	Biodiversity (Flora and Fauna) Assessment
Chris van Rooyen – Chris Van Rooyen Consulting	Avi-fauna Assessment
Johnny Van Schalkwyk	Heritage Assessment
Nonka Byker and Sean Smith – MasterQ	Social Assessment
Paul da Cruz – SSI	Wetland Assessment
Paul da Cruz – SSI	Visual Assessment
Mike Clements – Geopractica	Geotechnical Assessment
Reinie Meyer	Geohydrology
Kerry Schwartz – SiVEST	GIS and Mapping
Nicolene Venter – SiVEST	Public Participation Practitioner

Please refer to attached CV's in Appendix 2 for more information.

1.4 Legislation, Development Strategies and Guidelines

In terms of the EIA Regulations (GN R385, GN R386, GN R387 of 21 April 2006, as amended) published under the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), the proposed project, together with associated structures and infrastructure, comprise a number of listed activities under GN R386 and GN R387 of 21 April 2006 (as amended). It is thus required that an EIA be undertaken for purposes of seeking to obtain an environmental authorisation to undertake the listed activities.

1.4.1 The general duty of care in terms of section 28 of NEMA

Section 28(1) of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) stipulates that "Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

Eskom therefore has a responsibility to ensure that the undertaking of the proposed activities conforms to this general duty of care in terms of section 28 of NEMA. The proponent is accordingly obliged to take the appropriate reasonable measures to prevent, minimise or rectify pollution or degradation of the environment in terms of section 28 of NEMA.

1.4.2 NEMA 2006 EIA Regulations Requirements

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an environmental authorisation, the result being that NEMA now governs the EIA process with the promulgation of the EIA Regulations in April 2006. The EIA Regulations are contained in three Government Notices (GN R385, GN R386, GN R387 of 21 April 2006, as amended) and generally came into force on 3 July 2006.

The new EIA Regulations were promulgated on the 18th of June 2010 and came into effect on the 2nd of August 2010. However, the application for the proposed Mookodi Integration Project was made before the promulgation of the new regulations and is therefore being done in accordance with the stipulations and requirements as set out in the EIA Regulations, 2006. SiVEST will however, aim to take the new regulations into cognisance throughout the EIA process.

In terms of matters regulating the EIA process, GN R385 lays out two distinct authorisation processes. Depending on the nature of the listed activity that is proposed to be undertaken, either a so-called “basic assessment” process or a so-called “scoping and EIA” process is required to apply for an environmental authorisation in terms of NEMA. GN R386 lists the activities that trigger the requirement for the basic assessment process to be followed, while GN R387 lists the activities that require scoping and a full EIA. If an application is for two or more listed activities for both a basic assessment and EIA as part of the same development, and scoping and EIA must be applied in respect of any of the activities, then scoping and EIA must be applied to the application as is the case in this instance. All applicable activities have been outlined in Table 1 above (Section 1.2).

1.4.3 National Heritage Resource Act, 1999 (Act 25 of 1999)

The protection and management of South Africa’s heritage resources is primarily regulated by the National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA). The law ensures community participation in the protection of national heritage resources and involves all three levels of government (national, provincial and local) in the management of the country’s national heritage.

The South African Heritage Resources Agency (SAHRA) is the enforcing authority for the NHRA; however a provincial agency, the North West Provincial Heritage Resource Agency was established in 2008. In terms of the Act, various forms of heritage resources (such as graves, certain trees, archaeological artefacts, fossil beds, etc.) are afforded protection and a permit may be required to destroy, damage, excavate, alter, etc. protected heritage resources).

Furthermore, in terms of section 38 of the NHRA, the responsible heritage resources authority can call for a Heritage Impact Assessment (HIA) where certain categories of development are proposed. The activities identified in section 38 of the NHRA that apply to this proposed project include:

- Section 38 (1) (a): The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- Section 38 (1) (c): any development or other activity which will change the character of a site

i) exceeding 5 000 m^2 in extent; or
ii) involving three or more existing erven or subdivisions thereof; or
iii) involving three or more erven or subdivisions thereof which have been consolidated within the past five years; and

- Section 38 (1) (d): The rezoning of a site exceeding 10 000 m^2 in extent.

However, the provisions of section 38 do not apply to a development as described if an evaluation of the impact of such development on heritage resources is required in terms of (amongst other legislation), NEMA. This is subject to the proviso that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of section 38(3) and that any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent.

1.4.4 National Water Act (Act 36 of 1998)

The National Water Act 1998 (Act 36 of 1998) (NWA) provides a framework to protect the water resources of South Africa.

In the context of the proposed project and any potential impact on water resources there are two aspects of the NWA which are of key importance. The first is the mechanism for authorising various water uses (as detailed in section 21 of the NWA). If any water uses are to be undertaken as part of the project they will need to be authorised in accordance with one of the mechanisms created under the NWA, which include Schedule 1 water uses, generally authorised water uses and licensing of water uses.

In terms of section 19 of the NWA, "An owner of land, a person in control of land or a person who occupies or uses the land on which any activity or process is or was performed or undertaken, or any other situation exists, which causes, has caused or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring".

These measures may include (inter alia):

- Measures to cease, modify, or control any act or process causing the pollution;
- Compliance with any prescribed waste standard or management practice;
- Containment or prevention of the movement of pollutants;
- Remediation of the effects of the pollution; and
- Remediation of the effects of any disturbance to the bed and banks of a watercourse.

This Act is relevant to the proposed project as the construction of the power lines and the substations may impact negatively on water resources (for example, streams, rivers, wetlands and underground water resources). Eskom is therefore required to take all reasonable measures

to prevent pollution to water resources as a result of the proposed project, and to seek authorisations under the National Water Act where applicable.

1.4.5 National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)

The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) operates in conjunction with the National Environmental Management: Protected Areas Act No. 57 of 2003. Both Acts emerge from the recommendations of the White Paper on the Conservation and Sustainable Use of South Africa's Biodiversity (1998) and were originally conceived of as one Act.

The overarching aim of the National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA), within the framework of NEMA, is to provide for:

- The management and conservation of biological diversity within South Africa, and of the components of such biological diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources;
- To give effect to ratified international agreements relating to biodiversity which are binding on the Republic;
- To provide for co-operative governance in biodiversity management and conservation; and to provide for a South African National Biodiversity Institute (SANBI) to assist in achieving the objectives of the Act.

The South African National Biodiversity Institute (SANBI) was established by the NEMBA, its purpose being (*inter alia*) to report on the status of the country's biodiversity and the conservation status of all listed threatened or protected species and ecosystems.

NEMBA provides for a range of measures to protect ecosystems and for the protection of species that are threatened or in need of protection to ensure their survival in the wild, including a prohibition on carrying out a "restricted activity" involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. Lists of critically endangered, endangered, vulnerable and protected species have been published and a permit system for listed species has been established.

It is also appropriate to undertake a Faunal and Botanical Impact Assessment where developments in an area that is considered ecologically sensitive require an environmental authorisation in terms of NEMA, with such Assessment taking place during the basic assessment or EIA. These two studies will be undertaken during the Eskom project.

The NEMBA is relevant to the proposed project as the construction of the power lines and the substation may impact negatively on biodiversity. Eskom is therefore required to take appropriate reasonable measures to limit the impacts on biodiversity, to obtain permits if required and to also invite SANBI to provide commentary on any documentation resulting from the proposed EIA project.

1.4.6 The National Forest Act, 1998 (Act 84 of 1998) (NFA)

The National Forest Act (NFA), 1998 (No. 84 of 1998) was enacted to:

- Promote the sustainable management and development of forests for the benefit of all;
- Provide special measures for the protection of certain forests and trees;
- Promote the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes;
- Promote greater participation in all aspects of forestry and forest products industry by persons disadvantaged by unfair discrimination.

The NFA enforces the necessity for a license to be obtained prior to destroying any indigenous tree in a natural forest and, subject to certain exemptions, cutting, disturbing, damaging, destroying or removing any protected tree. The list of protected trees is currently contained in Government Notice 734 of 16 September 2011. Licenses are issued by the Minister and are subject to periods and conditions as may be stipulated.

The NFA is relevant to the proposed project as the removal and/or disturbance and/or clearance of protected vegetation may be required and a license\permit in terms of the NFA may be required for this to be done. The biodiversity studies conducted indicated that there is a possibility that a license\permit may be required although this can only be determined once a final walkdown study is conducted before development commences.

1.4.7 Integrated Development Plans

An Integrated Development Plan (IDP) is defined in the Local Government: Municipal Systems Act, 2000 (Act 32 of 2000), as an inclusive and strategic plan that:

- Links, integrates and co-ordinates plans and takes into account proposals for the development of the municipality;
- Aligns the resources and capacity of the municipality with the implementation of the plan

- Forms the policy framework on which annual budgets must be based; and,
- Is compatible with national and provincial development plans and planning requirements binding on the municipality in terms of legislation.

The main purpose of the IDP is considered the enhancement of service delivery and fighting poverty through an integrated and aligned approach between different role-players and stakeholders.

Each municipality is required to produce an IDP which would address pertinent issues relevant to their municipality. However, common concerns include municipal transformation and development, and service delivery and infrastructural development. With regards to the latter, electricity, amongst other municipal services, is highlighted as a priority issue warranting attention, in particular the provision of access to electricity to affected communities and the improvement of the electricity infrastructure (mini-subs, cables). These objectives are anticipated to be achieved through the following strategies (Naledi LM, IDP 2010/2011):

- Upgrade electricity supply
- Prepare business plans to access funding
- Provide electricity to affected communities
- Replace electricity metres

Currently 3285 households do not have electricity in the area.

The Naledi Local Municipality electricity objectives are:

- 'To provide sufficient electricity and areas lighting to the highest affordable level to all communities.'
- 'To maintain a good quality standard in all electricity related infrastructure and services.'
- 'To provide free basic electricity to poor households within Naledi.'

The target for 2010, according to Naledi Local Municipality IDP is:

- 630 households to be connected at Ditlhakwaneng by December 2010
- 195 households at Devondale to be connected by Eskom
- 1 500 erven to be completed by 31 July 2010 at Extension 25, Vryburg
- 1 500 erven to be completed by 30 June 2011 at Extension 28, Vryburg
- 40% of faulty electricity meters will be replaced by December 2010 and 60% by June 2011

The table below represents Naledi's five year infrastructure plan with regards to electricity provision.

Table 3: Naledi's five year Infrastructure Plan for electricity provision

PROJECT NAME	PROJECT LOCATION	PROJECT VALUE	YEAR 2010/2011	YEAR 2011/2012	YEAR 2012/2013	YEAR 2013/2014	YEAR 2014/2015
BULK SERVICES	Upgrade Eskom Supply-Vryburg	R17m	R7m	R10m			
	Vryburg Internal Electricity Upgrade	R35m	R7m	R7m	R7m	R7m	R7m
	Vryburg Electricity meter replacement	R3m	R3m				
	Vryburg Electricity Master plan	R1,10m	R1,10m				
CONNECTIONS	Electricity Connections to 1500 RDP Houses	R13m		R13m			
	Electricity connection to 170 Ditlhakwaneng houses	R1,5m	R1,5m				

In terms of the Kagisano Local Municipality IDP (2009/10), the main energy objective is to facilitate the provision of energy in the entire KLM to eradicate the backlogs as identified in the Ward Plans of the CBP process by the end of Dec. 2012. As a means of achieving this, at local level, Eskom is being provided with lists of Households that require extension of Power-lines (in-fill).

Thus the proposed development (new 132kV power line and substation sites in the Naledi Local Municipality and Kagisano Local Municipality of the North West Province) is aligned with the goals of the municipal IDPs in the Study Area.

1.4.8 Spatial Development Framework

A Spatial Development Framework (SDF) is a plan which outlines the desired spatial development of a municipality. It highlights priority investment and development areas and serves as a guide to decision-makers and investors. A SDF is an integral component of the corresponding IDP, its purpose being to translate the IDP into its spatial implications to provide broad, overall development guidelines. The aim of a SDF is not to control spatial development but rather to act as a framework that gives strategic guidance in respect of the location and nature of anticipated future development in a given municipality. Because land is a scarce resource, it needs to be planned in the most optimum manner.

Both the Naledi Local Municipality and Kagisano/Molopo Local Municipality have identical aims. The aims are essentially to improve/maintain the quality of life in these areas through the investment in appropriate social infrastructure and programmes and basic service delivery to eradicate backlogs and prepare the poor for future growth and development. Of course, any investment in social infrastructure and basic service delivery encompasses electricity. Both municipalities have therefore planned for extensive expansion in both the housing and industrial sectors, which necessitates the provision of electricity.

1.4.9 Integrated Energy Plan for the Republic of South Africa, 2003

The Integrated Energy Plan, developed by the DME, was formulated to address the energy demand of the country balanced with energy supply, transformation, economics and environmental considerations in concourse with available resources. One of the main objectives of the plan is to promote universal access to clean and affordable energy, with emphasis on household energy supply being co-ordinated with provincial and local integrated development programmes. Another objective is to ensure that environmental considerations in energy supply, transformation and end use are made. This project is thus a goal in order to implement this plan.

1.4.10 Integrated strategic Electricity planning (ISEP) 2005

Eskom's Integrated Strategic Electricity Planning (ISEP) process is intended to provide strategic projections of supply-side and demand-side options to be implemented to meet long-term load forecasts. It provides the framework for Eskom to investigate a wide range of new supply-side and demand-side technologies with a view to optimising investments and returns.

1.4.11 Conservation of Agricultural Resources Act No. 43 of 1982

The Conservation of Agricultural Resources Act (CARA) No. 43 of 1982 controls the utilization of natural agricultural resources in South Africa. The Act promotes the conservation of soil, water sources and vegetation as well as the combating weeds and invader plants. The Act has been amended in part by the Abolition of Racially Based Land Measures Act, No. 108 of 1991.

The primary objective of the Act is to conserve natural agricultural resources by:

- maintaining the production potential of land;
- combating and preventing erosion and weakening or destruction of the water resources;
- protecting vegetation; and
- combating weeds and invaders plants.

The CARA is relevant to the proposed project as the construction of wind energy facilities as well as other components (such as power lines and the substations) may impact on agricultural resources and vegetation on the site. The Act prohibits the spreading of weeds and prescribes control measures that need to be complied with in order to achieve this. As such, measures will need to be taken to protect agricultural resources and prevent weeds and exotic plants from invading the site as a result of the proposed development.

An agricultural potential assessment has been conducted to explore how the proposed development may impact on the agricultural production potential of the proposed site.

1.4.12 Subdivision of Agricultural Land Act No. 70 of 1970, as amended

The Subdivision of Agricultural Land Act No. 70 of 1970 controls the subdivision of all agricultural land in South Africa; prohibiting certain actions pertaining to agricultural land. Under the Act the owner of agricultural land is required to obtain consent from the Minister of Agriculture in order to subdivide agricultural land.

The purpose of the Act is to prevent uneconomic farming units from being created and degradation of prime agricultural land. To achieve this purpose the act also regulates leasing and selling of agricultural land as well as registration of servitudes.

The Act is of relevance to the proposed development as any land within the study area that is zoned for agricultural purposes will be regulated by this Act.

Although the whole of this Act has been repealed by section 1 of the Subdivision of Agricultural Land Act Repeal Act 64 of 1998, this Repeal Act has not been implemented and no date of coming into operation has been proclaimed.

It is important to note that the implementation of this act is problematic as the Act defines 'Agricultural Land' as being any land, except land situated in the area of jurisdiction of a municipality or town council, and subsequent to the promulgation of this Act uninterrupted Municipalities have been established throughout South Africa.

1.4.13 Additional Relevant Legislation

Additional relevant legislation includes the following:

- Occupational Health and Safety Act No. 85 of 1993
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
- Development Facilitation Act No. 67 of 1995
- Northern Cape Planning and Development Act, 1998 (Act No. 7 of 1998)

2 APPROACH TO UNDERTAKING THE STUDY

The EIA was undertaken in accordance with the EIA Regulations (2006) published in GN No. 385, No 386 and No 387 in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No 107 of 1998) as amended as well as with the relevant legislation and guidelines mentioned above.

2.1 Environmental Scoping Study

The Scoping Study identified the potential positive and negative impacts associated with the proposed development. The Scoping Study also identified the studies which were required to be undertaken as part of the EIA stage of the project. The Draft Scoping Report was made available for public review from the 27th of October 2010 to the 25th of November 2010. The following studies were undertaken through into the Scoping Phase:

- Biodiversity;
- Avi-fauna;
- Surface Water;
- Geotechnical;
- Geohydrology;
- Heritage;
- Visual; and
- Social.

2.2 Authority Consultation

The National Department of Environmental Affairs (DEA) are the determining authority on this application. The following consultation has taken place with DEA:

- An amended application was submitted to DEA on the 13th of October 2010. This application was acknowledged on the 13th of October 2010 and was assigned the reference number 12/12/20/1929. Permission was thus granted to submit a Scoping Report for the proposed project.
- The Final Scoping Report was submitted to the National Department of Environmental Affairs (N DEA) on the 19th of January 2011 and approved on the 29th of March 2011.

A record of all authority consultation is included within Appendix 1.

Consultation with other relevant authorities was and is also being undertaken via meetings and telephonic consultation in order to actively engage them and provide them with information and gain their feedback.

2.3 Environmental Impact Report

The EIR Phase of the project has focused on consulting with Interested and / or Affected Parties (I&APs) as well as conducting specialist studies to address the potential impacts identified during the Scoping Phase.

The purpose of the EIR is to:

- address issues that have been raised during the scoping phase;
- assess alternatives to the proposed activity in a comparative manner;
- assess all identified impacts and determine the significance of each impact; and
- formulate mitigation measures.

3 ASSUMPTIONS AND LIMITATIONS

- All information provided by the applicant to the Environmental Team was correct and valid at the time it was provided.
- It is not always possible to involve all II&APs individually. However, every effort has / is being made to involve as many interested parties as possible. It is also assumed that individuals representing various associations or parties convey the necessary information to these associations / parties.
- The Mookodi Transmission Substation does not form part of the scope of this project, as Environmental Authorisation for the substation has been obtained as part of a separate EIA process. However, a single alignment for the Mookodi Transmission Substation site to the proposed Bophirima Substation Alternatives is included as part of the component of this proposed project.
- The decommissioning of Woodhouse Substation does not form part of the scope of this project.

4 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

Electricity provision in South Africa is a critical issue. It is impossible to create an economically sound country without a secure and reliable energy source. In addition, with the threat of climate change and global warming, the pressure to generate green energy (as an alternative to coal-fired energy, South Africa's primary energy source and the most damaging to the environment in terms of emissions) is becoming increasingly real.

In the context of the proposed project and study area, the need for an upgrade in electricity distribution infrastructure has been identified as a critical need to ensure improved electricity supply to support proposed housing development in the local municipal area. Concern has been raised about the capacity of feeders supplied from the existing Delareyville Substation. The feeders are highly loaded, are very long (experiencing low voltages) and have too many customers. The Tswaing Local Municipality is planning to build 10,000 RDP houses in the next few years which would result in a saturation load of 24MVA, and as such the network needs strengthening in order to create capacity for these new loads.

As such the need for the proposed power line and substations has been identified. The development of this electricity distribution infrastructure is critical in order to allow the housing needs of the municipality to be met.

4.1 Potential Advantages and Disadvantages

4.1.1 Advantages

- Employment and training opportunities for people in the local community and local contractors.
- The proposed substations and associated power line will result in a major benefit to the communities surrounding Delareyville in that it will increase electricity capacity of the area.

4.1.2 Disadvantages

- Potential visual impacts.
- A potential disadvantage of the proposed project will be the loss of arable land by the land owners due to the proposed substations and associated lines. This is however anticipated to be minor due to the small scale of the project and the fact that the

landowner will be able to continue with farming once the lines are in place. The land owner will be compensated for the loss of land due the development and for loss of crops during the construction phase.

- Minor disadvantages to be experienced would be the short term inconveniences caused by the construction phase of the substation and lines. This is however a short term impact and is anticipated to last for an approximate 12 month period.

5 PROJECT DESCRIPTION

This project includes the construction of two (2) substations and five (5) separate 132 KV power lines, with a total length of approximately 130km. The primary power line runs from the proposed Bophirima Substation to Kalplats Substation in the North West Province and is approximately 89 km. The Kalplats-Edwards Dam Ring Extension will consist of an additional ±35km 132kV power line, to be stepped down to 88kV at Edwards Dam existing Distribution Substation. A detailed project and route description is provided in the sections below.

5.1.1 Project Components

The proposed project consists of a number of components which are listed below:

Substations:

- the proposed Bophirima 132/88kV Distribution Substation; and
- the proposed Kalplats 132kV Distribution Substation.

132kV power lines:

- the proposed Bophirima Substation to Kalplats Substation 132kV servitude power line (~89km);
- the proposed Kalplats Substation to the existing Edwards Dam Substation 132kV servitude power line to be stepped down to 88kV at the Edwards Dam substation (~35km);
- the proposed Bophirima Substation to existing Vryburg Municipal Substation 132kV servitude power line (~7km);
- the proposed Bophirima Substation to existing Woodhouse 132kV servitude power line (~0.1km – temporary line until the decommissioning of Woodhouse Substation); and
- the proposed Bophirima Substation to Mookodi Transmission Substation 132kV servitude power line (~14km).[+]

[+] It should be noted that the Mookodi Transmission Substation does not form part of the scope of this project, as Environmental Authorisation for the substation has been obtained as part of a separate EIA process. However, a single alignment for the Mookodi Transmission Substation site to the proposed Bophirima Substation Alternatives is included as part of the component of this proposed project.

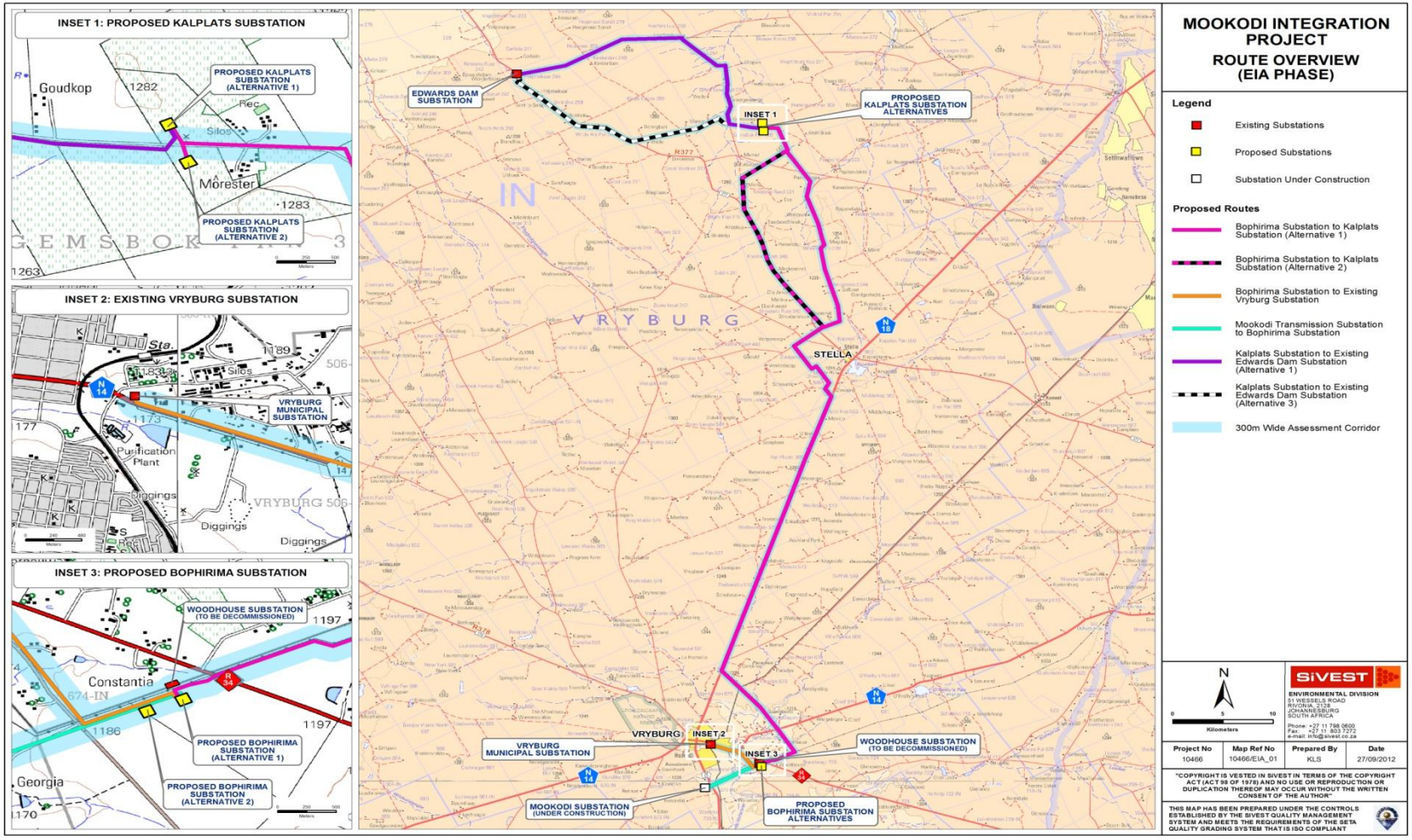


Figure 1: Map of the study area showing overview of the proposed power line alignments and proposed substation locations

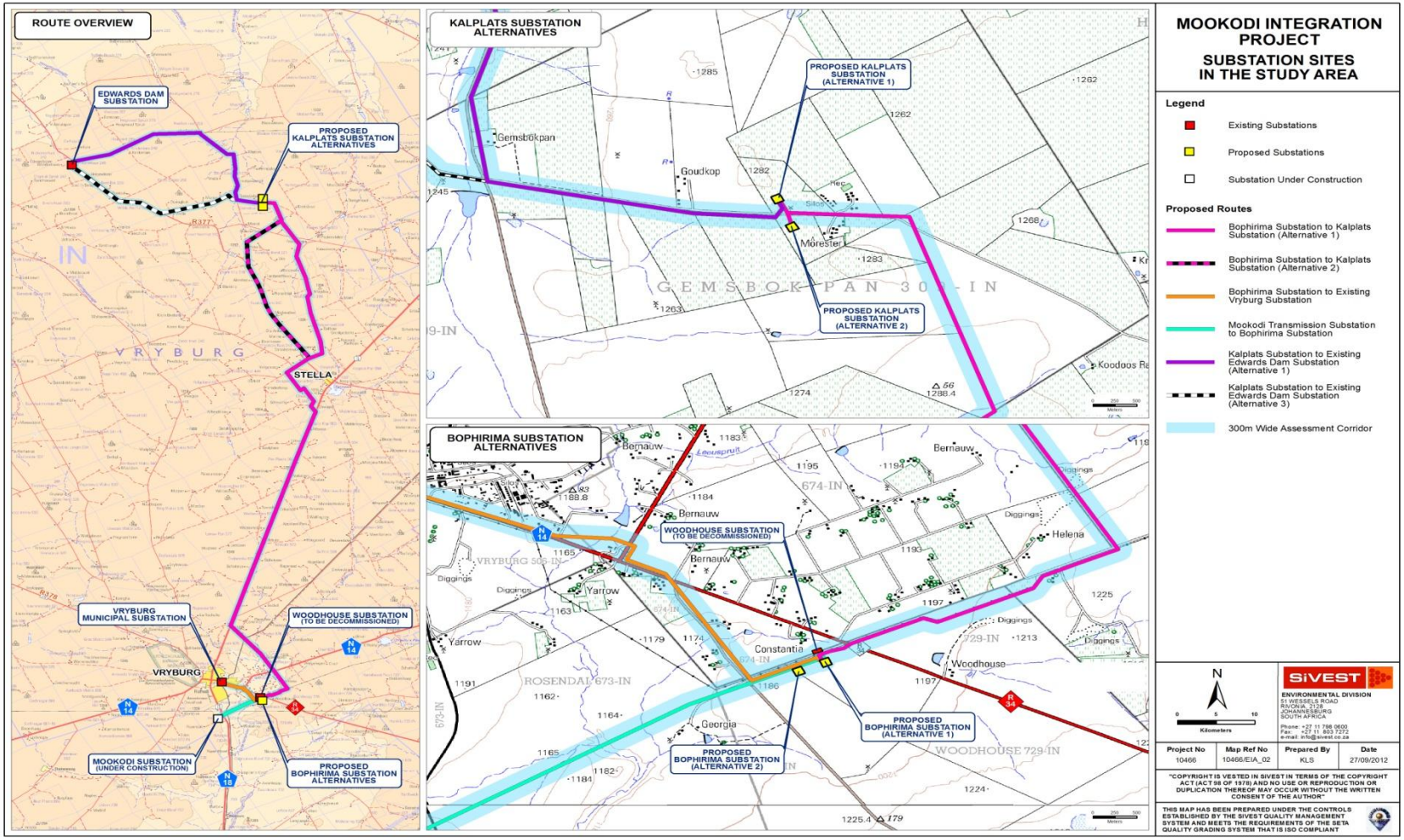


Figure 2: Map showing substation locations and surrounds

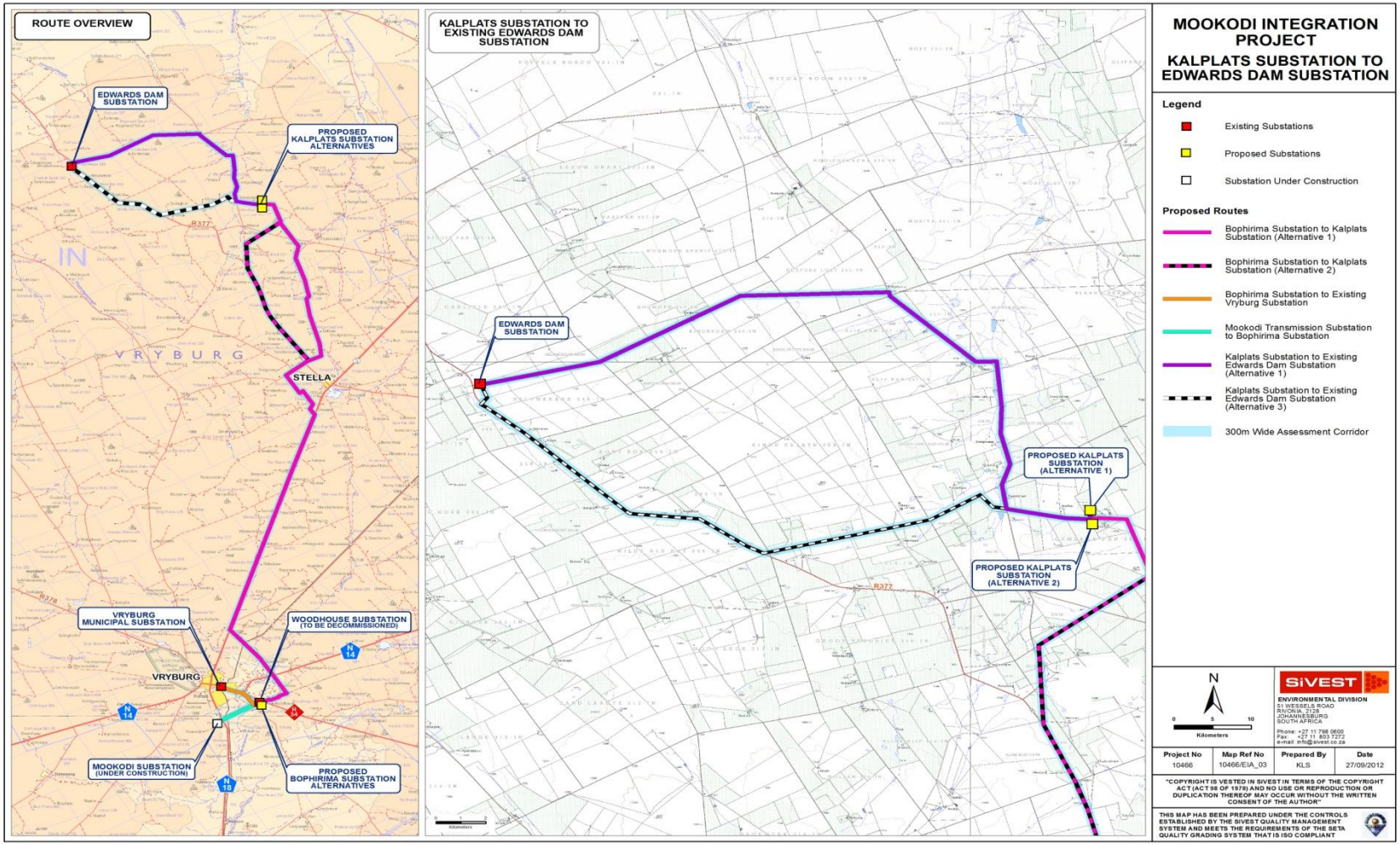


Figure 3: Map showing the Kalplats to Edwards Dam alignments and alternatives

5.1.2 Substations

The proposed substations will occupy an approximate area of 100m X 100m (~10,000m^2 or 1ha). The substations will consist of a number of different components, including feeder bays, transformers, a central control room, lightning conductor mast (14m-high) and a bunded oil drainage area (into which transformer oil / liquids would drain in the event of a spillage). The substation would be enclosed by two levels of fencing to secure the area. The substations will also be lit at night (by a number of 400 Watt floodlights) for security and emergency operational maintenance reasons. A number of power lines will typically enter / leave the substation.

5.1.3 Tower Types and Servitudes

It is proposed that both monopole structures (Figure 3) and lattice structures (Figure 4) will be used where appropriate. Single-tern conductor power lines are proposed. Monopole and lattice tower types that are bird-friendly will be used for the proposed power lines. The monopole tower type is approximately 25m in height. The footprint will be unique for each tower based on the ground conditions such as slope etc. A diagram of the proposed tower types are indicated below. Strain towers will also be used (A strain tower is a larger tower utilised in bends and where reinforcement is required with regards to tower stability).

In most cases the land beneath the overhead lines can be used, as normal, by the landowners. Eskom, however, require that no dwellings or vegetation/crops higher than 4m be established within the servitude.

The minimum servitude width for each line will be 31m.

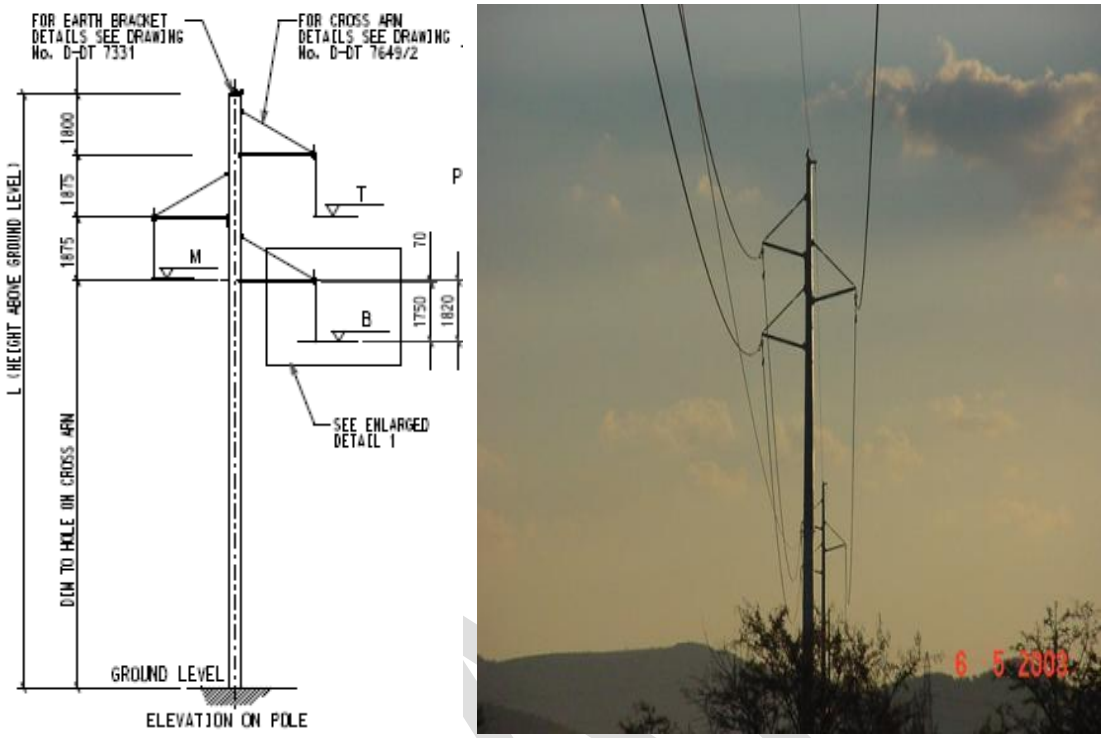


Figure 4: Proposed Monopole Structures

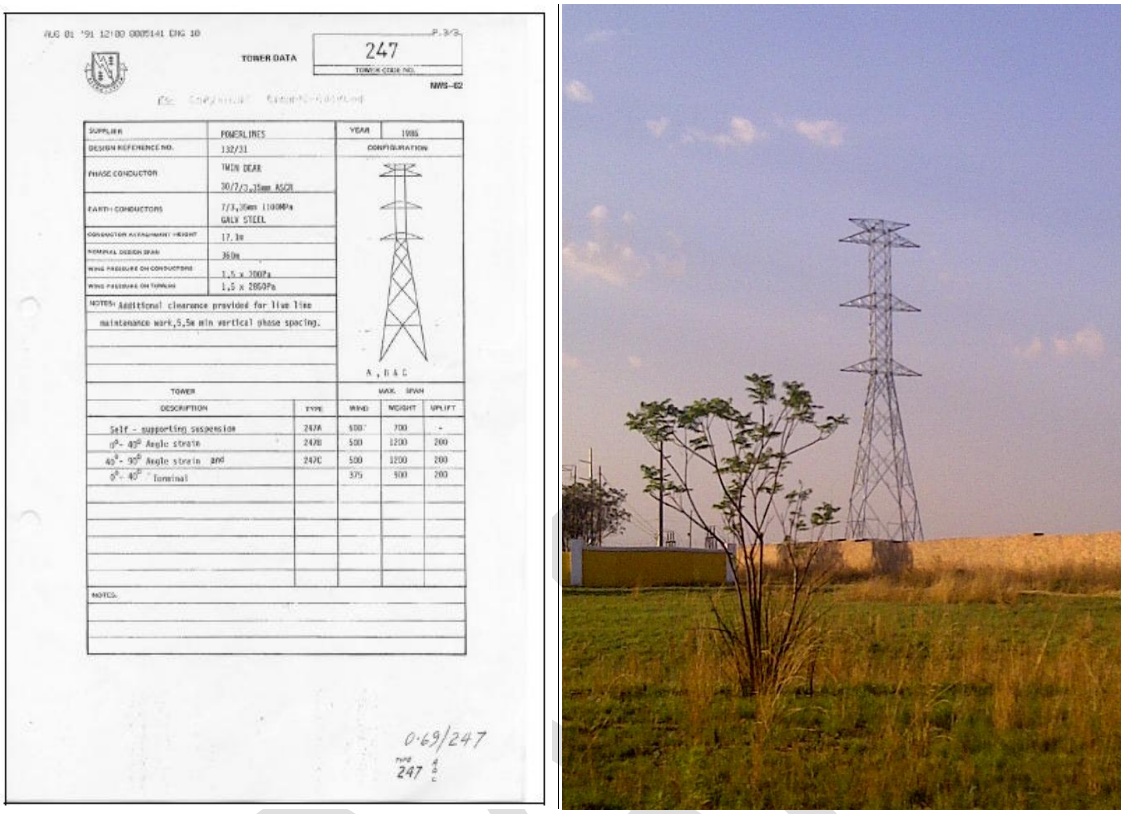


Figure 5: Proposed Lattice Structures

5.1.4 Assessment Corridor

A 300m-wide corridor is currently being investigated to allow some flexibility during construction, and to take any site-specific environmental sensitivities into account. The corridor will allow for numerous route alternatives within its width to potentially be selected, and thus forms part of the location alternative assessment. The 31m servitude will be placed within this corridor, unless the EIA studies identify the need to re-route the proposed alignment to avoid sensitive environmental or no-go areas.

5.2 Route Description

A number of proposed components have been included as part of the Mookodi Integration Project. These components are illustrated in the figures in Section 5.1 above and are described in detail below.

5.2.1 Proposed Bophirima Distribution Substation - Alternatives 1 and 2:

The general area of the proposed Bophirima Distribution Substation is located beyond the south-eastern outskirts of Vryburg close to the Bernauw smallholdings. The two substation alternative sites are located to the south of the R34 road, relatively close to the farmstead Constantia and the existing Woodhouse Substation. Alternative 1 and 2 are located in relatively close proximity to one another, with Alternative 1 being located immediately adjacent to the Woodhouse Substation and Alternative 2 being situated further to the south west from Alternative 1.

5.2.2 Proposed Kalplats Distribution Substation - Alternatives 1 and 2:

The general area of the proposed Kalplats Distribution Substation is located approximately 28.5km to the north of the town of Stella. The nearest settlement is the hamlet of Papiesvlakte located 8km to the south-east of the Alternatives locations. The two substation alternative sites are situated on agricultural land on the farm Gemsbokpan, to the west of the Môrester farmstead. Alternative 1 is located to the north of a district road, and Alternative 2 is located 500m to the south, on the southern side of the road.

5.2.3 Mookodi Transmission Substation to Bophirima Substation 132kV Power Line Route

The Mookodi Transmission Substation site is located approximately 6km to the south of the town of Vryburg, to the west of the N18 road on the farm Rosendal 673-IN. A single alignment for the 132kV lines that will link the Mookodi Transmission Substation and the proposed Bophirima Distribution Substation have been provided for assessment. The alignment runs from the Mookodi Transmission Substation site in a north easterly direction. It crosses the N18 road and a railway line, running in a north-easterly direction across open natural veld, passing north of the Georgia farmstead. The alignment then follows parallel to two existing distribution power lines in this area, as well as parallel to the initial section of the proposed Bophirima Substation to Vryburg Municipal Substation 132kV route alignment.

5.2.4 Bophirima Distribution Substation to Vryburg Municipal Substation 132kV power line route

From the proposed Bophirima Substation alternative sites the route of the proposed alignment runs to the south-west across open vacant land, running parallel to two existing distribution power lines and parallel to the alignment for the proposed Mookodi to Bophirima 132kV power line route.

The route turns north west before an unsurfaced district road. The route runs parallel with the unsurfaced district road until it meets with the N14. The route then crosses the N14 and runs in a north westerly direction for approximately 400m before turning north east for a short distance of approximately 100m, and then turns to the north-west behind a BP filling station / truck stop-over complex. The alignment heads back towards the N14 and crosses the Leeuspruit wetland. The alignment then runs towards the Vryburg town centre running through a light industrial area. The proposed power line will then run parallel to the N14 in the road reserve to where the existing Vryburg Municipal Substation is located.

5.2.5 Bophirima Distribution Substation to Kalplats Distribution Substation 132kV Power Line Route

Alternative alignments have been provided for comparative assessment along a part of the alignment to the north of the town of Stella. Both alternatives follow the same alignment between Vryburg (Bophirima) and Stella.

The route is proposed to exit the proposed Bophirima Substation, running north-east from the substation site and crossing the R34 road into the Bernauw smallholdings. The alignment crosses mostly open vacant grazing land in this area and is proposed to run parallel to a set of existing distribution power lines. To the south of the farmstead Helena, the alignment turns and runs in a north-westerly direction along a cadastral boundary between the farms Bernauw and Welgelegen. The alignment runs across open natural veld used for livestock grazing to where it crosses the N14 road near the farmstead Oppie Koppie. The route continues in a north-westerly alignment, crossing a railway, across open grazing land. The route intersects the Paradise unsurfaced local access road, running parallel to it before intersecting the N18 road.

To the north of this point the alignment turns to run parallel to the N18 in a north-easterly direction towards Stella. The alignment passes the Boereplaas Resort and the turn-off to Devondale, traversing the farms Elma, Thabanchu, Mabula, Weltevreden, Pan Plaats and Spitz Kop. The route traverses open veld and pastures which are used mainly for grazing through this area. Approximately 3km to the south of Stella the route turns away to the north-west from the N18, following a farm access road to the Chwaing farmstead. The alignment then moves away from the farm access road to follow a cadastral boundary, thus running to the east of the Chwaing farmstead. The route continues to run across open grazing pastures along the cadastral boundary of Zoutpansfontein to where it intersects with a local district road. The route turns to the north-east to run parallel to the road, then running across more pastures to the south of the Stroebelsrus farmstead. The route traverses the R377 (unsurfaced) road to the point where Alternative 1 and 2 split.

The proposed Bophirima Substation to Kalplats Substation Alternative 1 runs to the north east for a short distance along the boundary of the Farm Wilgemoed 344 consisting mainly of dry land maize cultivation before turning predominantly northwards. The proposed power line route runs through the farms Wilgemoed 344 (close to the Gelboer farmstead), Wonderklip 339 (close to the Waterval farmstead), and Koodos Rand near the Paardepan farmstead. The alignment traverses a mix of natural bushveld vegetation and cleared pastures and cultivated fields as it passes the farms Wonderklip and Koodoos Rand. From this point, the proposed route turns to the northwest, traversing a district road and the farm boundary of the Koodoos Rand and Gemsbok Pan for a relatively short distance. The proposed route then turns to the west where it eventually meets with the two proposed Kalplats Substation Sites.

Bophirima Substation to Kalplats Substation Alternative 2 leaves Alternative 1 to the north of Stella, running across maize fields before intersecting, and then running parallel to the R377 in a north-westerly direction. It crosses a mix of farming land (maize fields) and natural thornveld, traversing the farms Welgemoed, Koodoos Dam, Blink Klip and Koodoos Rand. At the intersection of the R377 and a district road, the route turns away from the R377 in a northerly direction for a short distance before following the cadastral boundary of the farm Koodoos Rand to the north east. The route intersects the district road still running in a north easterly direction until meeting up with the Bophirima Substation to Kalplats Substation Alternative 1 where the proposed alignment follows the same route to the Kalplats Substation Sites.

5.2.6 Proposed Kalplats Substation Alternatives 1 and 3 to existing Edwards Dam Substation 132kV power line route

Alternative 1 exits the proposed Kalplats substation and heads west over agricultural/ cultivated land for approximately 3.7kms until it meets with a district road. The route then turns north, following the district road alignment across the farm Groot Gewaagd to Klip Pan, and then heads north-west towards Heeferslust. Just south of Heeferslust, the route turns west and then south-west following an existing power line servitude all the way to Edwards Dam situated adjacent to the Provincial Road R377. This last sector of the route travels across cultivated lands comprising the farms Heefers Lust, Kinderdam, Houmoed and Helpmekaar.

Alternative 3 exits the proposed Kalplats substation and heads west across the District Road following the alignment of a local road for approximately 2kms through agricultural land. The route then runs along the northern boundary of the farm Gemsbok Pan heading in a westerly direction where it then follows the Groot Verdriet 310 farm boundary until it meets up with the R377. The proposed route then follows the alignment of the Provincial Road R377 to Edwards Dam crossing the farms Bont Bok 259 and Helpmekaar.

5.3 Route Discards and Adjustments

Several routes have been discarded and as well as a few adjustments have been made to the original routes identified during the scoping phase for the proposed development which have been taken forward in the EIA phase. A breakdown of these discards and adjustments are summarised below. The reasons for the various discards and/or adjustments are also provided below.

5.3.1 Finalisation of the power line route between the proposed Bophirima Substation and Mookodi Transmission Substation

At the start of the EIA process there were two potential sites for the Mookodi Substation, Site A to the south-east of Vryburg along the R34 (Schweizer Reneke road), and Site C to the south of Vryburg along the N18. Accordingly, two potential routes to link the Bophirima Substation with the Mookodi Substation were presented, and two separate applications to reflect the two different Mookodi Substation alternatives were made to the DEA. During the course of the scoping phase, a different nearby location was granted Environmental Authorisation (as part of a separate EIA) by the DEA. It should thus be noted that both Site A and Site C as well as the proposed power lines linking the proposed Bophirima Substation Site to Site A and C falls away. The application containing this link has also been withdrawn. The Bophirima to Mookodi power line now runs directly to the approved Mookodi Substation site. Please refer to the attached overview map for this route.

5.3.2 Decommissioning of the existing Woodhouse Substation

Eskom plans to decommission the existing Woodhouse Substation that is located just to the south of the R34 provincial road to the east of Vryburg. This old substation will now be replaced by the proposed Bophirima Substation which is proposed to be built directly east of the existing Woodhouse Substation on the Portion 26 of the Farm Bernauw 674-IN.

The Woodhouse Substation is nearing the end of its operational lifespan and Eskom have identified the opportunity to replace this substation and upgrade with the construction of the proposed Bophirima Substation. Importantly, the Bophirima Substation is proposed to be constructed prior to the Woodhouse Substation being decommissioned, thus alleviating any potential electricity supply disruptions.

It must be noted that the decommissioning of the existing Woodhouse Substation does not form part of this EIA process or application.

5.3.3 Discarding of the Bophirima to Woodhouse 132kV line

As the Woodhouse Substation is planned to be decommissioned, the short proposed power lines that would have linked the proposed Bophirima Substation with the existing Woodhouse Substation have been discarded.

5.3.4 Elimination of alternative route alignment corridors: Bophirima to Vryburg Municipal Power line

Due to technical constraints that have been recently identified, one of the alternatives for the proposed 132kV line between the proposed Bophirima Substation and the existing Vryburg Municipal Substation has had to be discarded. Due to a proposed housing development in the Bernauw Smallholdings area, Alternative 2 of the Bophirima to Vryburg line is no longer technically feasible and has been discarded. Due to other technical constraints identified, the route of the only remaining alternative (Alternative 1) between the proposed Bophirima Substation and the Vryburg Municipal Substation has changed slightly, please refer to the attached map for the latest alignment and associated corridor.

It should further be noted that the section of this proposed power line close to the Vryburg Municipal Substation that was proposed to be buried underground will no longer be buried. The entire length of the Alternative 1 will be overhead.

Change of alternative route alignment corridors: Proposed Bophirima Substation to proposed Kalplats Substation 132kV power line

Due to certain technical constraints, changes to the alignments have been made to the corridors of Alternatives 1 and 2 of the proposed Bophirima to Kalplats 132kV power line in the area to the south of the proposed Kalplats Substation. Due to space constraints around the Memel farmstead, and to accommodate space for the proposed Kalplats to Edwards Dam power line to the west of the proposed Kalplats Substation site, a part of Alternative 2 has been re-aligned to follow a cadastral boundary (south of the Memel farmstead) to link up with Alternative 1 to the south-east of the substation site. Additionally, the alignment of Alternative 1 has been altered slightly to the south-east of the proposed Kalplats Substation Site. The revised alignments and corridors are indicated in the attached map.

5.3.5 Change of alternative route alignment corridors: Proposed Kalplats Substation to Edwards Dam Substation 132kV power line

Due to technical constraints, Alternative 2 of the proposed Kalplats to the existing Edwards Dam 132kV power line has been discarded. Two alternatives, Alternative 1 and Alternative 3 have been retained. Following landowner feedback in the Scoping Phase Public Participation Process, a part of Alternative 3 in the area to the west of Dirkiesrus has been changed to follow the R377 for a greater distance and to follow a cadastral (property) boundary. The revised alignment and associated corridor is indicated in the attached map.

6 ALTERNATIVES

The EIA Regulations under NEMA require that alternatives be assessed. For the proposed development, location alternatives have been provided for environmental assessment and have thus been considered as part of this EIA. In addition to location (routing) alternatives, the "no-go" alternative has been assessed.

6.1 Location Alternatives

A number of alternative corridors have been provided for investigation in the environmental assessment. The corridors have an average width of 300m. As previously mentioned, the reasoning behind investigating a 300m wide corridor is to allow some flexibility during construction, and to take any site-specific environmental sensitivities into account. The corridor will allow for numerous route alternatives within its width to potentially be selected, and thus forms part of the location alternative assessment. The 31m servitude will be placed within this corridor, unless the EIA studies identify the need to re-route the proposed alignment to avoid sensitive environmental or no-go areas.

Two alternative corridors have been proposed for two of the proposed power line routes. This includes two alternative corridors for the proposed Bophirima Distribution Substation to Kalplats Distribution Substation 132kV power line route. In addition, two alternative corridors have been proposed for the Kalplats Substation to the existing Edwards Dam Substation 132kV power line route. These alternatives are presented in Table 4 below.

Table 4: Corridor Routing Alternatives assessed for the proposed development.

Alternative	Location
Bophirima Distribution Substation to Kalplats Substation Alternative 1	Both alternatives follow the same alignment between Vryburg (Bophirima) and Stella. However, from the point where Alternative 1 and 2 split, the proposed Bophirima Substation to Kalplats Substation Alternative 1 runs to the north east for a short distance along the boundary of the Farm Wilgemoed 344 consisting mainly of dry land maize cultivation before turning predominantly northwards. The proposed power line route runs through the farms Wilgemoed 344 (close to the Gelboer farmstead), Wonderklip 339 (close to the Waterval farmstead), and Koodos Rand near the Paardepan farmstead. The alignment traverses a mix of natural bushveld vegetation and cleared pastures and cultivated fields as it passes the farms Wonderklip and Koodoos Rand. From this point, the proposed route turns to the northwest, traversing a district road and the farm boundary of the Koodoos Rand and Gemsbok Pan for a relatively short distance. The proposed route then turns to the west where it eventually meets with the two proposed Kalplats Substation Sites.
Bophirima Distribution Substation to Kalplats Substation Alternative 2	Both alternatives follow the same alignment between Vryburg (Bophirima) and Stella. However, from the point where Alternative 1 and 2 split, the Bophirima Substation to Kalplats Substation Alternative 2 leaves Alternative 1 to the north of Stella, running across maize fields before intersecting, and then running parallel to the R377 in a north-westerly direction. It crosses a mix of farming land (maize fields) and natural thornveld, traversing the farms Welgemoed, Koodoos Dam, Blink Klip and Koodoos Rand. At the intersection of the R377 and a district road, the route turns away from the R377 in a northerly direction for a short distance before following

Alternative	Location
	the cadastral boundary of the farm Koodoos Rand to the north east. The route intersects the district road still running in a north easterly direction until meeting up with the Bophirima Substation to Kalplats Substation Alternative 1 where the proposed alignment follows the same route to the Kalplats Substation Sites.
Kalplats Substation to the existing Edwards Dam Substation Alternative 1	Alternative 1 exits the proposed Kalplats substation and heads west over agricultural/ cultivated land for approximately 3.7kms until it meets with a district road. The route then turns north, following the district road alignment across the farm Groot Gewaagd to Klip Pan, and then heads north-west towards Heeferslust. Just south of Heeferslust, the route turns west and then south-west following an existing power line servitude all the way to Edwards Dam situated adjacent to the Provincial Road R377. This last sector of the route travels across cultivated lands comprising the farms Heefers Lust, Kinderdam, Houmoed and Helpmekaar.
Kalplats Substation to the existing Edwards Dam Substation Alternative 3	Alternative 3 exits the proposed Kalplats substation and heads west across the District Road following the alignment of a local road for approximately 2kms through agricultural land. The route then runs along the northern boundary of the farm Gemsbok Pan heading in a westerly direction where it then follows the Groot Verdriet 310 farm boundary until it meets up with the R377. The proposed route then follows the alignment of the Provincial Road R377 to Edwards Dam crossing the farms Bont Bok 259 and Helpmekaar.

Two location alternatives for the substation sites have also been proposed to be investigated for the location of the proposed Bophirima Distribution Substation and the proposed Kalplats Substation. These alternatives are presented in Table 4 below.

Table 5: Routing Alternatives assessed for the proposed Northern Corridor

Alternative	Location
Bophirima Substation Alternative 1	The general area of the proposed Bophirima Distribution Substation is located beyond the south-eastern outskirts of Vryburg close to the Bernauw smallholdings. The two substation alternative sites are located to the south of the R34 road, relatively close to the farmstead Constantia and the existing Woodhouse Substation. Alternative 1 and 2 are located in relatively close proximity to one another, with Alternative 1 being located immediately adjacent to the Woodhouse Substation and Alternative 2 being situated further to the south west from Alternative 1.
Bophirima Substation Alternative 2	The general area of the proposed Bophirima Distribution Substation is located beyond the south-eastern outskirts of Vryburg close to the Bernauw smallholdings. The two substation alternative sites are located to the south of the R34 road, relatively close to the farmstead Constantia and the existing Woodhouse Substation. Alternative 1 and 2 are located in relatively close proximity to one another, with Alternative 1 being located immediately adjacent to the Woodhouse Substation and Alternative 2 being situated further to the south west from Alternative 1.
Kalplats Substation Alternative 1	The general area of the proposed Kalplats Distribution Substation is located approximately 28.5km to the north of the town of Stella. The nearest settlement is the hamlet of Papiesvlakte located 8km to the south-east of the Alternatives locations. The two substation alternative sites are situated in agricultural land on the farm Gemsbokpan, to the west of the Môrester farmstead. Alternative 1 is located to the north of a district road, and Alternative 2 is located 500m to the south, on the southern side of the road.
Kalplats Substation Alternative 2	The general area of the proposed Kalplats

Alternative	Location
	Distribution Substation is located approximately 28.5km to the north of the town of Stella. The nearest settlement is the hamlet of Papiesvlakte located 8km to the south-east of the Alternatives locations. The two substation alternative sites are situated in agricultural land on the farm Gemsbokpan, to the west of the Môrester farmstead. Alternative 1 is located to the north of a district road, and Alternative 2 is located 500m to the south, on the southern side of the road.

Each of these alternatives has been comparatively assessed by each specialist study. These comparative assessments and the result of these have been presented in Section 15 below.

6.2 The "No-go" Alternative

The "no-go" alternative assumes that the proposed activity does not go-ahead, implying a continuation of the current situation or the status quo. The "no-go" or "no-action" alternative is regarded as a type of alternative that provides the means to compare the impacts of project alternatives with the scenario of a project not going ahead. In evaluating the "no-go" alternative it is important to take into account the implications of foregoing the benefits of the proposed project.

In the case of this project, the "no-go" alternative would entail that no distribution power lines would be constructed to allow electricity to be transmitted out of the power station. . The absence of the proposed distribution power lines to link the proposed distribution substations with the national grid would not allow the power station to provide any electricity to the grid, thus not allowing the power station to assist in the improvement of the electricity supply situation in the country. In this case, none of the negative or positive impacts associated the proposed power lines would be likely to occur. Accordingly a number of negative impacts would be unlikely to materialise, but this should be weighed up against the non-materialisation of the positive impacts associated with the project and in particular the benefits to the national economy that would be associated with the provision of electricity from the proposed power station. The selection of the no-go option would also hinder the future supply of electricity to the Vryburg and Edwards Dam area.

7 DESCRIPTION OF THE ENVIRONMENT

This section summarises the baseline findings of the Scoping Phase of the project.

7.1 Regional Locality

In a macro-geomorphological context the study area falls on a flat plateau as it occurs at the interface between the Highveld plateau which dominates much of the central parts of South Africa and the flat Kalahari Basin which comprises much of the western interior of the subcontinent. The terrain in the study area is thus very flat, with only localised high ground occurring in the northern part of the study area. The Study Area is predominantly rural in character and the predominant land use and economic activity which characterises most of area is commercial beef farming. Areas of dry land maize cultivation occur in the northern parts of the study area. The largest urban centre within the study area is the town of Vryburg, around which much of the proposed electrical infrastructure is proposed. A number of roads bisect the area; the main arterial routes are the N14 national road (which runs through Vryburg, linking it to Delareyville to the east and Kuruman to the west), the N18 national road (which links Vryburg with Stella and Mafikeng to the north and Taung to the south) and the R377 unsurfaced provincial road (which links Stella with Piet Plessis to the north-west).

The study area is located within the central part of the North West Province, approximately 330km to the west of Johannesburg. Most of the alignment traverses the Naledi Local Municipality, while parts of the Kalplats to Edwards Dam alignment fall within the Molopo Local Municipality and the Kagisano Local Municipality. Most of the proposed shorter power line components lines and the proposed new Bophirima Distribution Substations are located within the vicinity of the town of Vryburg, whilst the sites for the proposed Kalplats Substation are located to the North of the town of Stella. The longest power line component, the proposed Bophirima – Kalplats 132kV power line, stretches from Vryburg north to an area beyond the town of Stella. The proposed Kalplats- Edwards Dam power line extends from the north of Stella to Edwards Dam to the west of the proposed Kalplats substation.

7.2 Surrounding Land-uses

Land-use within the study area is dominated mainly by undeveloped natural land along the proposed power line routes and substation sites (Figure 6). Cultivation is however, extensively practised along the proposed power line routes along with relatively isolated areas of subsistence

agriculture and degraded areas. Finally, built up areas and settlements dominate in the Vryburg area.

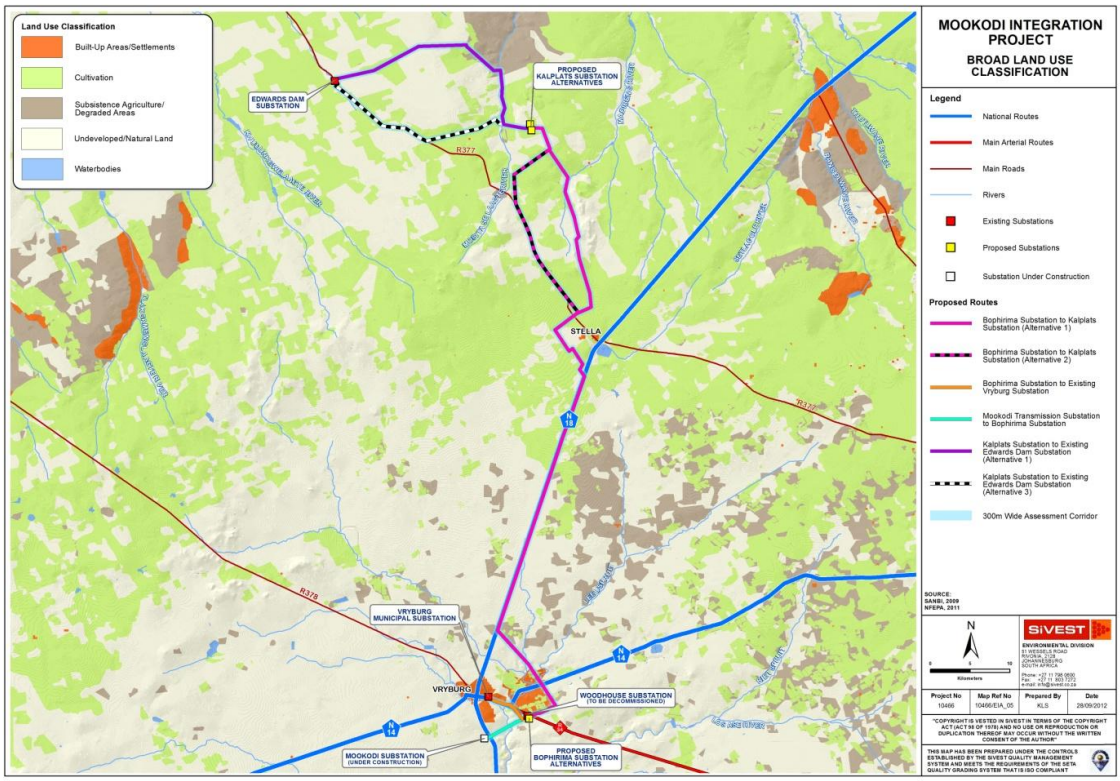


Figure 6: Land-use Map for the Proposed Project

7.3 Climate

The climate of the Study Area can be classified as semi-arid with a summer rainfall regime and with most of the rainfall confined to summer and early autumn (Mucina and Rutherford, 2006). The summer movement of the Inter-Tropical Convergence Zone over southern Africa is responsible for most of the rain over the Study Area.

Mean Annual Precipitation (MAP) ranges from 300mm to 500mm and Mean Annual Moisture Stress (MAMS) (i.e. percentage of days when evaporative demand is greater than double the soil moisture supply) is estimated at 83% (Mucina and Rutherford, 2006). Climatic data indicates that there is very strong seasonality in the rainfall, with little to no rainfall occurring in the months between May and October. The vast majority of the rainfall occurs in the months of December, January February and March (Mucina and Rutherford, 2006). Rainfall typically occurs in the form of short convective thundershowers of short duration. Average daily minimum temperatures range

from 22°C in summer to 15°C in winter, while average daily maximum temperatures range from 34°C in summer to 22°C in winter.

7.4 Biodiversity (Flora and Fauna)

A floral and faunal assessment was conducted by SiVEST and is included in Appendix 3A.

7.4.1 Flora of the Study Area

The vegetation of the broad study area falls within the Savanna Biome, Grassland Biome and Inland Azonal Vegetation. Several vegetation types are present along the proposed route and these are listed below (Table 6 and Figure 7). Two Vulnerable vegetation types i.e. Mafikeng Bushveld and Stella Bushveld and two endangered vegetation types i.e. Schweizer-Reneke Bushveld and Western Highveld Sandy Grassland are present. Meanwhile Ghaap Plateau Vaalbosveld, Southern Kalahari Salt Pans and Highveld Alluvial Vegetation types are least threatened.

Table 6: Vegetation types in the study area

Vegetation Class	Conservation Status	Protection Status
Mafikeng Bushveld	Vulnerable	Not Protected
Stella Bushveld	Vulnerable	Not Protected
Ghaap Plateau Vaalbosveld	Least Threatened	Not Protected
Southern Kalahari Salt Pans	Least Threatened	Poorly Protected
Highveld Alluvial Vegetation	Least Threatened	Poorly protected
Schweizer-Reneke Bushveld	Endangered	Not Protected
Western Highveld Sandy Grassland	Endangered	Hardly protected

Greater Study area
Directly affected

It is important to note that only Mafikeng Bushveld, Stella Bushveld and Ghaap Plateau Vaalbosveld vegetation types are anticipated to be directly affected by the proposed development as they are traversed by the power lines. The other vegetation types are quite distant from the proposed development and hence the impact is not expected to be significant.

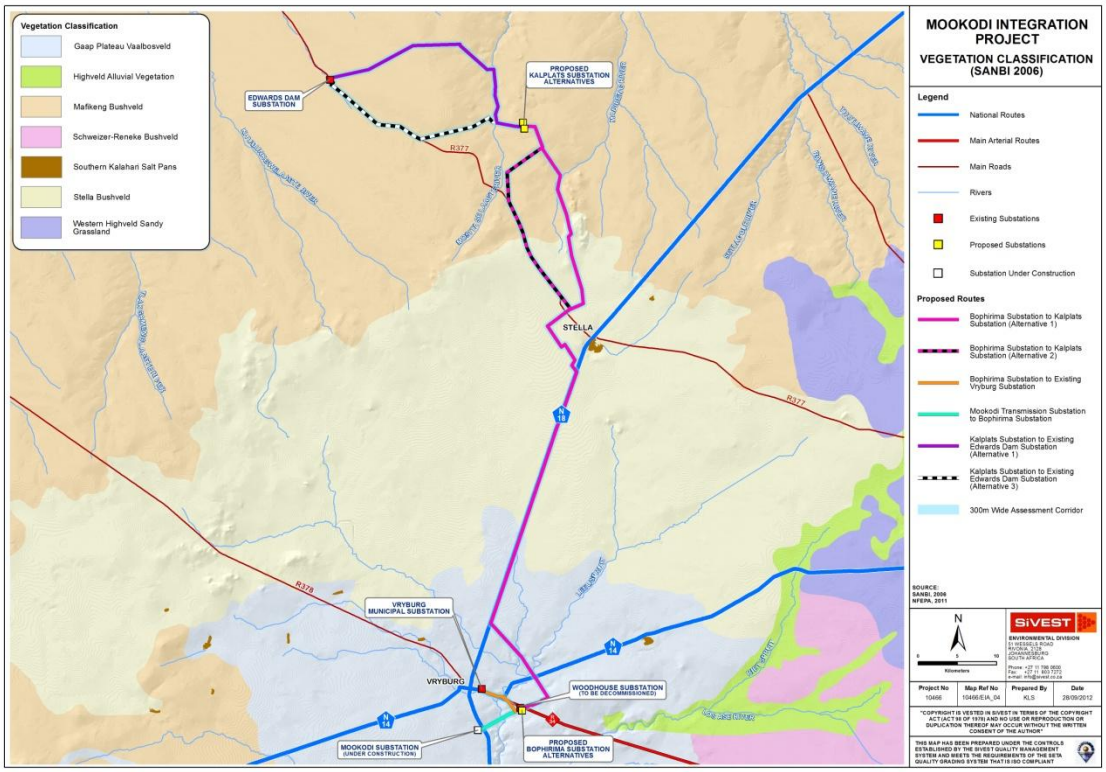


Figure 7: Vegetation of the study area

- Mafikeng Bushveld

This bushveld is occurs on Aelioan Kalahari sand of tertiary to recent age, flat sandy plains and soils deep. It is vulnerable with about 25% already transformed mainly by cultivation and urban development. While tall tree species are dominated by *Acacia erioloba*, small tree species are dominated by *Acacia karroo*, *Ziziphus mucronata* and *Terminalia sericea*. Shrubs include: *Dichrostachys cinerea*, *Grewia flava*, *Rhus tenuinervis* and *Acacia hebeclada* subsp. *Hebeclada*. (Mucina & Rutherford, 2006)

- Stella Bushveld

The Stella Bushveld is found on plains to sometimes slightly undulating plains with open tree and shrub layers. Trees such as *Acacia erioloba* and *A. tortillis* and shrubs such as *A. hebeclada*, *Dichrostachys cinerea*, *Grewia flava* and *Tarchonanthus camphorates* (Mucina & Rutherford, 2006). Soils are that of the Andesitic lavas of the Allanridge formation of the Ventersdorp supergroup. Up to 21% has been transformed by cultivation (Mucina & Rutherford, 2006).

- Ghaap Plateau vaalbosveld

This vegetation type occurs on a flat plateau with well developed shrub layer with *Tarchonanthus camphorates* and *Acacia karroo*. The open tree layer has *Olea europaea* subsp. *africana*, *A. tortilis*, *Ziziphus mucronata* and *Rhus lancea* (Mucina & Rutherford., 2006). Much of the South-central part of this unit has remarkably low cover of Acacia species for an arid savanna and is dominated by the non-thorny *T. camphoratus*, *R. lancea* and *O. europaea* subsp. *africana*. Soils are surface limestone of tertiary to recent age and dolomite and chert of the Campbell Group (Griqualand West Supergroup, Vaalian Erathem) support shallow soils (0.1-0.25 m) of Mispah and Hutton soil forms (Mucina & Rutherford, 2006). Only about 1% is already transformed (Mucina & Rutherford, 2006).

- Southern Kalahari Salt Pans

It occurs on low grassland on pan bottoms which are often devoid of vegetation and dominated by *Sporobolus* species mixed with dwarf shrubs (Mucina & Rutherford, 2006). Low shrublands are dominated by *Lycium* and/or *Rhigozum* which normally form the salt pan zonation system outer belt (Mucina & Rutherford, 2006). Soils are sandy sediments of the Cenozoic Kalahari Group (Mucina & Rutherford, 2006)

- Highveld Alluvia Vegetation

This vegetation type is found on flat topography supporting riparian thickets dominated by *Acacia karroo* which is accompanied by seasonally flooded grasslands and disturbed herblands. The herblands are often dominated by alien plants. The soils within this vegetation type are deep, sandy to clayey alluvial soils developed over Quaternary alluvial sediments. Some of the dominant species include *Acacia karroo*, *Salix mucronata*, *Phragmites australis*, *Felicia muricata* among others. In terms of conservation, the vegetation type is least threatened (Mucina & Rutherford, 2006).

- Schweizer-Reneke Bushveld

Schweizer-Reneke Bushveld occurs on Plains, slightly undulating plains and a few hills (Mucina & Rutherford, 2006). It is characterised by open woodland with a fairly dense shrub layer. Trees include *Acacia erioloba, A. Karroo, A. tortilis, Rhus lancea*. Shrubs include *A. hebeclada, Diospyros lyciodes, Grewia flava* and *Tarchonanthus camphorates* (Mucina & Rutherford, 2006). Soils are Andesitic lavas of the Allanridge formation of the Ventersdorp subgroup (Mucina & Rutherford, 2006).

- Western Highveld Sandy Grassland

Found on flat gently undulating plains with short, dry grassland with some woody species occurring in bush clumps. Soils are basaltic lavas of the Klipriviersberg group and andesitic lavas of the Allan ridge formation (Mucina & Rutherford, 2006). Some of the dominant species include: *Anthephora pubescens*, *Aristida congesta*, *Sporobolous africana*, *Themeda triandra*, *Eragrostis chloromelas, Gazania krebsiana* and *Stachys spathulata*. The vegetation type is endangered and more than 60% has been ploughed (Mucina & Rutherford, 2006).

7.4.2 Red Data Plant Species

A list of Red Data plant species that may occur within the study area can be found in the biodiversity specialist report. No Red Data species were noted during the detailed site inspection.

7.4.3 Protected Plant Species

The prominent plant of concern in this regard is Camel thorn *Acacia erioloba* which is common throughout the area (Figure 8). It is declared as a Protected Tree under the National Forests Act of 1998. In terms of this Act, protected tree species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by the Department of Water Affairs and Forestry (or a delegated authority).

Applications for permits to undertake such activities should be applied for with the Department of Forestry and Fisheries (DAFF). Each application is evaluated on merit (including site visits) before a decision is taken whether or not to issue a license (with or without conditions). Such decisions must be in line with national policy and guidelines.

Figure 8: Camel thorn *Acacia erioloba.* Photo taken along alternative 1 between Kalplats substation to the existing Edwards dam substation

Acacia erioloba ranges from a 2m spiny shrub to a 16m robust tree. The stem is shiny reddish brown when young. The bark of a mature tree is grey to blackish brown and is deeply furrowed; bearing pairs of almost straight, whitish or brown spines. Spines often have swollen bases and appear at the bases of the leaves. The fully developed spines may be up to 60 mm long. The leaves are twice divided. There are normally 2 to 5 pairs of pinnae per leaf and 8 to 18 pairs of leaflets (pinnules) per pinna. They are hairless and have a prominent underside vein on the undersurface (SANParks 2009).

The tree bears bright yellow ball-like flowers that are sweetly scented. They are borne in late winter and last through to summer. The fruit is variable and ranges from small and almost cylindrical to typically large, flat, thick, semicircular or half-moon-shaped pods. They are up to 130 mm long and 50 mm wide and are covered by velvety grey hairs. They are semi-woody, but spongy inside; the pods do not open even when ripe but fall to the ground in winter. Seeds are thick, robust and lens-shaped.

Mitigation measures will thus need to be included within the EMPr and a permit applied for with the DAFF if these trees are to be removed.

7.4.4 Fauna of the Study Area

Friedman and Daly, (2004) list several red data mammal species that could potentially occur in the study area e.g. the Brown Hyaena (*Hyaena brunnea*) and the Honey Badger (*Mellivora capensis*) and Schreiber's Long-fingered Bat (*Miniopterus schreibersii*) are listed as Near Threatened. However due to the large amount of anthropogenic activities present in the area, particularly near Vryburg, these species may not exist in the study area.

Bird life in the study area is will be investigated by the Avifauna assessment investigates this further.

The African Giant Bullfrog (*Pyxicephalus adspersus*) which is a Red Data species potentially occurs within the study area (Du Preez and Carruthers, 2009). It occurs in seasonal shallow grassy pans, vleis and other rain filled depressions in open flat areas of grassland or savanna (Du Preez and Carruthers, 2009). This species is considered to be Near Threatened as its specialized habitat is at risk from increasing urbanization and agricultural activity (Du Preez and Carruthers, 2009).

Reptile species e.g. Southern African Python (*Python natalensis*) listed as Vulnerable and Blunt-tailed Worm-lizard (*Dalophia pistillum)* could potentially occur in the study area (Cook, 2008).

Invertebrate information for the study area is limited although several species are anticipated to be present.

- Mammals

Various mammal species are likely to occur within the study area. Appendix 2 comprises a list of mammals that are likely to occur in study area with the assigned level of threat facing a particular species. A map was used to correlate the occurrence of the Red Data species with their approximate occurrence within the study area. According to Friedman and Daly, (2004), the majority of species within the study area are listed as species of least concern. However, a few species are such as Brown Hyaena (*Hyaena brunnea*); Honey Badger (*Mellivora capensis*); Schreiber's Long-fingered Bat (*Miniopterus schreibersii*); Geoffroy's Horseshoe Bat (*Rhinolophus clivosus*); and Darling's Horseshoe Bat (*Rhinolophus darling*) are listed as Near Threatened. Roan Antelope (*Hippotragus equinus*) is Vulnerable. African Wild Dog (*Lycaon pictus*) and White-tailed Rat (*Mystromys albicaudatus*) are Endangered while Black Rhinoceros (*Diceros bicornis*) is Critically Endangered. Table 7 below identifies the probability of these species occurring within the study area. The analysis indicates that the likelihood of the majority of Red Data species occurring within the study area is fairly low although the possibility still remains.

Table 7: Mammal probability analysis

Common Name	Scientific name	SA Red data list status	Habitat availability	Food availability	Probability of occurrence
Black Rhinoceros	*Diceros bicornis bicornis*	CE	very little	very little	low
Honey Badger	*Mellivora capensis*	NT	very little	minimal food available	low
Schreibers' Long-fingered Bat	*Miniopterus schreibersii*	NT	very little	minimal food available	low
Geoffroy's Horseshoe Bat	*Rhinolophus clivosus*	NT	very little	minimal food available	low
Darling's Horseshoe Bat	*Rhinolophus darling*	NT	very little	minimal food available	low
Roan Antelope	*Hippotragus equinus*	VU	very little	very little	low
African Wild Dog	*Lycaon pictus*	EN	very little	very little	low
White-tailed Rat	*Mystromys albicaudatus*	EN	minimal habitat available	minimal food available	low to medium

Table 8 below presents mammal species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 which potentially occur within the study area.

Table 8: Mammal species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007

Common name	Scientific name	Status under GN 1187
White Rhinoceros	*Ceratotherium simum*	Protected
Black Wildebeest	*Connochaetes gnou*	Protected
Black-footed Cat	*Felis nigripes*	Protected
Brown Hyaena	*Hyaena brunnea*	Protected
Honey Badger	*Mellivora capensis*	Protected
Cape Fox	*Vulpes chama*	Protected
South African Hedgehog	*Atelerix frontalis*	Protected
Black Rhinoceros	*Diceros bicomis bicomis*	Endangered
African Wild Dog	*Lycaon pictus*	Endangered
Leopard	*Panthera pardus*	Vulnerable
Roan Antelope	*Hippotragus equinus*	Vulnerable

Note that Friedman and Daly, (2004) list Black Rhinoceros as Critically Endangered while GN 1187 lists the species as Endangered.

Overall, the majority of these species are highly unlikely to occur within the study area, particularly the large mammals due to the level of transformation and lack of protected areas.

- Amphibians

Several frog species potentially occur in the study area (Table 9). Most species are of Not Threatened except for the Giant Bullfrog which is considered Near Threatened (Du Preez and Carruthers, 2009).

The Giant Bullfrog (*Pyxicephelus adspersus*) breeds in seasonal shallow grassy pans, vleis and other rain filled depressions in open flat areas of grassland or savanna (Du Preez and Carruthers, 2009). This habitat is present along the proposed routes however these are likely to be spanned and thus habitat for these species is not likely to be affected.

Bullfrog density commonly varies within certain habitats (open grassland habitat). High densities are often associated with specific microhabitats or patches (hygrophytic or aquatic ephemerophytic grass and sedge dominated temporary pans) that can be identified and randomly sampled (Cook, 2008). Emphasis must be placed on remaining natural open grassland habitats (important migratory and foraging areas) as well as seasonal wetlands (drainage and marshland vegetation) in the study area. The seasonal wetland habitats offer the most suitable breeding habitat for Giant Bullfrogs in the area (Cook, 2008).

Table 9: Red data amphibian species in the study area

Common name	Scientific name	Category (Du Preez and Carruthers, 2009)	Habitat
Eastern Olive Toad	*Amietophrynus garmani*	Not Threatened	Bushveld vegetation types (Savanna biome)
Guttural Toad	*Amietophrynus gutturalis*	Not Threatened	Savanna, Grassland, and Thicket biomes
Bubbling Kassina	*Kassina senegalensis*	Not Threatened	Savanna and Grassland biomes
Bushveld Rain Frog	*Breviceps adspersus*	Not Threatened	Semi-arid habitats with Sandy to sandy-loam soils (Savanna biome)
Banded Rubber Frog	*Phrynomantis bifasciatus*	Not Threatened	Bushveld vegetation types (Savanna biome)

Common name	Scientific name	Category (Du Preez and Carruthers, 2009)	Habitat
Boettger's Caco	*Cacosternum boettgeri*	Not Threatened	Savanna, Grassland, Nama Karoo, Fynbos and Thicket biomes
Common Platanna	*Xenopus laevis*	Not Threatened	Natural water bodies, Farm dams and ponds
Giant Bullfrog	*Pyxicephalus adspersus*	Near Threatened	Savanna, Grassland, Nama Karoo and Thicket biomes Savanna and Grassland biomes (Breeds in seasonal shallow grassy pans, vleis and other rain filled depressions in open flat areas of grassland or savanna)
Tremolo Sand Frog	*Tomopterna cryptotis*	Not Threatened	A variety of habitats in Savanna and Grassland Biomes. Breeds in shallow, standing water at the edges of dams, pans and small water bodies i.e. roadside puddles

The Giant Bullfrog is a protected species in terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007.

Based on habitat assessments during field surveys, the habitat for Giant Bullfrogs in the study area is minimal and hence food availability is minimal. Therefore the probability of occurrence of this species in the study area is medium.

A number of large termite mounds *Trinervitermes haberlandii* which potentially house numerous amphibian species are present in the Vryburg area (Cook, 2008).

Apart from the Giant Bullfrog, no other amphibian species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 potentially occurs within the study area.

- Reptiles

Several reptile species are present in the study area. Table 10 highlights the species which are likely to be present within the study area. The only Red Data species which is likely to be present is the Southern African Python (*Python natalensis)* which is listed as Vulnerable in the outdated South African Red Data Book (Cook, 2008).

Table 10: Reptile species potentially present in the study area (Branch, 1998)

Common name	**Scientific name**
Leopard Tortoise	*Geochelone pardalis*
Cape Thick-toed Gecko	*Pachydactylus capensis*
Serrated or Kalahari Tent Tortoise	*Psammobates Oculiferus*
Marsh or Helmeted Terrapin	*Pelomedusa subrufa*
Delalande's Beaked Blind Snake	*Rhinotyphlops lalandei*
Bibron's Blind Snake	*Typhlops bibronii*
Peters' Thread Snake	*Leptotyphlops scrutifrons*
Southern African Python	*Python natalensis*
Southern or Bibron's Burrowing Asp	*Atractaspis bibronii*
Brown House Snake	*Lamprophis fuliginosis*
Cape Wolf Snake	*Lycophidion capense*
Mole snake	*Pseudoaspis cana*
Two-striped Shovel-snout	*Prosymna bivittata*
Striped Skaapsteker	*Psammophylax tritaeniatus*
Kalahari Sand Snake	*Psammophis trinasalis*
Cross-marked or Montane Grass Snake	*Psammophis crucifer*
Common or Rhombic Egg Eater	*Dasypeltis scabra*
Herald or Red-lipped Snake	*Crotaphopeltis hotamboeia*
Eastern Tiger Snake	*Telescopus semiannulatus*
Boomslang	*Dispholidus typus*
Cape Cobra	*Naja nivea*
Puff adder	*Bitisarietansarietans*
Kalahari Round-headed Worm Lizard	*Zygaspis quadrifrons*
Blunt-tailed Worm Lizard	*Dalophia pistillum*
Cape Skink	*Mabuya capensis*
Montane Speckled Skink	*Mabuya striata punctatissima*

Common name	Scientific name
Variable Skink	*Mabuya varia*
Common Rough-scaled Lizard	*Ichnotropis squamulosa*
Spotted Sandveld Lizard	*Nucras intertexta*
Holub's Sandveld Lizard	*Nucras holubi*
Spotted Sand Lizard	*Pedioplanis lineoocellata*
Namaqua Sand Lizard	*Pedioplanis namaquensis*
Yellow-throated Plated Lizard	*Gerrhosaurus flavigularis*
Karoo Girdled Lizard	*Cordylus polyzonus*
Transvaal Girdled Lizard	*Cordylus vittifer*
Rock or White-throated Monitor	*Varanus albigularis*
Nile or Water Monitor	*Varanus niloticus*
Ground Agama	*Agama aculeata*
Southern rock and Knobel's Agama	*Agama atra*
Flap-neck Chameleon	*Chamaeleo dilepis*
Cape Dwarf Gecko	*Lygodactylus capensis*

Some reptile species recorded in the study area (Table 10) are listed in CITES Appendix II (Convention in the Trade of Endangered Species). These species include: Leopard Tortoises (*Geochelone pardalis*); Rock or White-throated Monitor (*Varanus albigularis*) and Nile or Water monitor (*Varanus niloticus*). These species have been placed on the CITES list due to the illegal pet trade.

During the preliminary field survey, a Leopard Tortoise was sighted in the study area (Figure 9). Its habitat varies from montane grassland, fynbos, valley bushveld as well as arid and mesic savanna (Branch 1988).

Figure 9: Leopard Tortoise (*Geochelone pardalis*)

The African Rock Python (*Python natalensis)* which potentially occurs in the study area is a protected species in terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007.

No other reptile species listed species in terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 potentially occurs in the study area.

- Invertebrates

The list of Lepidoptera species that may possibly occur in the North West province can be found in the specialist report. This information was obtained from the 2008 North West Environmental outlook (a report on the state of the Environment).

No reptile species listed species in terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 potentially occurs in the study area.

No detailed assessment of invertebrates have been undertaken due to the scale of the project although it is not likely that invertebrate species would be affected by the proposed construction process as they are mobile. Suitable vegetation is currently available for these invertebrate species and the project is not going to result in massive habitat destruction.

7.4.5 Habitats

Faunal populations are dependent on the flora that supports them therefore assumptions regarding the presence of fauna can be made based on the flora present. Habitats within the study area are dominated by Stella Bushveld vegetation type, followed by Ghaap Plateau Bushveld vegetation type and Mafikeng Bushveld vegetation type (Figure 10, Figure 11 and Figure 12).

The Leeuspruit River, the Losase River and a few wetlands near Vryburg within the Ghaap Plateau Vaalbosveld vegetation type are potential habitats for several faunal species.

Figure 10: Scrub vegetation near Vryburg (Ghaap Plateau Vaalbosveld)

Figure 11: Transformed vegetation along road to Stella (Stella Bushveld)

Figure 12: Bushveld vegetation north of Stella (Mafikeng Bushveld)

7.4.6 Transformation

The study area has been affected by habitat transformation to a certain degree. Large expanses of natural vegetation have been impacted by cattle farming however habitat connectivity has still

been retained. The northern part of the study area is considered to be relatively natural with evidence of more natural vegetation being present in this area. Along the N18 the level of transformation is more evident with more uniform grasslands dominating the landscape. The level of transformation increases closer to Vryburg.

7.5 Avifauna

An avifaunal assessment was conducted by the Endangered Wildlife Trust. The detailed report is included in Appendix 3B.

7.5.1 Relevant bird populations

The relevant bird populations that have been reported by the South African Bird Atlas Project can be found below in Table 11. In addition, the preferred habitat as well as likelihood of occurrence can be seen in the last two columns of the table. Report rates are essentially an expression of the number of times a species was recorded in a square, as a percentage of the number of times that square was counted. A report rate of 0 means that the species was recorded in the square, but at a very low frequency. It is important to note that these species could have been recorded anywhere in the square, and not necessarily in the exact study area

Table 11: Red Data species report rates for the quarter degree squares which cover the study area (Harrison *et al*, 1997)

Total Cards		11	13	6	14	11	48		
Total Species		106	132	90	100	106	204		
Name	**Conservation status**	**2624BD**	**2624DB**	**2724BB**	**2624DD**	**2624BD**	**2624BC**	**Habitat**	**Likelihood of occurrence**
White-backed Vulture	VU	9	8			9	83	Savanna and bushveld	Likely
Lesser Kestrel	VU		23		7		31	Open grassveld, , usually near towns or farms	Possible
Kori Bustard	VU			17			29	Open plains of karoo, highveld grassland, Kalahari sandveld, arid scrub	Possible
Lappet-faced Vulture	VU						27	Savanna to desert	Possible
Martial Eagle	VU						10	Woodland, savanna	Possible
Yellow-billed Stork	NT		8		7			Mainly inland waters; rivers, dams, pans, floodplains	Possible
Lesser Flamingo	NT		15					Large bodies of shallow water, both inland and coastal; saline and brackish waters preferred	Unlikely
Secretarybird	NT		8	17			67	Semidesert, grassland, savanna, open woodland, farmland, mountain slopes	Likely
Black Stork	NT			17			2	Feeds in or around marshes, dams, rivers and estuaries; breeds in mountainous regions	Unlikely
Greater Flamingo	NT				21			Large bodies of shallow water, both inland and coastal; saline and brackish waters preferred	Possible
Lanner Falcon	NT						4	Mountains or open country from semidesert to woodland and agricultural land; also cities	Possible
Short-clawed Lark	NT						4	Open ground in semi-arid scrub	Possible
White Stork	Bonn		8			9	13	Highveld grasslands, mountain meadows, cultivated lands, marshes, karoo	Possible
Abdim's Stork	Bonn		8				21	Mainly highveld grassland; also semi-arid Kalahari (especially after rain), cultivated lands, inland waters	Possible

EN = Endangered; V = Vulnerable; NT = Near-threatened; Bonn = Protected Internationally under the Bonn Convention on Migratory Species.

7.5.2 Southern African Bird Atlas Project 2 (SABAP2)

SABAP 2 data for the pentads in the study area were examined, and it was found that the area is relatively poorly counted by this project at present (i.e. low numbers of cards have been submitted per pentad). Table 12 shows the report rates for species deemed relevant to the study, for selected pentads in the study area.

Table 12: Report rates from Southern African Bird Atlas Project 2, for relevant species

	Pentad Report Rate							
	2655_2440	**2645_2445**	**2630_2450**	**2620_2450**	**2620_2440**	**2615_2435**	**2615_2445**	**2610_2440**
No Cards	8	14	9	3	3	3	3	3
Total Species	132	128	123	104	55	76	99	86
White-backed Vulture						33.3%	33.3%	
Lesser Kestrel	12.5%	42.9%	11.1%					
Kori Bustard				33.3%				
Lappet-faced Vulture								
Martial Eagle								
Yellow-billed Stork								
Lesser Flamingo								
Greater Flamingo			77.8%					
Secretary Bird								*Incident-al*
Lanner Falcon								
Black Stork	12.5%							
White-Stork		7.1%						
Abdims Stork			11.1%					
Northern Black Korhaan	75%	78.6%	77.8%	100%	100%	66.7%	66.7%	100%
Red-crested Korhaan				66.7%			66.7%	33.3%
Brown Snake-eagle							33.3%	
African Fish Eagle							33.3%	

Interestingly, 5 of the red-listed species identified in the SABAP 1 data, have not been recorded in the SABAP 2 data for the pentads examined. They are: Lappet-faced Vulture, Martial Eagle, Yellow-billed

Stork, Lesser Flamingo and Lanner Falcon. This however, does not necessarily mean that these species do not occur here, or that they have moved from the area, post SABAP1, but may merely be due to the low counting effort of the pentads. Although, it is still surprising as these are relatively conspicuous species. Species shown in bold are listed species, while the remainder are species of interest deemed relevant to the study.

7.5.3 Co-ordinated water bird Counts (CWAC), Co-ordinated Avifaunal Road counts (CAR) and Important Bird Areas (IBA's).

The site is not situated within or close to any CWAC sites or IBA's. Furthermore, there are no CAR routes that pass within close proximity to the site.

7.6 Surface Water

A surface water assessment was conducted by the SSI Environmental (now known as Royal Haskoning DHV). The detailed report is included in Appendix 3C.

7.6.1 Macro Drainage characteristics and surface water feature occurrence

The study area traverses the boundary between two primary catchments, that of the Orange, and Vaal Rivers. The northern-most parts of the Bophirima-Kalplats alignment falls within the D41B quaternary catchment. This quaternary catchment forms part of the wider Molopo River Catchment. Surface water drainage in this part of the study area drains in a roughly north-westerly direction towards the Setlagole River which itself is a tributary of the westward-flowing Molopo River. Drainage from the Molopo catchment never reaches the Orange River and the Atlantic Ocean as sand dunes near Nonieput have blocked its course. This is attributable to six major periods of dune activation have occurred over the last 115 000 years. During one or more of the arid intervals dunes advanced across the lower course of the Molopo River, effectively cutting off flow from the lower reaches of the system (Partridge et al, 2010). Although two tributaries of the Setlagole River, the Morita se Laagte and the Madibeng watercourses drain from the vicinity of the northern parts of the Bophirima-Kalplats and Kalplats-Edwards Dam Route, surface water drainage in this area is very poorly defined, in common with the characteristics of the Kalahari Geomorphic Province in which this part of the study area is located.

The remainder of the power line routes traverse the upper parts of the Dry Harts River catchment area. A number of quaternary catchments make up this area, including the C32B, C32A (Leeuspruit) and C32C (Losase) catchments. These areas form part of the uppermost parts of the Lower Vaal and

Orange Geomorphic Province. The greater occurrence of surface water drainage in this area reveals a differing geomorphic drainage regime, and to the south of Vryburg, the valley of the Dry Harts River becomes increasingly more pronounced.

The very flat nature of the topography is a strong factor influencing the nature of surface water occurrence in the Study Area. Over much of the southern part of the Study Area very shallow, wide valleys occur. Drainage is southwards-aligned towards the Dry Harts River Valley. In this area watercourses typically take the form of ephemeral drainage lines. The occurrence of hydric soils within these watercourses may be restricted by the presence of very shallow outcroppings of calcrete. The only prominent wetland noted in this area occurs in the valley bottom of the Leeuspruit River. The wetland forms a flat valley bottom where it is crossed by the Bophirima-Vryburg line as it runs parallel to the N14 road.

To the north of Vryburg, the very flat nature of the topography and the endorheic nature of the drainage is revealed by a number of small pans that are distributed across the area. This drainage pattern is common across many of the world's semi-arid climatic zones, with occurrence of ephemeral lakes and pans characterised by alluvial deposits, as is typical of the study area. Overland and shallow sub-surface drainage in this context occurs towards low points in the landscapes where pans / depressions occur. This water will collect within the soils, and as such hydric (hydromorphic) or wetland soils typically occur in these localities. Many of these pans are expected to have a thick accumulation of sediments within them. The clayey nature of these sediments that have accumulated in these bottomlands through catenal processes is anticipated to assist in the water retention characteristics of these surface water features. Due to the impermeable nature of this substrate, it is unlikely that surface-groundwater interaction would be present in many of these features. Most of these pans are ephemeral, i.e. not being permanently inundated with surface water and most of these pans are relatively small features. A number of small pan wetlands occur within the corridor of the Bophirima-Kalplats line to the south of Stella. The large Salt Pan in Stella will not be affected by the proposed development as the route turns north-west, thus avoiding the town and its immediate surrounds. The pans decrease in number to the north of Stella. In this area the first order drainage of the Setlagole catchment occurs as very poorly-defined drainage lines. No linear (valley bottom) wetlands were noted in this area during the site verification visit.

Lastly, a series of very poorly defined linear drainage systems is encountered in the area to the north-west of Stella. The eastern end of Alternative 1 of the Kalplats-Edwards Dam line runs parallel to one of these northward drainage systems. Due to the flatness of the terrain these drainage lines are barely discernible on the ground, and in places take the form of a very shallow wide valley bottom.

7.6.2 Study Area Surface Water Characteristics

There are three different types of surface water features in the study area, including two different wetland hydrogeomorphic forms. It is important to note that not all surface water features can be classified as wetlands.

In the context of wetlands that occur in the study area, a classification system exists for different types of wetlands – a hydrogeomorphic-based classification system. The wetland hydrogeomorphic (HGM) approach to wetland classification which uses hydrological and geomorphological characteristics to distinguish primary wetland units has been used to classify wetland types in South Africa (Kotze et al, 2005; SANBI, 2009). This approach has been used, and the classification system has been recently updated as part of the National Wetland Classification System for South Africa (SANBI, 2009). Under this classification system there are a number of different types of terrestrial (as opposed to marine) wetlands, of which the following occur in the study area:

- Channel
- Pan / Depression (Example shown in Figure 10 below)
- Un-channelled Valley-Bottom Wetland

Figure 13: Small Pan in the Northern part of the study area

The HGM forms that do not occur in the study area are true floodplains, seepage wetlands, and flats.

Wetlands can be found all across a landscape. The landscape can be divided up into a number of units (refer to Figure 14 below), each of which can contain wetlands. Wetlands occurring on these different terrain units typically differ in terms of their formative processes and hydrological inputs, and

thus differ in terms of their functionality. Wetlands in the study area occur in two primary landscape units – valley floors and plains.

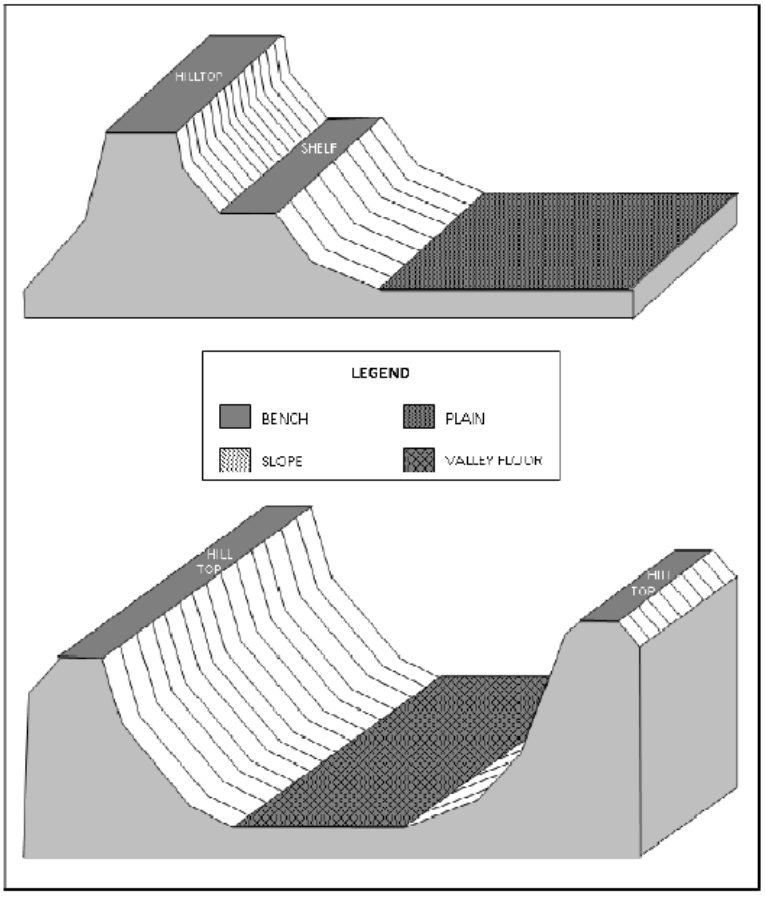


Figure 14: Different Terrain units on which wetlands can be found (SANBI, 2009)

The primary type of surface water feature occurring across the study area is the pan wetland. As described above, pans occurring in the vicinity of the lines are relatively small features that are characteristics of a poorly-drained (endoreic) drainage network. The other 'true' wetland HGM form is the valley bottom wetland. These occur only sporadically across the study area, and take the form of non-channelled valley bottom wetlands. The third type of surface water feature is the drainage line or ephemeral watercourse. These are similar features to the valley bottom wetlands, except they are purely watercourses containing a channel, with no evidence of hydric soils (thus not qualifying as a wetland). Typically these features have a distinct riparian zone.

7.6.3 Hydrology and Geomorphological Processes

Hydrological and geomorphological processes are the major drivers of surface water feature formation. Surface water features can be characterised in terms of their hydrological and geomorphological characteristics as discussed in this section.

Wetlands are dynamic features of the natural environment, especially as they are associated with the movement of water which is a very important formative factor in a macro- or micro-landscape context. As described by the different hydrogeomorphic forms, different wetlands have different hydrological regimes. A key distinction can be made in terms of the surface hydrology of wetlands in the area; i.e. whether these are linear drainage features or inward-draining pans and their immediate catchments. As described above, pans occur in many parts of the study area, in particular within the very flat plains to the north of Vryburg traversed by the Bophirima – Kalplats alignment. These pans are primarily fed by surface water runoff from the immediate catchment. They are unlikely to be fed by groundwater and are similarly unlikely to feed some water back into the groundwater reserve as part of groundwater recharge due to the accumulation of clays in the depression that would act as impermeable strata. The accumulation of salts within the depression is expected to contribute to the lack of vegetation within the pan itself.

Certain pans appear to be linked to relict drainage features, as indicated by linear patterns of greyer (bleached) hydric soils aligned in a certain direction away from the pan. These linear features run for a short length and then dissipate, not being linked to the wider drainage network. This characteristic is thought to reflect the macro-geomorphological development of the study area over time (as discussed above), in which diminution of surface fluvial activity over time occurred in the wider Kalahari area. Although dunes are not found in the study area, the development of endorheic drainage, as occurred in the Kalahari, has occurred in the study area, with many rivers poorly defined, and 'severed'. The figure below at Die Anker farmstead north of Stella indicates an example of this phenomenon. The grey colour of the soils to the north of the pan as opposed to the surrounding orange soils as evident on the aerial photographs indicates the presence of hydric soils. The linear distribution of the soils is thought to reflect a relict drainage line that has retained some form of hydromorphic character. Many of these 'severed' drainage systems are linked to pans, with the possibility of pans being the expression of the process of development of this endorheic drainage.

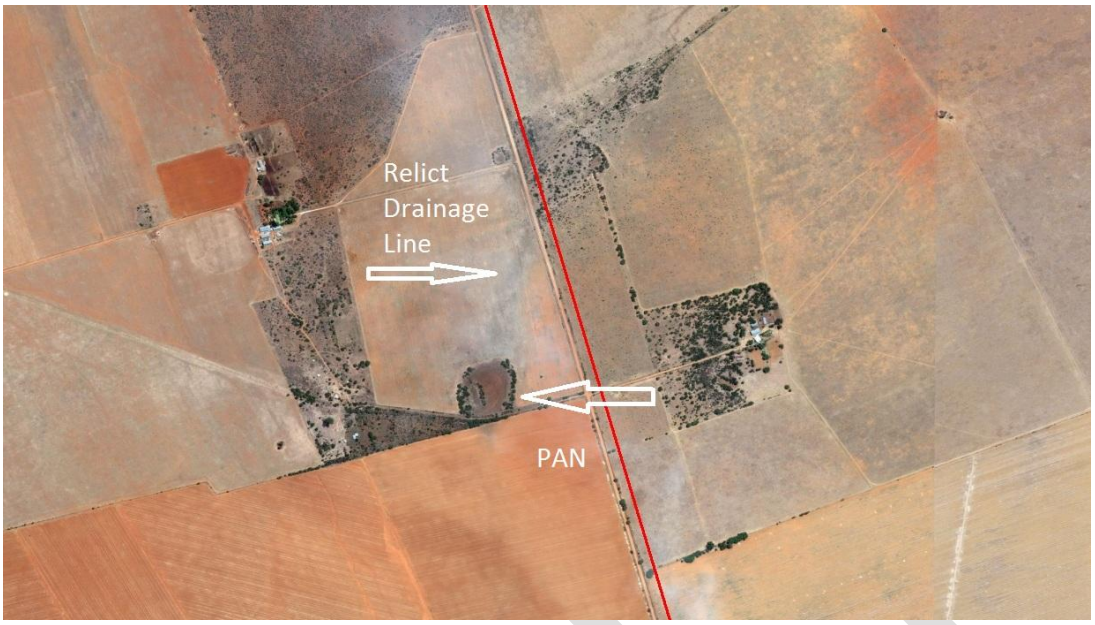


Figure 15: Aerial Photograph of a Pan and associated 'severed' drainage feature

As described above, linear drainage line features or wetlands, where they occur in the northern part of the study area are poorly defined in a morphological context. A defined channel does not typically occur, or where it does occur is poorly defined in terms of its structure. These systems are largely un-channelled, and thus any water movement along them is likely to be diffuse overland flow, or more likely as sub-surface flow within the upper parts of the soil profile. The majority of surface water movement along these systems is likely to be shallow sub-surface water movement.

Wetlands occurring in the southern part of the study area on the outskirts of Vryburg are fairly wide, un-channelled valley bottom systems. Interestingly these wetlands form the upper-most part of the Dry Harts river system and are different in characteristic to the Dry Harts watercourse structure just to the south of the town; the topography becomes more incised and the system takes the form of a channelled stream system rather than the un-channelled wetlands found in the flatter areas around the town to the north.

7.6.4 Vegetative Characteristics of Surface Water Features

Wetlands and drainage lines are characterised by the existence of both grassy and woody vegetation. In terms of vegetation characteristics, many wetlands tend to take the form of seasonally damp grassland, being characterised by a mix of sedges and both grasses. In the wetlands assessed in the field, certain grass species were noted to be prominent within both pans and wide valley bottom systems that are encountered in the study area (Figure 16). The most common typical wetland hydrophytes (plant species adapted to grow in wet environments) encountered in the wetlands in the study area included *Arundinela nepalensis* and *Panicum repens*. The facultative hydrophyte *Setaria sphacelata var. Torta* was also found commonly in many of the clayey valley bottom wetlands in the

area. A number of other grass species not typical of wetlands were also encountered within the valley bottom wetlands particularly closer to the margins of the wetlands, reflecting a relatively short period of inundation in the less inundated parts of the wetland. These included species such as *Eragrostis bicolor*, *E. superba*, *E. rotifer*, *Cenchrus cilliaris* and *Echinochloa colona*. In the un-channelled valley bottom wetlands on the eastern outskirts of Vryburg, the wetlands are dominated by *Typha capensis* rushes as well as *Phragmites australis* reedbeds. These reedbeds are fairly localised and tend to occur where artificial factors (such as the impounding action of roads) have caused these

Figure 16: View into a flat valley bottom wetland at the upper end of the Mosita se Laagte System

In certain of the drainage lines / valley bottom wetlands there is a distinct riparian zone. The riparian zone of rivers and watercourses is defined by the NWA as including 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. In the context of the study area this vegetation is typically distinct from the surrounding scrubby or grassy vegetation in terms of the vegetation composition (a greater degree of woody vegetation) and the size of vegetation, with larger trees and shrubs being encountered in this zone. The easy availability of water is responsible for the more vigorous growth of the vegetation in this particular zone. Along some drainage lines where no distinct channel occurs the riparian zone forms a dense thicket across the drainage line.

Figure 17: Narrow wetland with fringing riparian zone

It is interesting to note that certain pans in the area are surrounded on their outskirts by woody vegetation similar to that found in riparian zones. It is thought that the presence of moisture on the pan fringes facilitates the growth of this vegetation, in the same way as riparian zones. The most commonly-occurring woody species in riparian zones are *Ziziphus mucronata*, *Rhus lancea*, and *Acacia karoo*.

7.6.5 Wetland Soil Characteristics

In spite of the sandy nature of much of the substrate in the study area, valley bottom wetlands sampled typically displayed heavy clay soils. Within the drainage lines and wetlands, these soils typically displayed light to dark grey chromas usually associated with wetland soils. In addition to the chroma, other signs of hydromorphism were present to confirm the presence of hydric soils within these systems. These included the presence of soft iron concretions (mottles) in certain locations, as well as the presence of distinctive soil horizons typically associated with wetlands, such as soft plinthic B horizons and E horizons.

Figure 18 : Soil Sample Showing transition between the othic A and underlying E horizon

In the pans sampled, very clayey soils were also encountered, which is typical of these wetland features due to catenal processes which lead to the washing of clays and minerals into the lowest-lying areas. Soils were noted to have a dark grey chroma, with signs of hydromorphism in the form of iron mottling and clay depletions.

Figure 19: Iron Mottles and soft lime concretions in a dark clayey matrix

7.7 Geotechnical

A desktop geological study was conducted by Geopractica in the scoping to determine the geological baseline environment and is included in Appendix 3D.

7.7.1.1 Bedrock types and associated Soil Types encountered across the Study Area

The various geological formations that the power lines will cross weather to produce residual soils that typically have certain common characteristic geotechnical parameters. Each typical soil type will be discussed below, considering the potential problems which can be generally anticipated, as well as possible geotechnical solution.

- Recent Transported Soil Types

It can be anticipated that the entire route will have a surface cover of recent transported soils. The thickness of this cover can be expected to vary, according to the recent geological depositional processes that were active at the time. Main critical factors will be the general topography as well as the presence of large rivers and lakes. They can be considered to be of a loose consistency, and could experience significant settlement under applied foundation loading. With regards to alluvial deposits, these could exhibit settlement if of a soft consistency, as well as expansive behaviour if of a high plasticity.

Most structures are therefore founded at the base of these recent transported materials, on the more competent residual soil horizons. Alternately, the loose / soft / potentially expansive soils are removed down to a specified depth, and replaced with well compacted, inert, granular fill materials, which provide a competent base for the proposed structures.

- Wind Blown Aeolian Sands

These soils have been transported under the action of wind. Due to their method of deposition, these sandy soils are generally of low cohesion and consistency, and can be expected to settle under foundation loading.

Where this sandy surface horizon is thick, the most appropriate geotechnical solution would be to excavate to a specified depth, and re-compact the removed soils back up to foundation level. This solution is referred to as constructing and engineered soil mattress. If the horizon is thin, structures could be founded on competent underlying residual soil horizons.

- Water Transported Hillwash

These soils have been transported by water and, generally over fairly short distances, from higher ground down to lower areas. They usually form more cohesive soils but are also of generally low

consistency. A further characteristic of these soils is that over time, downward percolating rain water carrying dissolved cementing solutions can create bridges between the individual soil particles. On saturation of these soils under foundation loads, these soil bridges can break down, resulting in significant collapse settlement.

The geotechnical solution to founding in such soils is to place the foundation on an engineered soil mattress as described above.

- Water Transported Alluvium

Alluvium is sediments that have been deposited from rivers, either after overflowing their banks in periods of flooding, or as alluvial fans entering lakes and lagoons, as well as bottom sediments dropped as the velocity of the river was impeded and reduced. These sediments can include boulders, gravels and sands, as well as fine silts and clays.

The coarse gravel and sandy soils are often suitable as a founding medium, provided they are not immediately underlain by very soft silt or clayey soils. The alluvial clays can however be a problem, as they could exhibit settlement or expansive behaviour. Where materials of high plasticity are present at founding elevation, it is recommended that they be excavated out, and replaced with well compacted, inert, granular materials as described above.

- Pedogenic Formations

  - Ferricrete and Calcrete

Where a fluctuating perched water table occurs, the near surface permeable soils form well cemented ferricrete or calcrete horizons. Due to the high consistency and competence of these soils, they provide a good founding medium for lightly loaded structures. If of a hardpan nature, some difficulty may occur during excavation, to provide a level founding surface.

- Sedimentary Rock Types

These rock types have all been laid down by water born agents, and have over geological time been consolidated by overburden pressure into solid rock.

  - Diamictites

These soils are characterised by abundant inclusions of different rock fragments in a fine grained matrix. The residual soils produced from the weathering of this rock type, are typically composed of gravelly silty sands, which usually provide a suitable founding medium for lightly loaded structures.

  - Conglomerates

Conglomerates comprise a cemented mass of cobbles, gravels and sands, and on weathering produce correspondingly gravelly sandy soils, suitable as a founding medium.

- Shales and Siltstones

These rock types weather to produce very fine grained, silty soils, which can be moderately expansive in behaviour.

The plasticity of the soils at founding level needs to be assessed, and if they appear to have a significantly high Plasticity Index, then an engineered soil mattress may be required. If the competence and plasticity of these residual soils is seen to significantly
reduce with depth, it may be possible to found at a slightly deeper depth.

- Chemical Sedimentary Rock Types

  - Dolomites

These rocks are formed due to biological synthesis and inorganic precipitation, in an ancient inland sea. As these rocks are highly soluble by slightly acidic ground waters, under these conditions the possibility exists for the formation of sinkholes and doline depressions. These features generally only occur where static or flowing water is present, such as human settlements, water dams, irrigation trenches, stormwater drains etc. Where none of these are present, the risk of sinkholes is considerably reduced. The sandy and gravelly composition of soils derived from dolomite and chert residuum normally make the upper horizons suitable for founding in.

- Volcanic Rock Types

These rocks have been derived from liquid volcanic magmas of certain mineralogical content, cooling and solidifying at various depths within the earth.

  - Diabase

These rock types form dykes (vertical pipes) and sills (horizontal layers) due to magma being forced to surface through cracks and fissures in the upper crust. The rock is crystalline and hard, and reasonably resistant to weathering. They characteristically form extended linear low ridges across the countryside.

They may present some problems as a founding medium due to their ridge like topography, as well as scattered large, talus boulders rolling down from higher up. Individual bases for structures may also be difficult to cut into areas of hard rock.

  - Andesites

These rock types typically produce plastic, clayey and silty soils which may potentially expansive.

The plasticity of the soils at founding level needs to be assessed, and if they appear to have a significantly high Plasticity Index, then an engineered soil mattress may be required. If the competence and plasticity of these residual soils is seen to significantly reduce with depth, it may be possible to found at a slightly deeper depth.

- Metamorphic Rock Types

Metamorphic rocks result from the physical and chemical alteration of existing rocks, due to an increase in pressure and temperature on them, induced by a range of geological processes.

  - Quartzites, Granite Gneiss's, Migmatites

These are generally hard, course grained rocks, which decompose to form gravelly and sandy soils. Where suitably competent, these residual soils produce a suitable founding medium for lightly loaded structures.

  - Schists

Schists are highly sheared and foliated rocks, containing primary minerals such as mica, quartz, feldspar, amphibole and sometimes graphite and talc. The platy and elongated fibrous minerals such as mica, graphite and talc, generally make such soils difficult to adequately compact, to form a solid soil base.

Mixing with more granular, transported sandy soils may be required to improve their compactibility. These soils are not however likely to be significantly active.

  - Amphibolite

This rock type contains the primary minerals of hornblende and plagioclase.

They are anticipated to produce fine, gravelly, silty and sandy soils of reasonably low plasticity and potential expansiveness. Where suitably competent, these residual soils produce a suitable founding medium for lightly loaded structures.

7.7.1.2 Substation sites

- Kalplats Substation

This substation is situated on metamorphic rocks such as granite gneiss, Quartzites, and Schists. The anticipated geotechnical conditions are mentioned above.

- Bophirima Substation

This substation is situated on Diamictites. This is discussed above.

- Edwards Dam Substations

This substation is situated in an area where aeolian sands overly metamorphic rocks such as granite gneiss, quartzites, or schists. The anticipated founding conditions are as discussed above.

7.7.1.3 Seismic Hazard Zoning

According to the Seismic Hazard Map of South Africa, Vryburg falls within the very high risk zone for seismic tremors. The estimated peak ground acceleration is estimated to fall within the 0.2 - 0.24 ms range. There is a 10% probability that this peak ground acceleration could be exceeded within a 50 year period. Eskom needs to take these seismic hazard predictions into account, when designing the power line pylons, as well as their concrete foundations.

7.8 Geohydrology

The geohydrological assessment was conducted by Reinhard Meyer and is included in Appendix 3E. Most of the baseline information presented below however, can be found in the scoping level geohydrological study (Meyer, 2010).

According to the available geological map of the area (CGS, 1993), the town of Vryburg is developed on shale and diamictite of the Dwyka Group, Karoo Supergroup, that unconformably overlie various dolomite, shale, quartzite, conglomerate and lava rock types of the much older Chuniespoort Group of the Transvaal Supergroup. Apart from a short section near Vryburg, most of the power line to Stella will be constructed on outcrops of basaltic lava of the Allanridge Formation, Ventersdorp Supergroup (van der Westhuizen *et al*., 2006). At Stella, the alternative routes turn in a NW to NNW directions towards Mookodi. For the initial approximately 10 km the routes traverse outcrops of the Allanridge lava formation and greenstone of the Stella Belt forming part of the Kraaipan Greenstone Terrane (Brandl *et al*, 2006). Further towards the Kalplats area, the power lines and proposed alternatives will be constructed on geologically young aeolian sands of the Gordonia Formation, Kalahari Group. These sands are presumably underlain over most of the area by granitic type rocks of the Kraaipan Group.

According to Vegter (2000) the power lines and proposed alternative routes and substations will traverse across Groundwater Region 18 referred to as the Western Highveld with the principal ground water bearing rocks being the lava of the Allanridge formation. The Hydrogeological map sheet 2522 (Vryburg, DWAF 2000) indicates that the aquifer type in the rock types traversed by the power lines is described as intergranular and fractured (secondary aquifers) with an average borehole yield of 0.1 to

0.5 l/s. The quality of the ground water as indicated by the electrical conductivity (EC) complies generally to the National Drinking Water Standard (SABS 241: 2006) with an EC range between 70 and 300 mS/m. Nitrogen concentration (as N) of ground water in the area often exceeds 10 mg/l (DWAF, 2000; Tredoux, *et al*., 2009).

According to a map prepared by Vegter et al. (1995), static ground water levels in the lava (i.e. most of the power line route) are generally within the range of 10-20 m below ground surface, while around Vryburg in the Dwyka and dolomite formations, it could be somewhat deeper (20-30 m). Due to the relative depth of the water level (relative to the depth of pylon foundations) no immediate impact on ground water quality due to the construction and operation of the power line, would be expected.

7.9 Heritage

The Heritage Assessment was conducted by Johnny van Schalkwyk and is included in Appendix 3F.

7.9.1 Site Significance and Heritage Assessment

- Heritage assessment criteria and grading

According to the NHRA, No. 25 of 1999, Section 2(vi), the *significance* of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, Spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential.

A matrix was developed whereby the above criteria, as set out in Sections 3(3) and 7 of the NHRA, No. 25 of 1999, were applied for each identified site (see Appendix 3F). This allowed some form of control over the application of similar values for similar sites.

The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III**: Other heritage resources worthy of conservation, on a local authority level.

The occurrence of sites with Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the application of mitigation measures would allow the development Activities to continue.

7.9.2 Overview of the region

The cultural landscape qualities of the region essentially consist of a two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

An overview of the location of known sites of heritage significance is presented in Figure 20. Due to the scale of presentation, some sites overlap, with the result that there seems to be fewer sites than is the case. In similar vein, it might seem that sites occur in the various corridors, but are actually some distance from the exact route.

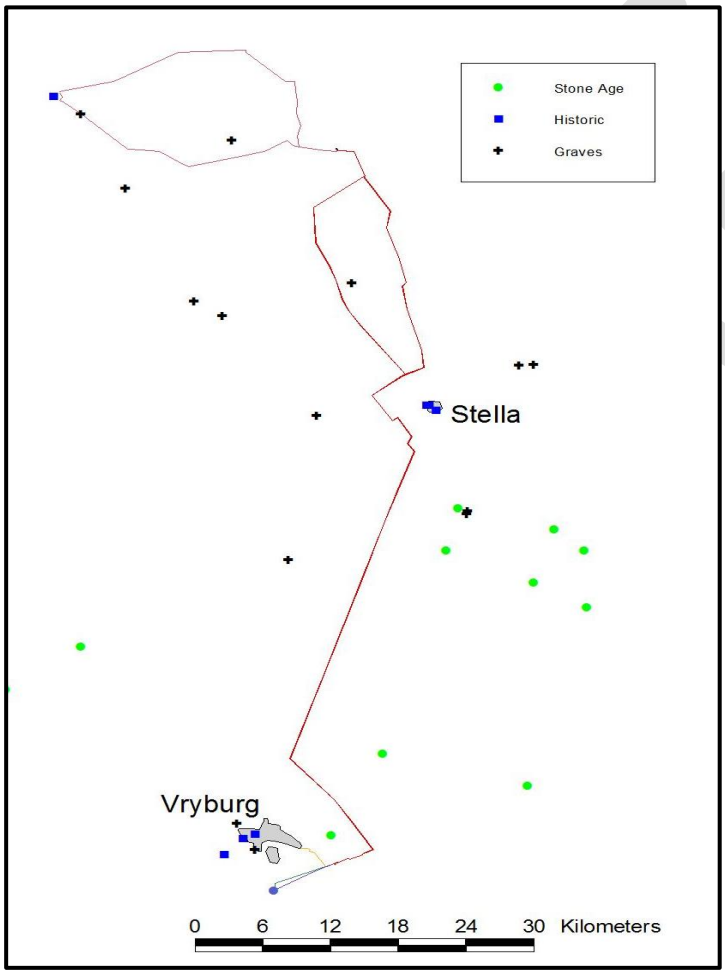


Figure 20: The study area in relation to known heritage sites.

7.9.3 Early history

Very little habitation of the central highveld area took place during Stone Age times. Tools dating to the Early Stone Age period are mostly found in the vicinity of larger watercourses, e.g. the Vaal River or the Harts River and especially in sheltered areas such as at the Taung fossil site. During Middle Stone Age (MSA) times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. In many cases, tools dating to this period are found on the banks of the many pans that occur all over. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology.

Late Stone Age (LSA) people had even more advanced technology than the MSA people and therefore succeeded in occupying even more diverse habitats. Some sites are known to occur in the region. These are mostly open sites located near river and pans. For the first time we also get evidence of people's activities derived from material other than stone tools. Ostrich eggshell beads, ground bone arrowheads, small bored stones and wood fragments with incised markings are traditionally linked with the LSA.

The LSA people have also left us with a rich legacy of rock art, which is an expression of their complex social and spiritual believes. One such site is located on the farm Bernauw located to the east of the study area.

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Broederstroom south of Hartebeespoort Dam dating to AD 470. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior highveld area. Because of their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water.

The occupation of the larger geographical area (including the study area) did not start much before the 1500s. By the 16th century things changed, with the climate becoming warmer and wetter, creating condition that allowed Late Iron Age (LIA) farmers to occupy areas previously unsuitable, for example the treeless plains of the Free State and North West Province.

The earliest Iron Age settlers who moved into the North West Province region were Tswana-speakers such as the Tlhaping, Hurutshe, Fokeng, Kgatla and Rolong. In the region of the study area, it was mostly the booRapulana and booRatlou sections of the Rolong (Breutz 1959).

7.9.4 Archaeological sites

NHRA Category	Archaeological and palaeontological sites
Protection status	
General Protection - Section 35: Archaeology, palaeontology and meteorites	

Heritage sites assessment		
Site type	Site significance	Site grading (Section 7 of NHRA)
None	-	-

7.9.5 Historic period

Many early travellers, hunters and missionaries (Burchell 1824, Campbell 1822, Smith 1834-1836 (Lye 1975), Moffat 1842 and Harris 1852) either passed through the area or close to it. Their writings leave us a tantalising description of what life was in these communities before large-scale interaction with white settles took place. Some of the first whites to settle here were the missionaries Samuel Broadbent and Thomas Hodgson, who settled some distance to the east of what later became known as Wolmaransstad.

White settlers moved into the area during the first half of the 19th century. They were largely self-sufficient, basing their survival on cattle/sheep farming and hunting. Few towns were established and it remained an undeveloped area.

During the 1880s the white settlers exploited conflict between the different Tswana chiefdoms to obtain more land. From this developed the Republic of Stellaland, which, due to British intervention in the area due to the discovery of diamonds, was very short-lived. The town of Stella was to be the capital of the republic.

The last chapter in the history of the region was its incorporation under the policy of homeland development, into the Republic of Bophuthatswana. This was a very fragmented ‘State’ and it would have needed permanent support by the central government to keep it in place. Since 1994, this has fallen away and the people and the region were reincorporated into the larger Republic of South Africa

7.9.6 Farmsteads

Farmsteads are complex features in the landscape, being made up of different yet interconnected elements. Typically these consist of a main house, gardens, outbuildings, sheds and barns, with some distance from that labourer housing and various cemeteries. In addition roads and tracks, stock pens and wind mills complete the setup. An impact on one element therefore impacts on the whole.

NHRA Category	Buildings, structures, places and equipment of cultural significance
Protection status	
General Protection - Section 34: Structures older than 60 years	

Heritage sites assessment		
Site type	Site significance	Site grading (Section 7 of NHRA)
None	-	-

Figure 21: Examples of farmsteads and farming related features identified in the region.

7.9.7 Cemeteries

Apart from the formal cemeteries that occur in municipal areas (towns or villages), a number of these, some quite informal, i.e. without fencing, is expected to occur sporadically all over, but probably in the vicinity of the various farmsteads. Many might also have been forgotten, making it very difficult to trace the descendants in a case where the graves are to be relocated.

Most of these cemeteries, irrespective of the fact that they are for land owner or farm labourers (with a few exceptions where they were integrated), are family orientated. They are therefore serve as important 'documents' linking people directly by name to the land.

NHRA Category	Graves, cemeteries and burial grounds
Protection status	
General Protection - Section 36: Graves or burial grounds	

Heritage sites assessment		
Site type	Site significance	Site grading (Section 7 of NHRA)
Cemetery	High on a regional level	III

Site identification:	
Description	Small informal farm cemetery. Contains grave of Willem van Holk, a Dutch

	teacher, who was buried here in 1896			
Farm	Help Makaar 248	Coordinates	S 26.28064	24.58969

Figure 22: The cemetery with the van Holk and other graves.

7.9.8 Towns

- Vryburg

This town was founded in 1883 as the capital of the Republic of Stellaland, an independent Boer republic. The Boers that inhabited the area styled themselves as free citizens, or vryburgers, in Dutch, from which the name of the town was derived. The town achieved municipal status in 1896.
According to available data bases this town has 5 buildings listed as of provincial significance. In addition some cemeteries and monuments also occur.

As the proposed power line does not cross into town, there would be no impact on any of these sites.

NHRA Category	Buildings, structures, places and equipment of cultural significance
Protection status	
General Protection - Section 34: Structures older than 60 years	

Figure 23: Examples of sites and features found in Vryburg.

- Stella

A small town that developed in 1882 as part of the independent Boer Republic Stellaland. This came about as the Boers supported the Koranna chied David Massouw in his fight against the Tswana chief Mankurwane of the Tlhaping. In order to compensate then Massouw gave then some farms which they turned into an independent Republic, named Stellaland. The name is derived from the Latin for star. It was coined as a comet was visible in 1882.

No buildings or other features are listed for this town in any database. However, is does have buildings older than 60 years, small monuments and the DR Church was designed by the well-known architect Gerhard Moerdijk.

As the proposed power line does not cross into town, there would be no impact on any of these sites.

NHRA Category	Buildings, structures, places and equipment of cultural significance
Protection status	
General Protection - Section 34: Structures older than 60 years	

Figure 24: Examples of sites and features found in Stella.

7.10 Visual

The Visual assessment was conducted by Paul da Cruz of SSI (now known as Royal Haskoning DHV) and is included in Appendix 3G.

7.10.1 Physical Landscape Characteristics and Visual Implications

The macro-geomorphological context of the Study Area determines the nature of the topography, which is largely very flat in nature. Most of the Study Area is located within a very flat area, a characteristic very common to the wider regional area The very flat nature of the topography is a strong factor influencing the types of vistas typically present in the Study Area, as there are few areas of rising ground which would block views and limit viewsheds, and no incised valleys within which views would be restricted. As a result, typically wide-ranging vistas are experienced within the Study Area (where there is no vegetation to block views), especially from locally higher elevations.

The Study Area falls within the savannah biome, and as such is characterised by a mix of grassy and wooded vegetation, with varying densities of tree / shrub and open grass cover reflecting a number of different natural and anthropogenic factors. The flatness of the area combined with the predominance of a very low shrub layer results in a visual environment that is characterised by wide, open vistas. Apart from the urban area of Vryburg and its immediate surrounds, natural low shrubveld was noted to be present across much of the southern part of the Study Area, with limited areas of transformation. In these areas much of the natural vegetation has been cleared to form cattle pastures (open grassy areas) which afford even more wide-ranging vistas

The northernmost reaches of the Study Area fall within the Mafikeng Bushveld vegetation type, which is characterised by relatively 'closed' woodland with medium-sized trees of 2-4m in size being relatively effective in limiting vistas. Much of the natural vegetation has been removed, however, and replaced either with open pastures or areas of dry land maize cultivation, with these areas affording much wider vistas.

The above physical and land use-related characteristics of the Study Area contribute to its visual character. Most of the Study Area can be considered to have a largely natural visual character, with certain parts displaying a rural or pastoral component where maize cultivation and farmsteads occur. Human infrastructure in this setting occurs at a low density, with limited roads, one north-south aligned railway and other structures such as power lines and phone lines typically being aligned along access roads. Closer to the town of Vryburg, in the areas characterised by smallholdings, the density of built infrastructure increases. In these areas the visual character can still be considered largely rural. Only in the light industrial area of Vryburg to the east of the railway line bisecting the town and the town's CBD doe the visual character change completely to an urban-industrial characteristic, with large buildings, warehouses and derelict railway yards characterising this part of Vryburg. Accordingly the area has been assigned to have a low visual absorption capacity and a high visual sensitivity in the context of the potential development of large electricity infrastructure. In assigning these visual sensitivity characteristics however, the potential sensitivity of receptors in the area needs was examined; in the southern parts of the study area the intensive nature of agricultural production along with the proposed routing of power lines along existing linear infrastructure such as roads and existing (albeit smaller) power lines has been assessed to engender these areas with a lower potential level of sensitivity than the northern parts of the study area, where thornveld vegetation is more predominant,

where there is a slightly lesser profusion of human infrastructure, and where certain highly visually sensitive land-uses (such as hunting) occur.

7.10.2 Sensitivity to Visual Impacts and Presence of Sensitive Receptors

Potential sensitivity to visual impacts is closely interrelated to the presence of sensitive visual receptors / receptor locations in the study area. For the purposes of this report, a sensitive receptor is defined as a receptor which would potentially be adversely impacted by a proposed set of power lines or a proposed substation. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described below, the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of power lines into a 'view', which may affect the 'sense of place'. Thus receptors of visual impacts in areas / landscapes where the current visual character of the environment is part of the appeal of an area and thus has a socio-economic or cultural importance are more likely to be considered as sensitive receptors. As such a distinction must be made between receptor locations and sensitive receptor locations – receptor locations may be able to view the proposed power lines and substations, but would not necessarily be adversely affected by any visual intrusion associated with the power lines

The low density of human habitation in the rural parts of the study area (mostly isolated farmsteads) entails that there would be a very low density of receptor locations that could be affected by the proposed power lines, In addition as mentioned above most of these are likely to be associated with commercial farming activities and thus unlikely to be highly sensitive to visual impacts. However in the northernmost part of the study area, the Kudu Hills Game Lodge property and the rural farmsteads and Game Farm situated in the area between the proposed Kalplats Substation and the existing Edwards Dam Substation have been identified to be potentially highly sensitive to the proposed power lines, due to the practising of nature-based ecotourism activities, hunting, and due to the value placed in the area related to its natural character and sense of place. Thus most of the sensitive receptors in the study area are located here, as indicated in Figure 25 below.

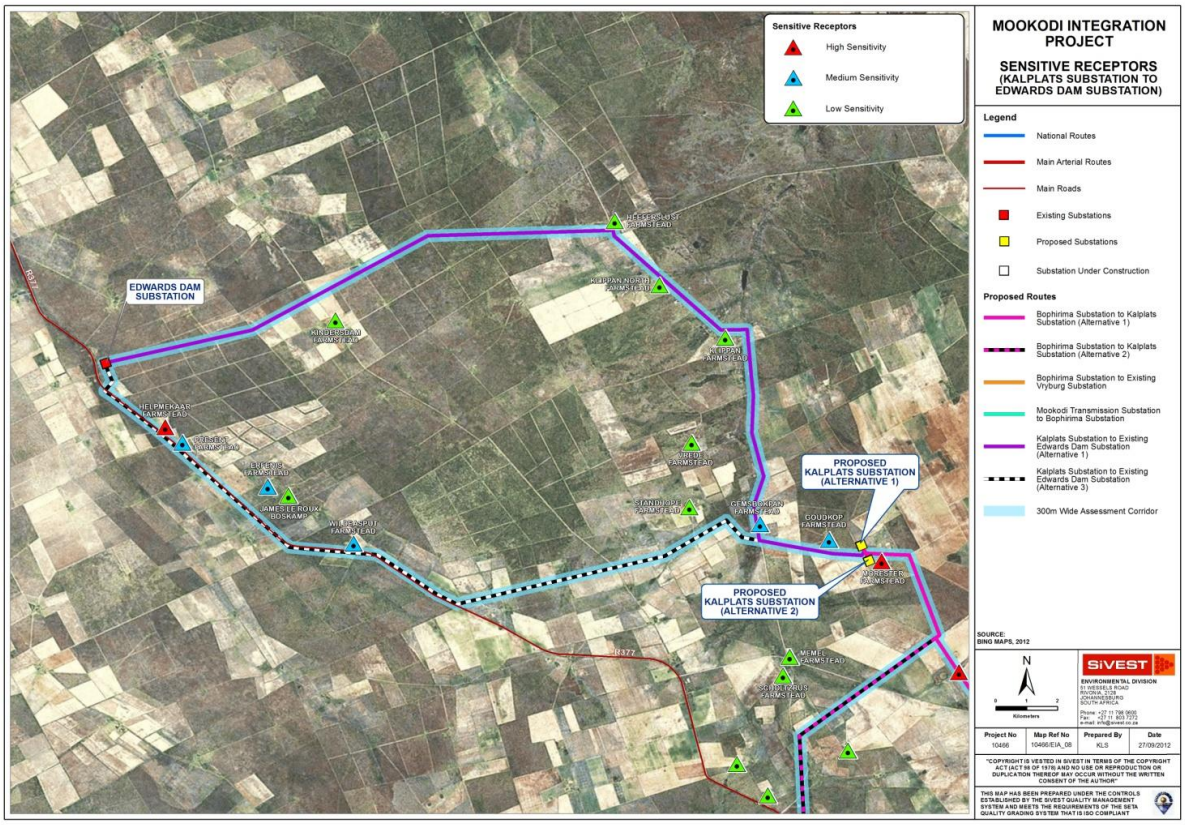


Figure 25: Sensitive Receptors identified in the Kalplats Substation to Edwards Dam Substation Alternative Corridors.

7.10.3 Sensitive Receptor Locations

Table 13 below lists all of the sensitive receptors that have been identified throughout the EIA to date, that could be potentially visually affected by the proposed power lines. As potential visual impacts would be potentially experienced in the immediate area outside of the corridor, receptors within a 2km buffer outside of the boundary of the corridors have also been included. A 2km buffer outside the boundary of the corridors has been chosen as beyond this distance it has been assumed that the visual impact associated with the power lines would greatly diminish (even if the power lines were located on the boundary of the corridor). The receptor locations are listed in the table below.

Table 13: Receptor Locations in the study Area

Receptor Location	Type of Receptor	Proximity to Line
Helpmekaar Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 3)
Present Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 3)
Wildeasput Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative

Receptor Location	Type of Receptor	Proximity to Line
		3)
Erfenis Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 3)
Standhope Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Kinderdam Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Heeferslust Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Klippan North Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Klippan South Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Gemsbokpan Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Memel Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Rustig Farmstead	Farmstead	Bophirima – Kalplats (Alternative 1)
Doorndam Farmstead	Farmstead	Bophirima – Kalplats (Alternative 1)
Waterval North Farmstead	Farmstead	Bophirima – Kalplats (Alternative 1)
Waterval Farmstead	Farmstead	Bophirima – Kalplats (Alternative 1)
Morestêr Farmstead	Farmstead	Bophirima – Kalplats
Taaiboschhoek Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Alleskop Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Geelhoutkoppie Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Dankbaar Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Scholtzrus Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Plankplaas Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)
Kudu Ridge Lodge and Owners House	Homestead and Tourism Accommodation	Bophirima – Kalplats (Alternative 1)
N14-R34 Homestead	Homestead	Bophirima – Vryburg Municipal
Oppie Koppie Farmstead	Farmstead	Bophirima – Kalplats
Oppie Koppie Farmstead West	Farmstead	Bophirima – Kalplats
Robyn Farmstead East	Farmstead	Bophirima – Kalplats
Robyn Farmstead West	Farmstead	Bophirima – Kalplats
Lushof Farmstead	Farmstead	Bophirima – Kalplats
James le Roux Boskamp	Farmstead	Kalplats – Edwardsdam (Alternative 3)
Vrede Farmstead	Farmstead	Kalplats – Edwardsdam (Alternative 1)
Kromdraai Farmstead	Farmstead	Bophirima – Kalplats (Alternative 1)
Goudkop Farmstead	Farmstead	Bophirima – Kalplats

Receptor Location	Type of Receptor	Proximity to Line
De Neute Dop Guesthouse and homestead	Homestead and Tourism Accommodation	Bophirima – Kalplats; Bophirima – Vryburg Municipal; Bophirima – Mookodi
Poppiesdale Farmstead - Bowmans Estate	Homestead	Bophirima – Kalplats
Bowmans Estate - Stand 1	Housing to be built	Bophirima – Kalplats
Bowmans Estate - Stand 13-4	Housing to be built	Bophirima – Kalplats
Bowmans Estate - Stand 23-24	Housing to be built	Bophirima – Kalplats
Smitsrus Farmstead	Farmstead	Bophirima – Kalplats (Alternative 2)

Maps of all of these sensitive Receptor locations have been generated and are presented below. The maps show the location of the receptor locations in relation to:

- the proposed alignments within the corridors;
- the corridors;
- the distance banding associated with the respective corridor

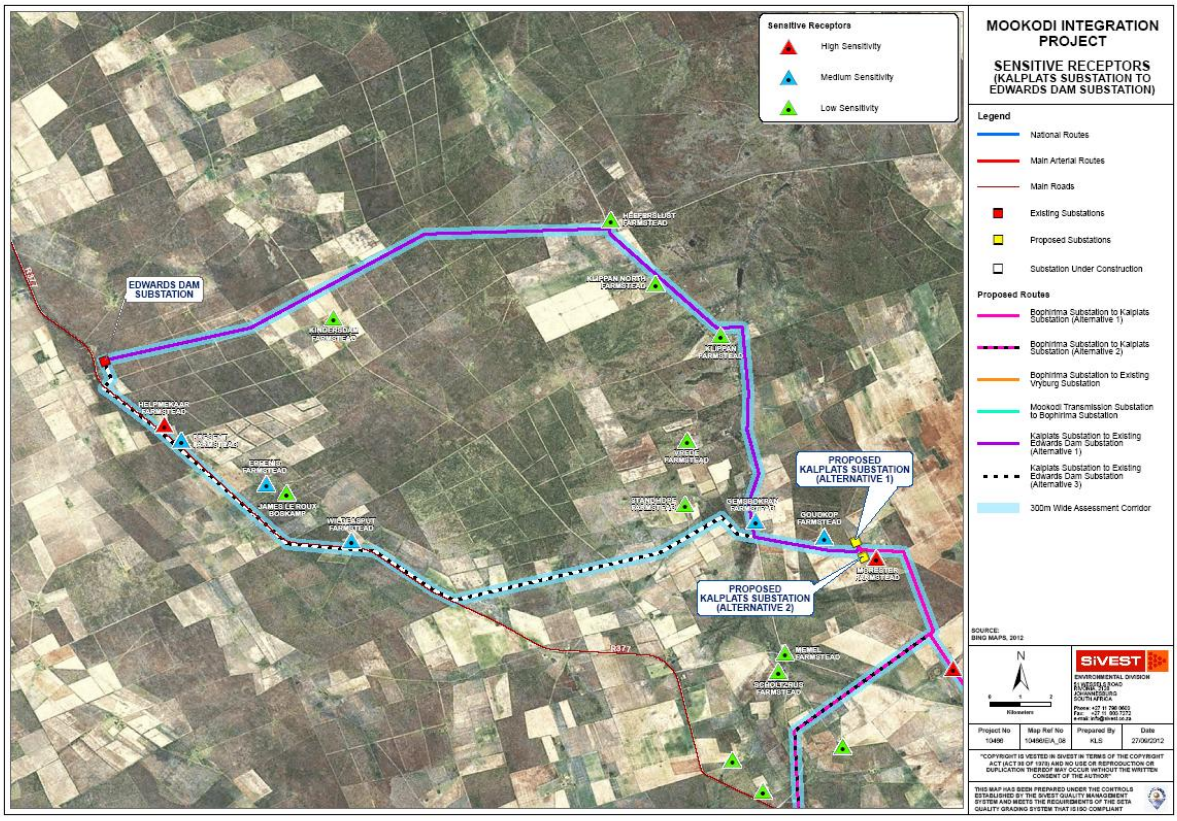


Figure 26: Sensitive Receptors identified in the Kalplats Substation to Edwards Dam Substation Alternative Corridors.

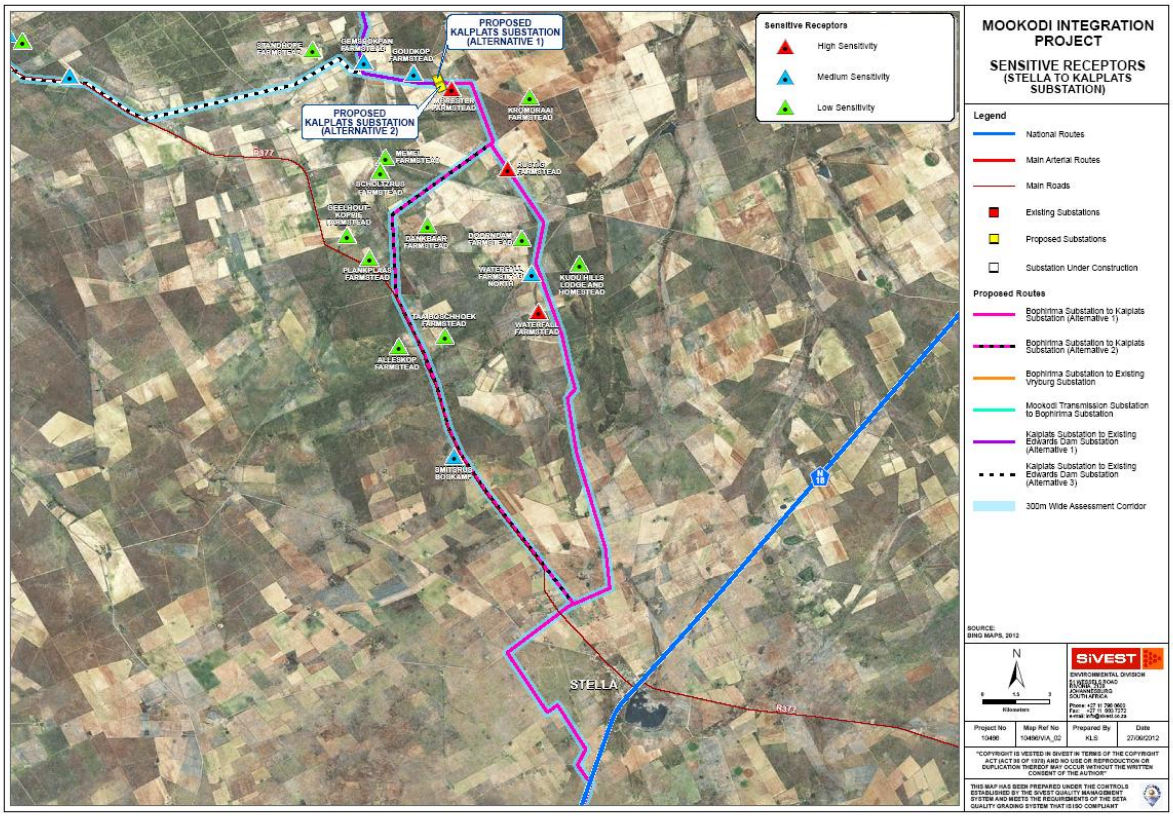


Figure 27: Sensitive Receptors identified in and around the Bophirima Substation to Kalplats Substation Alternative Corridors.

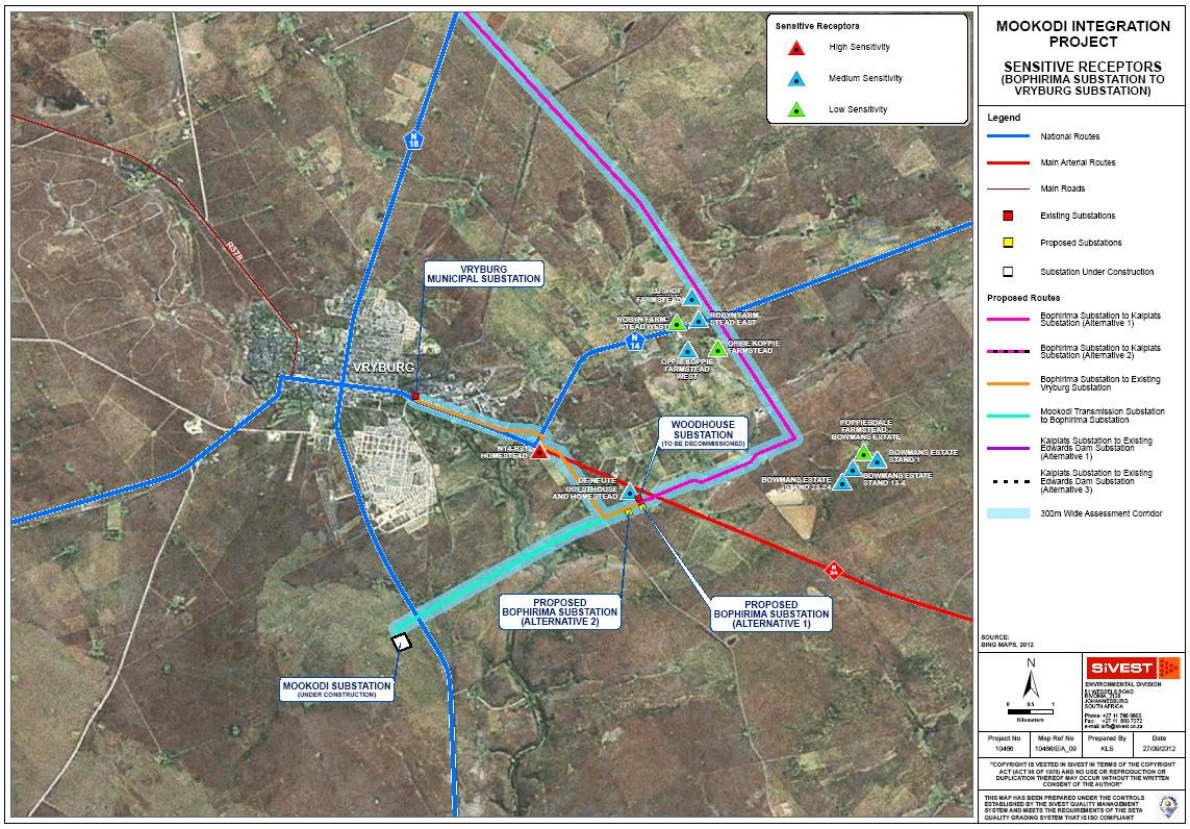


Figure 28: Sensitive Receptors identified in and around the Bophirima Substation to Kalplats Substation Alternative Corridors as well as the Vryburg Substation to Bophirima Substation Corridor.

7.11 Social

The Social Assessment was conducted by MasterQ Research and is included in Appendix 3H.

The subsections below presents the baseline profile (status quo) of the receiving environment in terms of various socio-economic change processes (cf. Vanclay, 2002). It is believed that the baseline profile would be maintained to a large degree (not taking into account variables outside of the project) in the event that a 'no go' option was implemented.

The baseline profile mostly focused on the local municipal area, but reference was made to the district and the province, where deemed necessary. The profile was structured according to the following social change processes:

- Geographic processes: land use patterns;
- Demographic processes: the composition of the local community;
- Economic processes: the way in which the local people make a living and the economic activities in the society;

- Institutional and Legal processes: the role and efficiency of the local authority and other service providers in the area in terms of their capacity to deliver services to the local area; and
- Socio-cultural processes: How the local population behave, interact and relate to each other, their environment, and the belief and value systems that guide these interactions.

7.11.1 Geographical Processes

As an overview of the study area in terms of land use, reference is made to the Northwest Province's Spatial Development Framework. According to this SDF the main land use is agriculture, which can be divided into mainly cattle and game farming in the north-western quadrant of the study area, and extensive agriculture (crops, cattle and game farming) in the north-eastern quadrant of the study area.

7.11.2 Demographical Processes

Demographical processes relate to the number of people and the composition of a community. This includes an overview of the population size, the race, age, gender and educational profile of a population as well as household compositions.

Unless otherwise stated, the baseline social profile was compiled based on data obtained from Census 2001 and the more recent Community Survey (CS) 2007. It is important for readers to note that CS data does not replace Census data, but that the CS merely attempted to adjust measurements to a best estimate. In this regard, Statistics South Africa stated the following: "Any adjustment done [in CS 2007] has maintained the profiling of the community in terms of the people and households while compensating and correcting the undercounted bias by different projections on national, provincial and municipalities level."1 Therefore, one must bear in mind that the following data should only be viewed as indicative of the broad demographical trends within the area and not as a rigid representation of the area.

- Population Composition

As previously mentioned, three local municipalities within the Dr Ruth Segomotsi Mompati District Municipality (DRSMDM) of the Northwest Province will be affected by the proposed construction and operation of the infrastructure developments associated with the Mookodi Integration Project. These municipalities are the Naledi Local Municipality (NLM), the Kagisano Local Municipality (KLM) and the Molopo Local Municipality (MLM). Together these municipalities cover a geographical area of approximately 34,542km2, of which the KLM is the largest area at 14,690km2 followed by the MLM at 12,588km2. The NLM is the smallest of the municipalities at 7,264km2.

[1] Statistics South Africa: Community Survey 2007: Key Municipal Data: ix.

In 2007 these municipalities had a combined total population of 140,385 people, of which just little over a half (75,946 people or 54.1%) were from the KLM, followed by the NLM with 57,931 people (41.3%) and the remainder 6,508 (4.6%) in the MLM. The average population density of the affected areas was around 4.1 persons per km2, which is indicative of the rural nature of these municipalities. However, the population density is based on the overall municipal profile and therefore it can be expected that the population density in urban areas would be much higher than that of the rural areas.

The economically active population group (defined by StatsSA as the ages between 15 and 65) accounts for approximately close on two thirds in Naledi (61.2%) and Molopo (60.5%). Although this is also the predominant group in Kagisano, it only accounts for slightly over half of the population (52.6%). There are slightly more females than males in Naledi (54.5%) and Kagisano (51.9%), while the reverse is true in Molopo where there is slightly more males (50.6%) than females. The Black African is the most dominant population group in all areas (81.2% in Naledi, 86.0% in Molopo and 97.1% in Kagisano).

In 2007 these municipalities had a combined total of 36,735 households, of which 19,888 were in Kagisano, followed by Naledi with 13,675 households and Molopo with 3,675 households. The average occupancy rate across all municipalities was 3.8 persons per household.

Table 14 below provides an overview summary of the population demographics of the study area in relation to South Africa and the Northwest province.

Table 14: Summary of Population Characteristics

	South Africa	North West	Dr Ruth Segomotsi Mompati District		Naledi		Kagisano		Molopo	
	2001	2007	2001	2007	2001	2007	2001	2007	2001	2007
Area size (km2)	1,219,912	116 180.3 (9.5% of SA)	47 478.2 (40.9% of NWP)		7 264 (15.3% of the DM)		14 690 (30.9% of the DM)		12 588 (26.5% of the DM)	
Total population	48,502,063	3 271 948 (6.8% of SA)	32,016	354 554 (10.8% of NWP)	58,095 (13.4% of the DM)	57 931 (16.3% of the DM)	96 387 (22.3% of the DM)	75 946 (21.4% of the DM)	11 690 (2.7% of the DM)	6 508 (1.8% of the DM)
Population density (people per km2)	39.8	28.2	9.1	7.5	8.0	7.9	6.6	5.2	0.9	0.5
Total households	12,500,610	911,119 (7.3% of SA)	104,877	100 073 (11.0% of NWP)	15,251 (14.5% of the DM)	13,675 (13.7% of the DM)	23 000 (21.9% of the DM)	19 888 (19.9% of the DM)	3 632 (3.5% of the DM)	3 172 (3.2% of the DM)
Avg. persons per household	3.9	3.6	4.1	3.5	3.8	4.2	4.2	3.8	3.2	2.1
Predominant Population Group	Black African (79.5%)2	Black African (90.8%)	Black African (92.2%)	Black African (92.2%)	Black African (74.2%)	Black African (81.2%)	Black African (97.2%)	Black African (97.1%)	Black African (90.1%)	Black African (86.0%)
Predominant Gender	Female (50.8%)9	Male (50.3%)	Female (52.1%)	Female (53.1%)	Female (51.3%)	Female (54.4%)	Female (53.1%)	Female (51.9%)	Male (50.2%)	Male (50.6%)
Predominant Age Group	Working age (62.9%)	Working age (64.4%)	Working age (57.6%)	Working age (56.8%)	Working age (63.2%)	Working age (61.2%)	Working age (54.1%)	Working age (52.6%)	Working age (63.1%)	Working age (60.5%)

[9] Census 2001 data

The baseline demographic profile provides an overview of the local area that will be affected to ensure proper planning that will affect the least amount of people during both construction and operation.

7.11.3 Economic Processes

Economic processes relate to the way in which people make a living and the economic activities within that society. The employment status within any given area gives an indication of the economic stability of such an area and also serves as an indicator of such an area's general well-being.

- Educational Attainment

One of the driving forces behind social change is educational attainment, which in turn is linked to poverty levels as there appears to be a correlation between the level of educational attainment and income levels. People with higher educational levels tend to be economically better off, and therefore contribute more to the reduction of the unemployment rate. Educational attainment is also linked to poverty in the sense that funds are required to further studies, therefore people living in less favourable economic conditions tend to be unable to further their education, which in turn holds them in a downward poverty spiral.

An overview of the educational profile for the local municipal areas is provided in Figure 29.

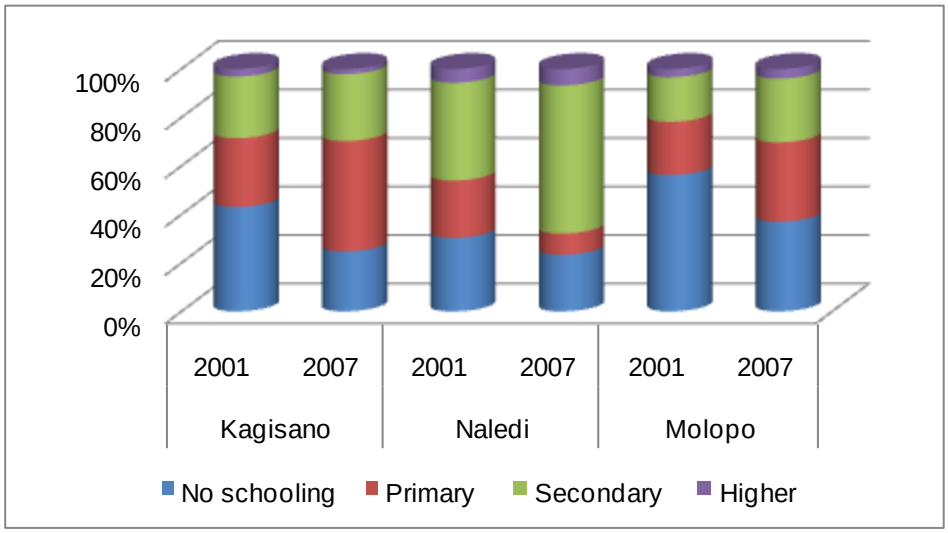


Figure 29: Overview of the Education Profile of the affected municipalities (2001 and 2007 compared).

In 2001, between a third and a half of the population had no form of schooling (30.3% in Naledi and as high as 56.2% in Molopo). Coupled with those individuals who only completed some form of primary education, this means that, in 2001, on average two thirds of the population (67.9%) within the affected municipal areas had limited educational skills, which in turn would hinder their employability on the general job market. On average, just over a quarter (28.0%) of the population completed some

form of secondary education, which could enhance their employability, but only slightly. Only 4.0% on average went on to obtain a tertiary or higher qualification.

The situation only improved marginally between 2001 and 2007: Although the number of people who had no form of education decreased drastically from an average of 43.2% to 28.3%, those who completed some form of secondary education now accounted for just over a third of the adult population (38.3% compared to 2001's 28.0%). The number of individuals who obtained some form of tertiary education remained relatively unchanged from an average of 4.0% in 2001 to an average of 4.3% in 2007.

- Local Employment

Table 15 below provides an overview of the employment and economic sectors of the study area in relation to South Africa, the affected province (Northwest), and the district. From this table it is clear that the study area is characterised by a fairly low employment rate where, on average, just over half of the working age population (excluding the not economically active population) within the study area were formally employed in 2007.

Table 15: Overview of Employment and Economic Sectors

	South Africa	North West	Dr Ruth Segomotsi Mompati District		Naledi		Kagisano		Molopo	
	2001	2007	2001	2007	2001	2007	2001	2007	2001	2007
Employed*	33.7%	38.5%	23.1%	22.3%	38.5%	32.4%	18.0%	14.9%	48.2%	45.2%
Unemployed*	24.0%	20.9%	21.7%	16.3%	20.9%	28.6%	15.6%	12.8%	4.4%	5.0%
Not economically active	42.3%	40.6%	55.2%	61.4%	40.6%	39.0%	66.4%	72.3%	47.3%	49.8%
Employment rate**	58.4%	64.8%	51.6%	57.8%	64.8%	53.1%	53.7%	53.9%	91.6%	90.0%
Predominant industry	Community services	Mining and quarrying	Unspecified	Unspecified	Unspecified	Community services	Agriculture	Community services	Agriculture	Agriculture

* This is the percentage employed/unemployed of the entire working age population and should not be read as the unemployment rate, i.e. the not economically active population is included in this segment.

** In order to reflect a more accurate employment rate, the not economically active population has been excluded from this segment.

When local employment figures are considered in the context of provincial and district information it seems that employment levels in the Naledi and Kagisano areas are more or less on par with that of the district and the province, whereas the employment rate in the Molopo area is much higher than the provincial and district average. Interesting to note is that the agricultural sector employs more than two thirds (67.2%) of those employed within the MLM.

- Personal Income Profile

The graph below (Figure 30) provides an overview of the personal income levels for the affected municipal areas (no data could be obtained on household income levels).

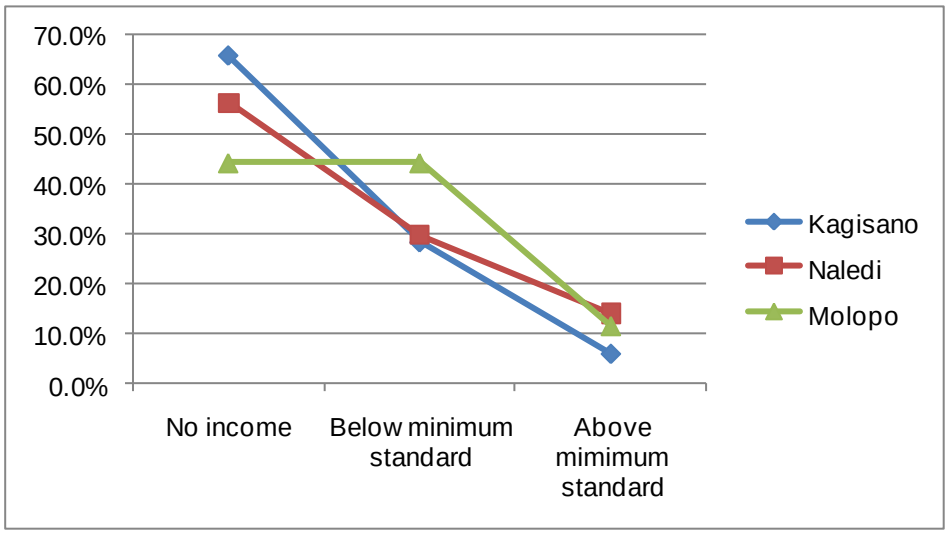


Figure 30: Overview of Personal Income (2007)

The majority of individuals within the affected municipalities do not earn any form of income (65.8% in Kagisano, dropping to 56.3% in Naledi and 44.3% in Molopo). However, it should be noted that the personal income category also included individuals who are not economically active and who would therefore have no income. Despite the fact that Molopo has the least amount of people who earn no income, it is also the area where an equal segment of the population (44.3%) earns below the acceptable minimum standard, nationally defined by government as an income of R 1,600 or less per month. Within the other two municipal areas, approximately a quarter of the population earn less than the acceptable minimum standard. Kagisano is the area with the smallest population who earn above the acceptable minimum standard (≥ R 1,601 per month).

The baseline educational profile provides the project proponent with an indication of the skills levels that might be available in the area in an attempt to predict whether or not it would be possible to source labour and services from the local community. The baseline economic profile gives an indication of how people in the area make their living and the economic activities within a given society. This is required in an attempt to minimise any potential negative impacts on people's livelihoods.

Despite higher employment levels in the local area, unemployment is still high. The project might provide some employment relief, depending on the hiring practices used during the project and the extent to which local employment is prioritised.

Loss of access to land for cultivation and grazing purposes is likely to be the main local negative economic impact that must be investigated.

7.11.4 Institutional and Legal Processes

Institutional and Legal processes refer to the role and efficiency of the local authority and other service providers in the area in terms of their capacity to deliver a quality and uninterrupted service to local communities.

- Municipal Services

Table 16 below provides an overview of the municipal services of the Naledi area in relation to the Dr Ruth Segomotsi Mompati District and the Northwest Province as a whole. No data could be obtained for the overall municipal service delivery in South Africa.

Table 16: Overview of Municipal Service Delivery

	South Africa	North West	Dr Ruth Segomotsi Mompati District		Naledi		Kagisano		Molopo	
	2001	2007	2001	2007	2001	2007	2001	2007	2001	2007
Energy Cooking	-	Electricity (65.8%)	Non-electrical (69.8%)	Electricity (53.9%)	Non-electrical (56.8%)	Electricity (63.2%)	Non-electrical (80.1%)	Non-electrical (64.3%)	Non-electrical (60.6%)	Electricity (51.0%)
Energy Heating	-	Electricity (58.9%)	Non-electrical (69.5%)	Non-electrical (59.0%)	Non-electrical (55.2%)	Electricity (60.6%)	Non-electrical (78.1%)	Non-electrical (75.1%)	Non-electrical (60.6%)	Non-electrical (52.4%)
Energy Lighting	-	Electricity (82.5%)	Electricity (59.9%)	Electricity (81.7%)	Electricity (65.1%)	Electricity (85.3%)	Electricity (67.2%)	Electricity (75.2%)	Non-electrical (50.5%)	Electricity (59.6%)
Refuse	-	Removed once a week (52.6%)	Own refuse dump (62.7%)	Own refuse dump (60.9%)	Removed once a week (63.2%)	Removed once a week (79.9%)	Own refuse dump (84.4%)	Own refuse dump (81.9%)	Own refuse dump (81.2%)	Own refuse dump (75.2%)
Sanitation	-	Equal or above RDP standard (54.6%)	Below RDP standard (50.4%)	Equal or above RDP standard (50.8%)	Equal or above RDP standard (76.0%)	Equal or above RDP standard (83.5%)	Below RDP standard (65.4%)	Below RDP standard (69.6%)	Below RDP standard (54.8%)	Equal or above RDP standard (57.2%)
Water	-	Equal or above RDP standard (89.9%)	Below RDP standard (54.1%)	Equal or above RDP standard (90.3%)	Equal or above RDP standard (67.5%)	Equal or above RDP standard (92.7%)	Below RDP standard (57.7%)	Below RDP standard (83.3%)	Equal or above RDP standard (78.3%)	Equal or above RDP standard (60.0%)

The baseline municipal profile suggests that the area is not well supplied with basic services such as electricity, refuse removal, sanitation services or water supply. Although the overall number of households who make use of electricity for lighting has increased between 2001 and 2007, large segments of the population still make use of non-electrical energy for cooking and heating purposes, most notably in Kagisano and Molopo. Overall refuse removal appears to be lacking in view of the fact that the majority of households make use of their own waste disposal facilities – this is often informal disposal, which means that waste is not properly stored or treated, which in turn can lead to unhealthy living conditions. In terms of water and sanitation services, most of the households within the affected area either do not have access to these services or their access to these services is below RDP standard3.

- Crime

As far as could be determined during the course of the study, the Naledi Local Municipal area is serviced by 3 police stations, one in Vryburg, one in Huhudi, and one in Stella. According to the South African Police Service's website, the ratio of police officers in the Northwest province as at June 2010 was 1 police official for every 412 citizens. On a population size of 140,385 people, theoretically this means that there are approximately 340 police officers deployed throughout the study area.

Figure 31 below provides an overview of the baseline profile on crime in the project area. This profile was based on information obtained from the Crime Information Management Services of the South African Police Service4 on crimes reported for the years 2006 – 2009 at the following Police Stations within the study area:

- Vryburg, Huhudi and Stella in the Naledi Local Municipality;
- Bray and Vorstershoop in the Molopo Local Municipality; and
- Ganyesa, Morokweng and Piet Plessis in the Kagisano Local Municipality.

For the purposes of this scoping study only crimes against the person (murder, sexual crimes, attempted murder, assault with grievance bodily harm, common assault, armed robbery and common robbery) and property-related crimes (burglary and theft) were considered.

[3] RDP standard for sanitation services include toilet facilities that is either connected to a waterborne sewerage system or a ventilated VIP-system. The RDP standard for water supply refers to piped water either within the dwelling or within a 200m radius from the dwelling.
[4] http://www.saps.gov.za/statistics/reports/crimestats/2009/crime_stats.htm

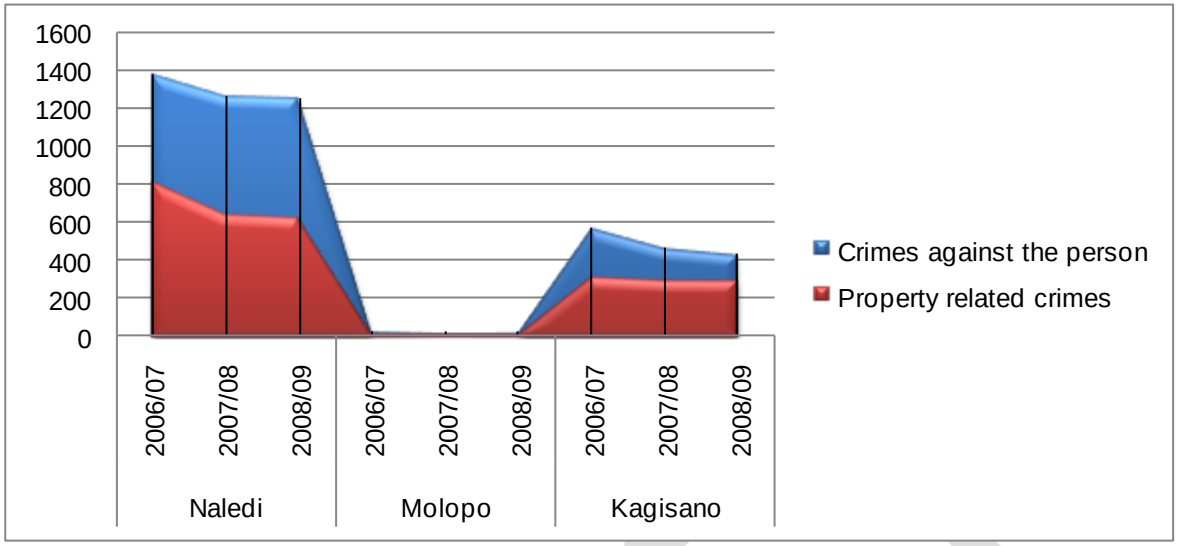


Figure 31: Crime profile of the study area

During the period under review a total of 3,899 crimes against the person were reported in Naledi, a further 71 cases in Molopo and 1,469 cases in Kagisano. As far as property related crimes are concerned, a total of 1,915 cases were reported in Naledi, a further 53 cases in Molopo and 904 cases in Kagisano. In general, the number of property related crimes are much lower than crimes against the person. Molopo has the lowest crime rate by far, whereas Naledi has the highest crime rate. In all areas the crime rate appears to be on the decline.

There is perception that crime increases in an area the moment that construction workers arrive on site. Because of this perception, occurrences of crime during the time of the project are likely to be ascribed to the construction workers. This has a mental health impact, such as fear. However, it should be noted that in most instances it is not the actual construction worker who engage in criminal activities but more likely job seekers who loiter at the site in search of employment.

- Infrastructure and Services

There are three district hospitals in the study area, one in Kagisano (Ganyena) and two in Naledi (Vryburg and Stella). The area is serviced by a total of 8 police stations, as outlined above.

No information could be obtained on the emergency services servicing the area.

The baseline institutional and empowerment profile gives an indication of the municipal services available, the local municipalities' ability to provide for additional connections if required (e.g. removing waste from site), and the capability of the area to provide in health and other emergency services. This information enables the project proponent and it's appointed contractors to plan ahead by ensuring that they include keys aspects such as emergency management plans in their planning process and costing.

7.11.5 Socio-Cultural Processes

Socio-cultural processes relate to the way in which humans behave, interact and relate to each other and their environment, as well as the belief and value systems which guide these interactions.

- Baseline Socio-Cultural Processes

The Vryburg area was established next to the Huhudi stream, which was the original Setswana name for the district, and has been occupied by the baRolong and then the baThlabing from around the 1750s.

The town itself came into existence more than a century later in 1882 following a dispute between the baTlhaping of Makurwane and the Kora people under David Mossweu over the relative fertile land that the baTlahping occupied in the greater Taung district. Boer mercenaries came to Mossweu's aid and a low intensity war followed during which the boers, under the leadership of GJ van Niekerk, a landowner and storekeeper from Christiana, established the short lived Stellaland Republic in 1883. The citizens of the Republic of Stellaland referred to themselves as vryburgers, hence the name Vryburg. The independence of the Republic of Stellaland was, however, short lived. First Paul Kruger annexed the area under the Transvaal Government, and then, in February 1884, the London Convention was signed making Vryburg and the Republic of Stellaland a British protectorate.

British colonial control replaced the largely Boer presence of Stelleland and in 1885 Vryburg became part of the Crown Colony of British Bechuanaland, which in turn was annexed by the Cape Colony in 1895. The area earned a reputation as a wild frontier and for a while served as a basecamp to the notorious outlaw Scotty Smith.

Modern day Vryburg forms part of a cattle rich farming area and has been referred to as the "Texas of South Africa". In the 1980s the residents of the nearby township Huhudi objected strongly to being incorporated into the homeland of Bophuthatswana, thus leaving Huhudi a hotbed of political opposition to the then government. To this day the legacy of apartheid remains. Farm areas are almost exclusively owned by white farmers, with a definite divide between the town of Vryburg and townships such as Huhudi and Thakwaneng.

8 PUBLIC PARTICIPATION PROCESS

Public participation is the cornerstone of any EIA. The principles of NEMA as well as the EIA Regulations govern the EIA process, including public participation. The Public Participation Process (PPP) for the proposed project has been conducted according to EIA Regulations, R. 543, promulgated on 18 June 2010, Chapter 6, Regulation 54.(These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment, and ensuring the participation of previously disadvantaged people, women and the youth.

The public participation process is primarily based on two factors; firstly, ongoing interaction with the environmental specialists and the technical teams in order to achieve integration of technical assessment and public participation throughout. Secondly, to obtain the bulk of the issues to be addressed early on in the process, with the latter half of the process designed to provide environmental and technical evaluation of these issues. These findings are presented to stakeholders for verification that their issues have been captured and for further comment.

Input into the public participation process by members of the public and stakeholders can be given at various stages of the EIA process (please refer to the Figure **32** below for the EIA process diagram). Registration on the project can take place at any time during the EIA process up until the final EIA report is submitted to DEA. There are however set periods in which comments are required from Interested and / or Affected Parties (I&APs) in order to ensure that these are captured in time for the submission of the various reports. The comment periods during the scoping phase were implemented according to the NEMA (107/1998), EIA Regulations in terms of section 24(5). The comment periods that were and still to be followed during the impact phase (as set out by DEA) are as follows:

- EIA Newsletter: Comments can be received throughout the impact phase period (August 2012 to end November 2012);
- Comment period for the Draft Environmental Impact Assessment Report (DEIR): 4 Calendar weeks (30 days); and
- Comment on the Amended/Revised DEIR: should there be a significant change from the DEIR an appropriate comment period will be set out in consultation with DEA. This period may be seven (7) days, fourteen days (14), etc., as to be approved or set by DEA. Should there be no significant changes, then the Final Impact Assessment Report (FEIR) will be submitted to DEA and all registered I&APs notified accordingly.

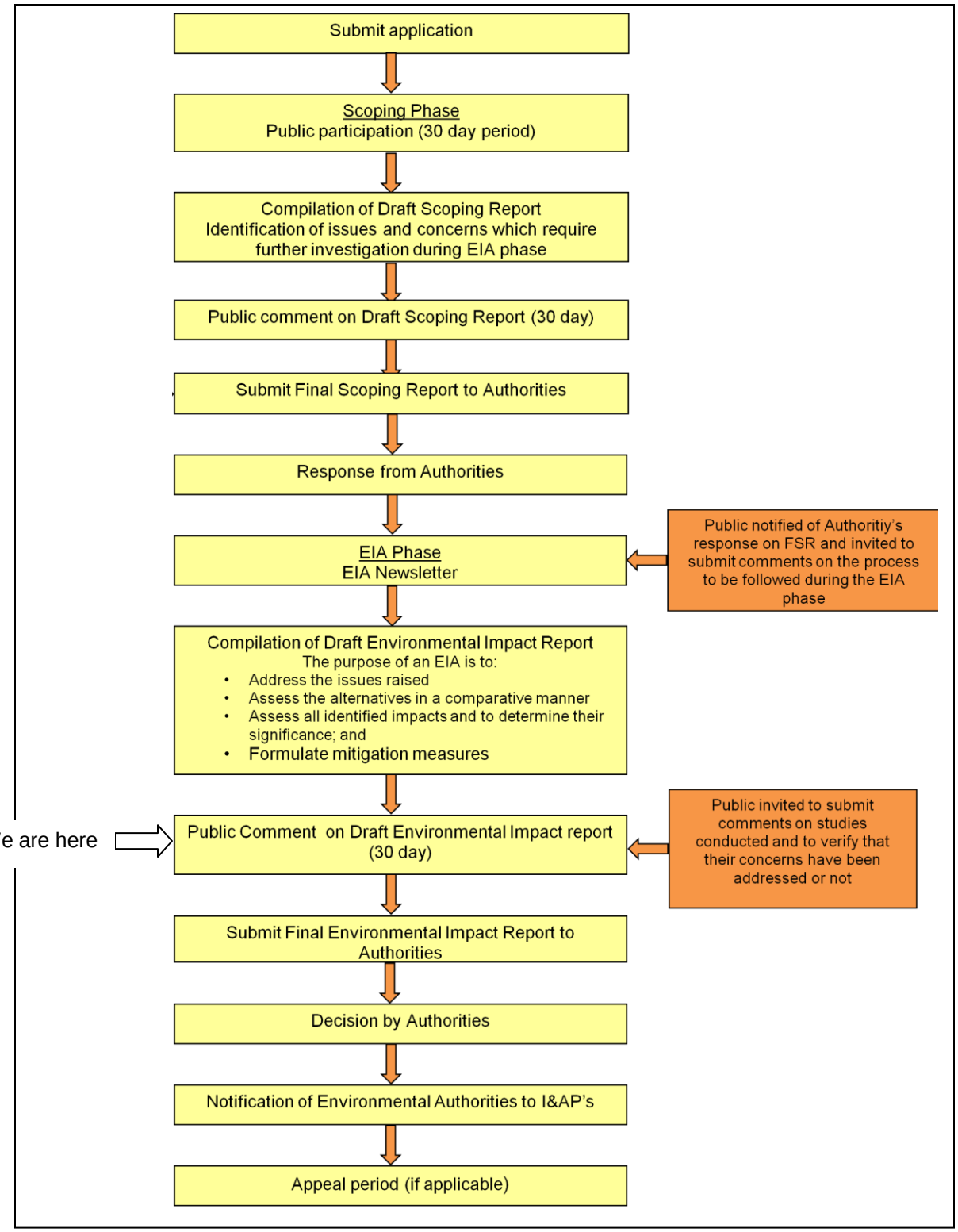


Figure 32: EIA process diagram (scoping and impact phase)

The EIA regulations emphasise the importance of public participation. In terms of the EIA regulations, registered I&APs –

- may participate in the application process;
- may comment on any written communication submitted to the competent authority by the applicant or environmental consultant;
- must comment within the timeframes as stipulated by the EIA Regulations;
- must send a copy of any comments to the applicant or Environmental Assessment Practitioner (EAP) if the comments were submitted directly to the competent authority; and
- must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused.

Further, in terms of the EIA regulations, the EAP:

- manages the application process;
- must be independent;
- must undertake the work objectively – even if this results in views and findings that are not favourable to the applicant;
- must disclose material information that may influence the decision; and
- must conduct a public participation process.

The following actions were taken upon receiving comments/queries/issues:

- The contact details provided were entered into or updated on the project database for use in future notifications;
- Confirmation of receipt of comments; and
- Addressed comments in the Issues and Response Report.

8.1 Objectives of Public Participation

It needs to be noted what Public Participation is and is what it is not.

- Public Participation is:
  - A communication mechanism to inform I&APs regarding a proposed project.
  - A communication mechanism to record comments and/or concerns raised during the relevant phase of the EIA by I&APs regarding a proposed project.

- What Public Participation is not:
  - A marketing exercise.
  - A process to address grievances but rather to record comments raised.
  - One-on-one consultation with each I&AP during the EIA process (not relevant to possibly affected landowners identified).

The primary aims of the PPP are:

- To inform interested and affected parties (I&APs) and key stakeholders of the proposed development;
- To initiate meaningful and timeous participation of I&APs;
- To identify issues and concerns of key stakeholders and I&APs with regards to the proposed development;
- To promote transparency and an understanding of the proposed project and its potential environmental impacts;
- To provide information used for decision-making;
- To provide a structure for liaison and communication with I&APs and key stakeholders;
- To assist in identifying potential environmental impacts associated with the proposed development;
- To ensure inclusivity (the views, needs, interests and values of I&APs must be considered in the decision-making process);
- To focus on issues relevant to the project and issues considered important by I&APs and key stakeholders;
- To provide responses to I&AP queries;
- To encourage co-regulation, shared responsibility and a sense of ownership.

In addition to the guidance of the PPP in the EIA Regulations every effort was also made to conform to the requirements of the Promotion of Administrative Justice Act 2000 (Act 3 of 2000).

8.2 Public Participation Process to Date

The public participation process that was followed during the Impact Phase of the project was the distribution of:

- the EIA Newsletter in September 2011; and
- the Updated EIA Newsletter in August 2012.

The stages that formed part of the public participation process to date for this proposed project are reflected in the Figure **33** below:

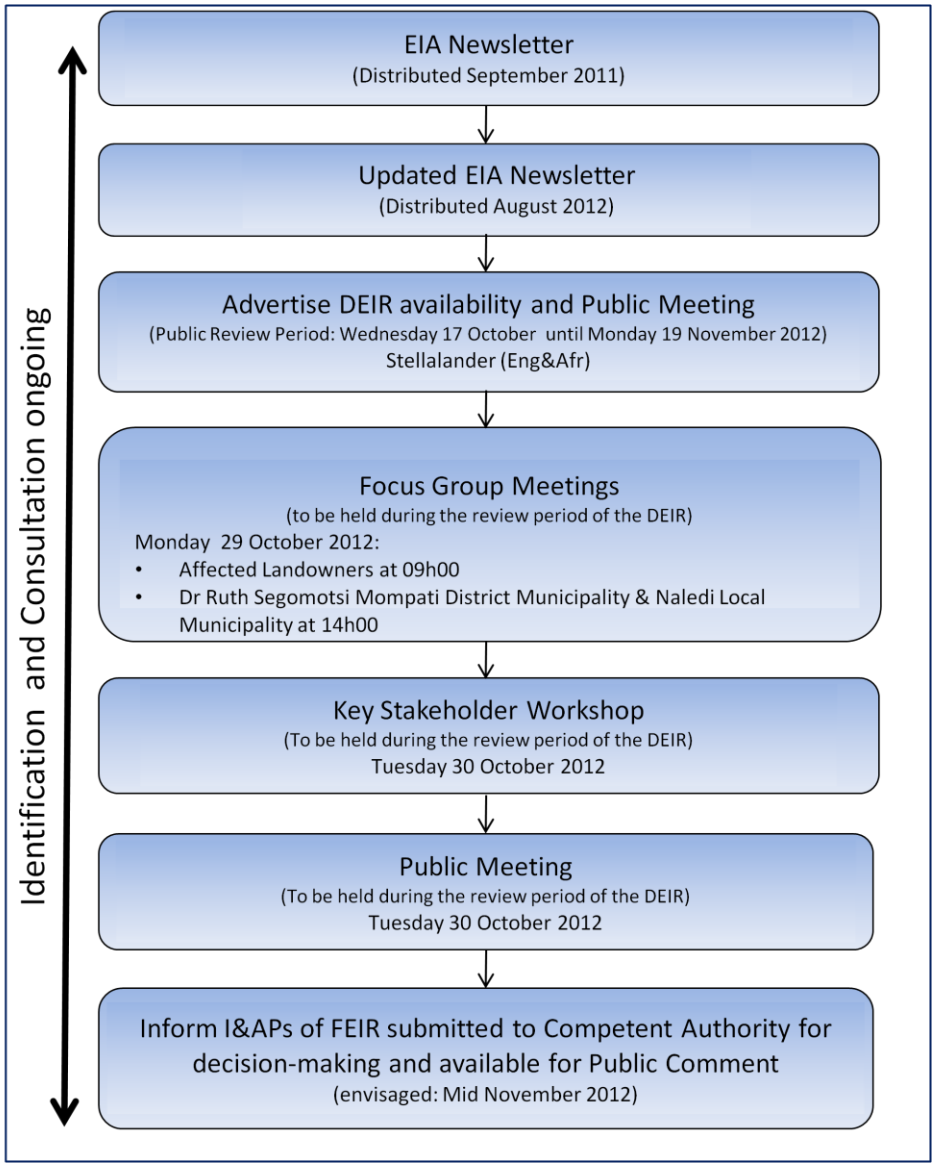


Figure 33: Public Participation Process

On-going consultation with key stakeholders (e.g. provincial, district and local authorities, relevant government departments, local business etc.) and identified I&APs ensured that I&APs were kept informed regarding the EIA process. Networking with I&APs effectively continued throughout the impact phase of the project until the FEIR is submitted to the DEA.

The following public participation activities, other than the EIA Newsletter and Updated EIA Newsletter, will be conducted during the DEIR review period:

- Update the project database of key Interested and Affected Parties was compiled;

- Public Meeting site notices will be erected in the towns of Vryburg and Stella;
- DEIR availability and the Public Meeting date and venue will be advertised in the Stellalander and Sowetan;
- DEIR available for a 30 day comment period (calendar days);
- Authorities and landowners to be invited, in writing, to Focus Group Meetings; and
- Key Stakeholders workshop.

Continuation of the EIA phase was therefore undertaken after receipt of the approval of the Final Scoping Report and Plan of Study. The EIA phase round of specialist studies commenced during which consultation with the public continued and an EIA Newsletter was distributed on the 5th September 2011. However, due to certain technical components and constraints, the project had to be put on hold until these issues could be resolved by the proponent. The issues were subsequently resolved and re-activation of the project commenced in August 2012. An updated EIA Newsletter was distributed on the 29th August 2012. During the review period of the DEIR, the following meetings will take place to present the findings of the DEIR and to provide a further opportunity to stakeholders and I&APs to raise comments on the DEIR or to raise any comment and/or concerns not yet raised to date on the proposed project:

- Focus Group Meetings:
  - Monday 29th October 2012:
    Affected Landowners at 09h00 in Stella; and
    Dr Ruth Segomotsi Mompati District Municipality & Naledi Local Municipality at 14h00 in Vryburg
- Key Stakeholder Workshop:
  - Tuesday 30th October 2012 at 09h00 at Lavender Lodge, Molopo Road, Vryburg.
- Public Meeting:
  - Tuesday 30th October 2012 at 18h00 at Coolridge Community Hall, Vryburg.

Minutes of all of these meetings will be included within the Final EIR and Issues and Response Report (Appendix 4D).

8.2.1 Public review of Environmental Impact Report

The Draft EIR will be made available for review at the following venues from the Wednesday 17th of October to Monday19th of November 2012:

- Vryburg Library
- Coolridge Library
- Huhudi Library
- Stella Municipal Offices
- SiVEST website

Once the comment period has ended, the comments received will be incorporated into the FEIR and finalised. The Final EIR will then be submitted to DEA for review and decision making and all registered stakeholders and I&APs on the project database will be notified of the submission to DEA.

8.3 Proof of Notification

Appendix 4 will include documentation as proof of Public Participation once the notices have been distributed. The documents will include:

- Original Proof of Newspaper adverts for Public Meeting and DEIR availability for public review(Appendix 4B)
- EIA Newsletter (Appendix 4A)
- Updated EIA Newsletter (Appendix 4A)
- Invitations to Focus Group Meetings, Key Stakeholder Workshop and Public Meeting (Appendix 4C)
- Photographic proof of Public Meeting Site Notices (Appendix 4A)
- Various communications to and from I&APs and Authorities, including:
    - To I&APs
    i. Agendas
    ii. Meetings (invitations to Feedback Public, Focus Group Meetings and KSWs)
    iii. Correspondence to I&APs
    - From I&APs
    i. EIA Newsletter Comments
    ii. Other
    - Authorities (Appendix 4C)
    i. Other
- Issues and Responses Report (Appendix 4D)
- Register of registered I&APs on database (Appendix 4E)

8.4 I&AP Register

Appendix 4E includes a I&AP database list which includes registered Interested and / or Affected Parties and Key Stakeholders that has registered, identified through networking, information submitted by already registered I&APs, etc. It needs to be noted that an I&AP register / database is a “working in progress” document and are regularly updated with information received by I&APs and/or stakeholders and information sourced by the project team. The update of the I&AP register / database will only reach completeness once the Environmental Authorisation has been issued.

8.5 Focus Group Meetings

Two (2) Focus Group Meetings (FGMs) are to be arranged for the 29th October 2012, during the review period of the DEIR. FGMs are smaller meetings with specific groups or organisations who have similar interests in or concerns about the project. The details pertaining to the focus group meetings are listed in Table 17 below.

Table 17: Focus Group meetings

Venue	Interested Parties	Date	Time
NG Church Hall, Stella	Affected Landowners	Monday 29th October 2012	09h00 to 11h00
Boardroom, Naledi Local Municipality	Local and District Municipal members		14h00 – 16h00

Minutes of these meetings will be compiled and forwarded to all attendees. The primary aim of these meetings will be to:

- disseminate information regarding the proposed development to I&APs as per the Impact Phase;
- provide I&APs with an opportunity to interact with the EIA team and the Eskom representatives present;
- provide feedback on the environmental findings as per the DEIR;
- provide an opportunity to submit comments on the DEIR; and
- provide a further opportunity to raise comments and/or concerns not raised to date regarding the proposed development.

8.6 Key Stakeholder Workshop

A Key Stakeholder Workshop has been arranged for Tuesday 30th October 2012 during the review period of the DEIR. The Key Stakeholder Workshop is to be held in order to provide commenting authorities and key stakeholders with additional information regarding the proposed development, to present the environmental findings of the impact-phase studies and to invite stakeholders to submit their comments on the DEIR as well as to raise any further comments and/or concerns that they may have. Details pertaining to the Key Stakeholder Workshop are provided in **Error! Reference source not found.** below.

Table 18: Key Stakeholder Workshop

Venue	Date	Time
Lavender Lodge, Molopo Road, Vryburg	Tuesday 30th October 2012	09h00 – 11h00

The draft minutes from the Key Stakeholder Workshop will be compiled and forwarded to all attendees. The final minutes are to be included in the FEIR for submission to the Competent Authority.

8.7 Public Meeting

A Public Meeting is to be held during the review period of the DEIR. The meeting is to take place on the Tuesday 30th October 2012. Details pertaining to the Public Meeting are provided in Table 27 below.

Table 19: Public Meeting

Venue	Date	Time
Coolridge Community Hall, Vryburg	Tuesday 30th October 2012	18h00

This meeting is to be advertised in the Stellalander (English and Afrikaans) and invitation letters are to also be sent via postal service and e-mail to all registered I&APs on the project's database.

Furthermore, posters advertising the Public Meeting are to be displayed at the public venue (as advertised) as well as various public places frequented by the public i.e. hotel, cafés etc in Vryburg and Stella areas. Proof of the posters will be included in Appendix 4B.

The Public Meeting will be held in order to provide I&APs with information regarding the proposed development, present the impact phase environmental findings and invite I&APs to raise any further comments and/or concerns that they may have.

Draft minutes of this meeting are to be compiled and forwarded to all attendees. Ultimately, the final minutes are to be included in the FEIR for submission to the Decision making Authority (Appendix 4F).

8.8 Public review of Environmental Impact Report

The DEIR is to be made available for review, for a period of 30 days as required by legislation, at the venues listed in Table 21 below from Wednesday 17th October 2012 to Monday 19th November 2012:

Table 20: Venues where the draft Environmental Impact Report will be publicly available

Venue	Street Address	Contact No
Vryburg Public Library	63 Stella Street	053 928 2270
Colridge Library	French Street, Colridge	053 928 2279
Huhudi Library	C/o Mosiatoa & Nelson Mandela Drive	053 928 2251
Stella Municipal Offices, Stella	175 Stella Street, Stella	053 983 0395

All comments received on this report will be incorporated into the Issues and Response Report which will be attached in Appendix 4D In the DEIR.

8.9 Summary of the issues raised and EAP Responses

All comment/concerns and/or issues raised through the public participation process during the impact phase have been captured in the Issues and Response Report (I&RR). The I&RR is attached as Appendix 4D. The I&RR provides a summary of the issues raised, as well as responses which were provided to I&APs. This information was used as the basis of the evaluation of environmental and social impacts. A separate section will be added capturing the comments received from I&APs, stakeholders and authorities during the review period of the Draft EIR.

It needs to be noted that comments made by the technical team are not captured in the I&RR.

The I&RR is included in the draft EIR to provide I&AP the opportunity to verify that their comments/concerns and/or issues raised have been captured and also provides the response from the relevant environmental specialist, the proponent or EAP. Should a written comment be received that the comment raised has not been captured correctly, it will be updated and confirmed with the relevant I&AP and the I&RR will be updated before inclusion in the Final EIR.

At present no issues have been raised from IAPs during the EIA phase of the proposed project.

8.10 Commenting Authority involvement

In order to ensure that authority comments are received on the DEIR, a comment form (Appendix 4A) will be sent to all authorities on the database. A drive of phone calls and SMS will also be undertaken to try and illicit their comments. Authority comments submitted to date are included in the I&RR (Appendix 4D) and those that will be received on the DEIR will also be included once received which will be submitted with the Final EIR to the competent authority.

To assist Authorities in submitting written comments, an Authority DEIR Comment Form will be distributed to them.

9 METHODOLOGY FOR IMPACT ASSESSMENT

The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

9.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in Table 21.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

9.2 Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

9.2.1 Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 21: Example of the significance impact rating table.

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.

IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects

2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects

INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

10 DESCRIPTION OF ALL ENVIRONMENTAL IMPACTS

As mentioned above, the following specialist studies (and associated impact assessment) were undertaken:

- Biodiversity (flora and fauna)
- Avifauna
- Surface Water
- Geotechnical
- Geohydrology
- Heritage
- Visual
- Social

10.1 Biodiversity (Flora and Fauna)

In order to determine the impacts that could result from the proposed project, a detailed route assessment was undertaken from a biodiversity perspective. In order to ensure a thorough assessment and allow for easy reading, the route was split up into four Biodiversity sections namely:

- Vryburg Biodiversity section
- Vryburg to Stella Biodiversity section
- Stella to Kalplats Biodiversity section
- Kalplats to Edwards dam Biodiversity section

Each section involved the assessment of the following:

- General land use description
- Vegetation type
- Faunal habitat provision and faunal species of concern
- Implications for development

10.1.1 Vryburg Biodiversity Section

The Vryburg section encompasses the following sections of the route:

- The proposed Bophirima Substation to Mookodi Transmission Substation 132kV servitude power line (~14km – green alignment)
- Bophirima Substation to existing Vryburg Substation (white alignment)
- A portion of the route from Bophirima Substation to Kalplats Substation. This portion ends at the intersection of N18 and the dirt road (purple alignment).

Figure 34: Vryburg biodiversity section

- General land use description

The Vryburg area is characterised by several land uses such as vacant/ unspecified, residential, commercial/ industrial, cultivated land and forestry (ENPAT data). The route running from Mookodi transmission substation to Bophirima substation predominantly cross vacant or unspecified land. The alignment also crosses a river, a dirt road, a tar road (N18) as well as a railway line.

A portion of the alignment from the Bophirima substation to existing Vryburg substation traverses a commercial/ industrial area (in the area closer to the existing Vryburg substation). The other portion of this route crosses vacant/ unspecified land. Furthermore, the area of the Mookodi and the Bophirima substations is classified as vacant/ unspecified. But during site visits, illegal dumping and signs of a previous fire were observed in portions near the Mookodi substation and the alignment. Also, there are existing power lines running near the Bophirima substation (Figure 35). This section of the study area is generally transformed in terms of biodiversity by small holdings and agricultural practices.

Figure 35: Existing power lines near the Bophirima substation

The portion of the route from Bophirima Substation to Kalplats Substation (which ends in the area of N18) is characterized by vacant/ unspecified land and a small section of cultivated land (ENPAT data). During site visits, land uses such as smallholdings, cultivation - maize (including farm houses) and cattle farming where noted in this section of the route. The route is also traversed by a railway and power lines.

Figure 36: Existing power lines and farm house along a portion of the proposed Bophirima Substation to Kalplats Substation route

Generally, the Vryburg area is largely transformed due to anthropogenic activities as well as poor land management practices as a result of overgrazing and dense human settlement (Cook, 2008). Nevertheless, small portions of relatively natural vegetation persist in the area traversed by the alignments.

- Vegetation type and dominant species

The Vryburg section falls under the Ghaap Plateau Vaalbosveld vegetation which is least threatened and not protected. The vegetation type is considered least threatened and it is not protected. According to Mucina and Rutherford, (2006), only about 1% of the vegetation type is already transformed. It dominated by a well developed shrub layer e.g. *Tarchonanthus camphorates* and *Acacia karroo*, the open tree layer has *Olea europaea* subsp. *africana*, *A. tortilis*, *Ziziphus mucronata* and *Rhus lancea* (Mucina and Rutherford, 2006). Much of the South-central part of this unit is dominated by the non-thorny *T. camphoratus*, *R. lancea* and *O. europaea* subsp. *Africana* (Mucina and Rutherford, 2006).

- Faunal habitat provision and faunal species of concern

In terms of terrestrial ecosystem status, Vryburg is located in an area that is generally considered least threatened whereas some portions present but no natural habitat remaining (SANBI Biodiversity GIS, 2007). Furthermore there are no protected areas in Vryburg.

Faunal sensitivity in this area relates mainly to reptiles, amphibian species as well as small mammals.

With regards to reptiles, only two reptile species are considered to be of conservation importance. These include the Southern African Python (*Python natalensis)* is listed as Vulnerable (although recent reports indicate that the species is being down listed) and the Blunt-tailed Worm Lizard *Dalophia pistillum* which is Peripheral. The Southern African Pythons are protected in South Africa. Pythons are exploited for their skins as well as for the muti trade and are thus threatened with extinction (Cook, 2008). The Blunt-tailed Worm Lizard has also been recorded in the Vryburg area and is relatively common due to the abundance of sandy soils within the study area (Cook 2008). The habitat for the Southern African Python and the Blunt-tailed Worm Lizard is present in the Vryburg area.

The rivers as well as the rocky outcrops (Figure 37) noted in the Vryburg area potentially house the Southern African Python. According to Branch, 1998, the Southern African Python is particularly found in rocky areas and riverine scrub.

Furthermore, several large termite mounds *Trinervitermes haberlandii* which house numerous snakes e.g. the Southern African Python and lizards were observed in the Vryburg area by Cook, (2008). Furthermore Trees

including stumps, bark and holes are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors) (Cook, 2008).

Figure 37: A rocky outcrop characterized by dense vegetation. This is a potential habitat for a few skinks, snakes and other reptiles.

The majority of reptile species are sensitive to severe habitat alteration and fragmentation yet large portions of the Vryburg area are transformed due to agricultural activities, removal of vegetation and poor land management practices such as overgrazing and dense human settlement. As such, the remaining habitat should be preserved as much as possible.

The habitat for several amphibians is potentially present near the streams and in termite mounds observed in the study area.

- Implications for development

As indicated above, although the Vryburg area is heavily transformed (Figure 38) due to anthropogenic activities and land management practices, small portions of relatively natural vegetation remain along most alignments (Figure 39). Therefore, the sensitive reptile species that occur in the study area could potentially be affected by the proposed development. In addition, river systems that are present are also considered to be sensitive as they provide habitat for all faunal groupings. It is assumed that intact habitat would result in higher faunal and floral species diversity.

Suitable mitigation measures can play an important role in preserving potential habitats and hence reducing impacts on flora and fauna. For instance, the few areas exhibiting dense natural vegetation can be avoided/

spanned in order to reduce vegetation loss. River systems must be spanned and no towers should be placed within the buffer zones dictated by the surface water studies.

Figure 38: Transformed area facing south east in a portion where the route traverses N14

Figure 39: Area of relatively natural vegetation along the proposed Bophirima Substation to Kalplats Substation route (Photo taken in the area between the railway line and N18)

10.1.2 Vryburg to Stella Biodiversity Section

This is the section of the Bophirima Substation to Kalplats Substation route between Vryburg and Stella. This section specifically starts at the intersection of N14 and the dirt road to the area in Stella where alternative 2 starts.

Figure 40: Vryburg to Stella Biodiversity Section

- General land use description

According to ENPAT data this section of the route traverses a vacant/ unspecified area and cultivated areas. The route runs adjacent to N18 to Stella for about 33km and the turns northwest. Vegetation along the entire section of the route is heavily transformed by activities such as cattle grazing, cultivation. Also, certain sections of the route indicated signs of a recent fire in the area.

Overall, this section of the route exhibits more transformed areas compared to the Vryburg section which exhibited a few areas of relatively natural vegetation. Agricultural practices, particularly grazing dominate this section of the route and the natural regime has been transformed dramatically. Shrubveld has been transformed into grasslands for grazing purposes. The route follows adjacent to the N18 thus following existing infrastructure. Small surface water features are also present along this section of the route.

- Vegetation type and dominant species

Table 22: Vegetation types in Vryburg to Stella Biodiversity Section

Vegetation Class	Ecological Status	Protection Status
Ghaap Plateau Vaalbosveld	Least Threatened	Not Protected
Stella Bushveld	Vulnerable	Not Protected

- Ghaap Plateau Vaalbosveld

About one-third of the section falls within this vegetation type. The Ghaap Plateau Vaalbosveld vegetation type is considered least threatened and it is not protected. According to Mucina and Rutherford, (2006), only about 1% of the vegetation type is already transformed. It dominated by a well developed shrub layer e.g. *Tarchonanthus camphorates* and *Acacia karroo*, the open tree layer has *Olea europaea* subsp. *africana*, *A. tortilis*, *Ziziphus mucronata* and *Rhus lancea* (Mucina and Rutherford, 2006). Much of the South-central part of this unit is dominated by the non-thorny *T. camphoratus*, *R. lancea* and *O. europaea* subsp. *Africana* (Mucina and Rutherford, 2006).

- Stella Bushveld

The reminder of the section along this route falls under the Stella Bushveld vegetation type. The vegetation type is vulnerable and not protected. Up to 21% has been transformed by cultivation (Mucina & Rutherford, 2006). Dominant species include: *Acacia erioloba, A. tortillis*, *A. hebeclada*, *Dichrostachys cinerea*, *Grewia flava* and *Tarchonanthus camphorates* (Mucina & Rutherford, 2006).

One of the most problematic declared weeds in the North West Province, Sweet prickly pear (*Opuntia ficus-indica*) was noted along the route near a farm house.

In addition, a few individuals of *A. erioloba* were noted in the area of the route northwest of Stella.
In terms of terrestrial ecosystem status, this section of the route is located in an area that is considered least threatened and some portions present no natural habitat whatsoever (SANBI Biodiversity GIS, 2007). Furthermore there are no protected areas along this section of the route.

- Faunal habitat provision and faunal species of concern

This section of the route is not expected to provide good habitat for faunal species due to the level of transformation by mainly cattle grazing as mentioned above. However, a ground squirrel burrow was observed in the area of the route northwest of Stella (Figure 41)

Figure 41: Possible ground squirrel habitat. Note burrow in this area of the route.

Amphibian species would be isolated to the wetland areas while common reptile species would be found throughout the area.

- Implications for development

The area is heavily transformed and hardly any habitat exists for faunal species. Apart from the area where ground squirrel activity was noted, no other faunal activities were observed along the entire section of this route. The small wetlands scattered along the route as presented by SANBI Biodiversity GIS, (2007) can easily be avoided. Furthermore vegetation removal must be limited to tower footprints and access roads.

No Red Data floral species were documented.

10.1.3 Stella to Kalplats Biodiversity Section

This section of the route starts in an area about 3km northwest of the small town of Stella. It comprises of a portion of the route from Bophirima substation to Kalplats substation, alternative 1 (Purple alignment) and Bophirima substation to Kalplats substation, alternative 2 (Blue alignment) (Figure 42)

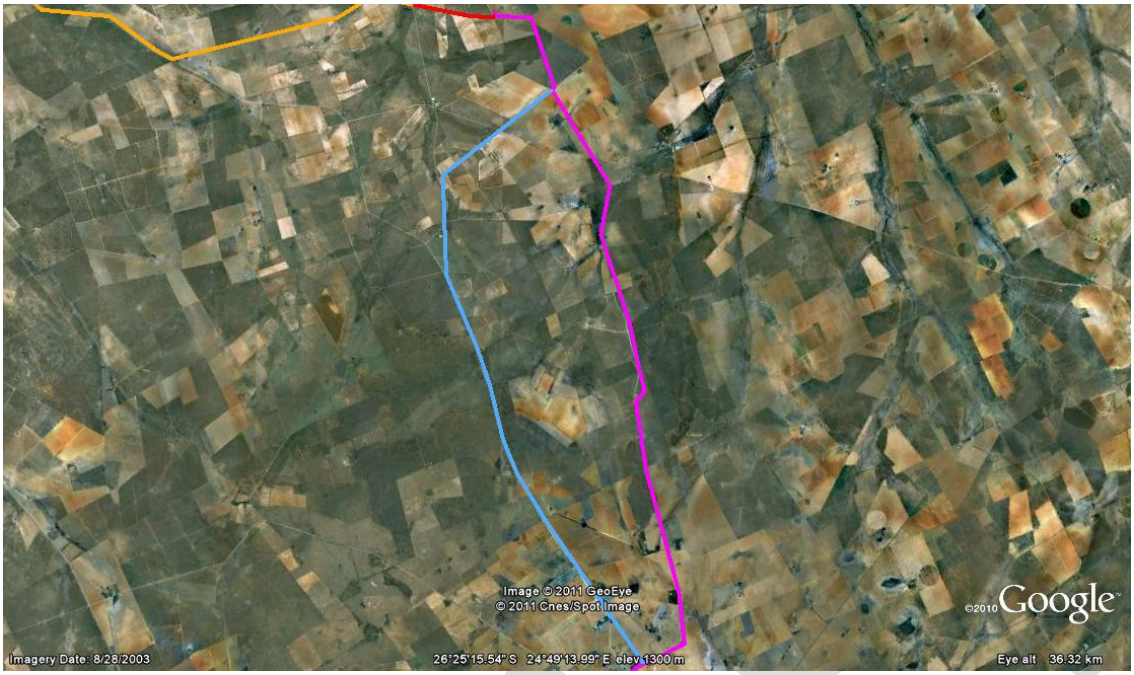


Figure 42: Stella to Kalplats Biodiversity Section

- General land use description

According to ENPAT data this section of the route traverses a vacant/ unspecified area as well as cultivated areas. Maize growing and cattle grazing were observed along this section of the route. Alternative 1 runs along an existing dirt road. It was noted during site investigations that in a number of portions along the route, the density of plants differed from one side of the road to another. While some sides of the road along the route presented denser and relatively intact vegetation, others exhibited sparse vegetation, transformed mainly due to cultivation activities (Figure 43 and Figure 44).

Alternative 1 follows an existing dirt road and passes through farming areas dominated by cattle farming. The vegetation regime has general been transformed from natural in this section. Patches of natural vegetation are present along the route however these are fairly isolated. The route follows existing infrastructure for the most part and will thus have little impact on the vegetation.

Alternative 2 follows a dirt road in part however it moves away from the road to follow cadastral farm boundaries. Grazing practices are also taking place in this area. More Camelthorn trees were noted along this section, one within the proposed servitude.

A portion of alternative 2 i.e. approximately 13km runs along the R377 and through cultivated lands. Furthermore, a few houses were noted along the route.

Figure 43: Photograph showing denser and relatively intact vegetation on the western side of the road

Figure 44: Photograph showing transformed vegetation on the eastern side of the road

- Vegetation type and dominant species

Table 23: Vegetation types the Stella to Kalplats Biodiversity Section Biodiversity

Vegetation Class	Ecological Status	Protection Status

Mafikeng Bushveld	Vulnerable	Not Protected
Stella Bushveld	Vulnerable	Not Protected

- Mafikeng Bushveld

This vegetation unit covers a slightly larger portion of the route compared to the Stella Bushveld vegetation unit. The Mafikeng Bushveld is vulnerable with about 25% already transformed mainly by cultivation and urban development (Mucina and Rutherford, 2006; SANBI Biodiversity GIS, 2007). Dormant species include: *Acacia erioloba*, A. *karroo*, *Ziziphus mucronata*, *Terminalia sericea*, *Dichrostachys cinerea*, *Grewia flava*, *Rhus tenuinervis* and *Acacia hebeclada* subsp. *Hebeclada*. (Mucina and Rutherford, 2006)

- Stella Bushveld

This vegetation unit also covers a relatively large section of the route. The Stella Bushveld vegetation unit is vulnerable and not protected. Up to 21% has been transformed by cultivation (Mucina and Rutherford, 2006). Dominant species include: *Acacia erioloba, A. tortillis*, *A. hebeclada*, *Dichrostachys cinerea*, *Grewia flava* and *Tarchonanthus camphorates* (Mucina and Rutherford, 2006).

Acacia erioloba was noted along both alternatives in this section of the route.

According to SANBI Biodiversity GIS, (2007) the status of the terrestrial ecosystem along the two alternatives in this section of the route varies from Vulnerable in some portions, to least threatened in others, while in other areas, no natural habitat remains. Almost the entire northern half of this section of the route falls under a vulnerable ecosystem (SANBI Biodiversity GIS, 2007)

It is important to note that there are no protected areas along this section of the route.

- Faunal habitat provision and faunal species of concern

As mentioned above, although a large part of this section is transformed, a few portions exhibit dense vegetation which could potentially house a number of faunal species. Common Duiker *Sylvicapra grimmia* which is listed as least concern potentially occurs in areas which have not been severely impacted by cultivation and grazing activities. Furthermore, amphibian species as listed above potentially occur in the damp areas or wetland areas recorded throughout the study area. In addition, common reptile species would be found throughout the area.

- Implications for development

Although large areas along the route are transformed, portions of relatively natural vegetation were observed. No Red Data floral species were identified during sampling however habitat is present for faunal species in terms of bushveld and wetland areas.

As indicated above, while some sides of the road along the route presented denser and relatively intact vegetation, others exhibited sparse vegetation. Therefore during construction, the alignment can be routed in already transformed portions and areas that show intact vegetation can be avoided. This will reduce further vegetation loss and hence preserve habitats for faunal species.

10.1.4 Kalplats to Edwards Dam Biodiversity Section

This section encompasses the portion from Kalplats substation to the existing Edwards dam substation, alternative 1 (red alignment) and the portion from Kalplats substation to the existing Edwards dam substation, alternative 3 (orange alignment) (Figure 45).

Figure 45: Kalplats to Edwards Dam Biodiversity Section

- General land use description

Land use in this section is mainly vacant/ unspecified and cultivated land. The area of the proposed kalplats substation is mainly pasture land (Figure 46) and almost 50% of alternative 1 runs along and existing dirt road. Also, the alignment passes cattle and game farming activities with several homesteads in the area. The route follows cadastral boundaries for the most part and sticks to existing infrastructure. The route follows the existing power line servitude into the Edwards Dam Substation and even though there is already a level of transformation present due to this line, the area is characterised by intact natural vegetation surrounding this line. Several Camelthorn trees were noted in this area.

Figure 46: Pasture land in the area of the kalplats substation

Figure 47: Portion along the alternative 1 exhibiting transformed land with existing power lines. The alternative is proposed to run in close proximity to these power lines.

Alternative 3 follows the R377 for the most part. Farming dominates this section of the route with several homesteads along the route in this area.

- Vegetation type and dominant species

The area falls under the Mafikeng Bushveld vegetation type. This vegetation unit covers a slightly larger portion of the route compared to the Stella Bushveld vegetation unit. The Mafikeng Bushveld is vulnerable with about 25% already transformed mainly by cultivation and urban development (Mucina and Rutherford, 2006; SANBI Biodiversity GIS, 2007). Dominant species include: *Acacia erioloba*, *A. karroo*, *Ziziphus mucronata*, *Terminalia sericea*, *Dichrostachys cinerea*, *Grewia flava*, *Rhus tenuinervis* and *Acacia hebeclada* subsp. *Hebeclada* (Mucina and Rutherford, 2006).

Acacia erioloba was observed along the alternatives.

- Faunal habitat provision and faunal species of concern

Limited habitat for faunal species is present in this section of the route due to the large scale transformation that has taken place due to cultivation and grazing activities. This is evident along both alternatives. Mammal species that are likely to be present would be limited to small mammal species.

Amphibian species would be limited to the small wetland areas recorded in the study area (SANBI Biodiversity GIS, 2007). No Red Data species are likely to be present in this section of the route.

Several reptile species are likely to be present throughout the section of the alignment but No Red Data species are likely to be present and none were observed.

- Implications for development

This section of the route is heavily transformed by anthropogenic activities moreover even areas with less agricultural activities show sparse vegetation. Towers can be placed in already transformed to avoid loss of vegetation. Furthermore, because the alternatives mostly follow exiting roads in some portions and power lines in others, the proposed development is not anticipated to contribute to much more transformation than what's already been observed in the area.

10.1.5 Sensitive Areas

There are limited sensitive areas identified along the route. Apart from a few rivers and wetlands (most of which are small), there are no other highly sensitive area along the route. A river has been identified in the Vryburg area and small wetlands are scattered throughout the study area. Rivers and wetlands not only provide important habitat for several species but also form natural corridors for the movement of species. The Southern African Python (*Python natalensis*), a Vulnerable species potentially occurs in riverine areas in the Vryburg.

The remainder of the study area can be viewed as lower sensitivity areas however these areas still require the strict implementation of mitigation measures to ensure that further transformation does not occur.

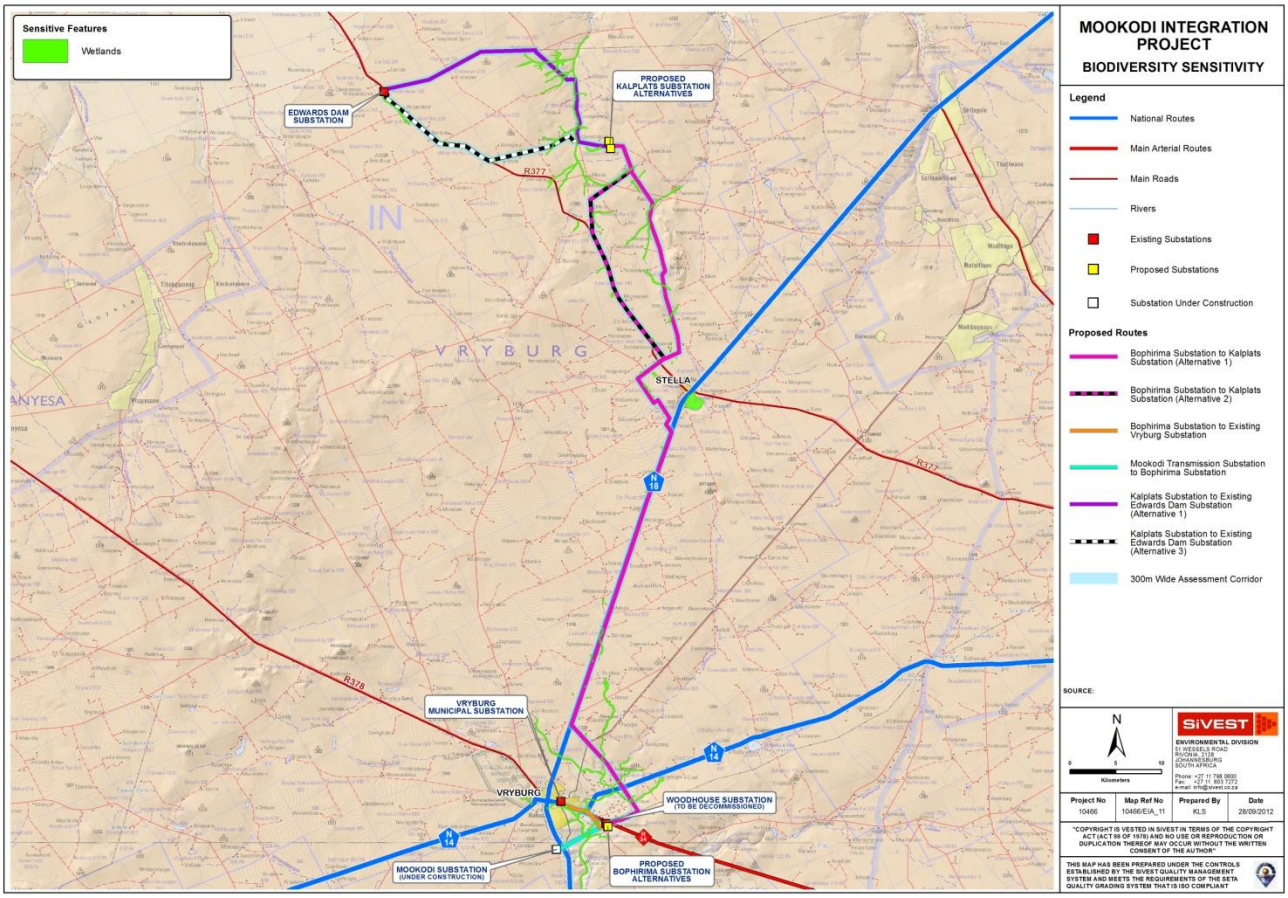


Figure 48: Sensitive Areas Map

10.1.6 Potential Impacts On Biodiversity And Biophysical Features

The potential impacts of the proposed power lines mainly related to loss of habitat for red data and general species; potential loss of species richness, edge effect, transformation and erosion. The impact of the proposed development will be limited to the assigned alignment. Vegetation outside the alignment will remain intact and will

not be impacted upon. As such, the impact is localised and if the mitigation measures are implemented, the overall impact can be reduced.

- Potential Impacts During the Construction Phase

Potential impacts during the construction phase can include the loss of habitat for general species. This is evaluated in Table 24 below.

Table 24: Rating of Related to Loss of Habitat for General Species during the Construction Phase

IMPACT TABLE	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Loss of habitat for red data / general species
Extent	The impact is only expected to affect the site.
Probability	The impact may occur (Between a 25% to 50% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in marginal loss of resources.
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
Cumulative effect	The impact would result in insignificant cumulative effects
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact will have negligible negative effects and will require little to no mitigation.

IMPACT TABLE		
	After mitigation measures: After mitigation measures, the negative low impact is persists.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-6 (low negative)
Mitigation measures	▪ Maintain footprint strictly during construction ▪ Appoint Environmental Control Officer (ECO) for the duration of construction. ▪ Conduct construction walk down prior to construction to conduct a search and rescue exercise. ▪ Existing indigenous vegetation must be retained where possible. ▪ Remove and relocate any plants of botanical or ecological significance (these must be indicated by the ECO) ▪ Vegetation to be removed as it becomes necessary ▪ No vegetation to be used for firewood. ▪ Demarcation of sensitive areas prior to construction activities starting.	

Potential impacts during the construction phase can include edge effect. This is evaluated in Table 25 below.

Table 25: Rating of Impacts Related to Edge Effect during the Construction Phase

IMPACT TABLE	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Edge effect
Extent	The impact is only expected to affect the site.

IMPACT TABLE		
Probability	Impact will certainly occur (Greater than a 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in significant loss of resources.	
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact would result in insignificant cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative medium impact i.e. the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** After mitigation measures, the negative low impact is achieved.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	2	1
Irreplaceable loss	3	1
Duration	3	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-30 (Medium negative)	-7 (low negative)

IMPACT TABLE	
Mitigation measures	▪ The contractor should be responsible for implementing a programme of weed control (particularly in areas where soil has been disturbed); and grassing of any remaining stockpiles to prevent weed invasion. ▪ The spread of exotic species occurring throughout the site should be controlled. ▪ All exotic vegetation must be removed from the site (if present). ▪ Rehabilitation must take place as soon as construction is complete to avoid the edge effect, the infiltration of alien species and soil erosion around the study area.

Potential impacts during the construction phase can include edge effect. This is evaluated in Table 26 below.

Table 26: Rating of Impacts Related to Transformation during the Construction Phase

IMPACT TABLE	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Transformation
Extent	The impact is only expected to affect the site.
Probability	The impact may occur (Between a 25% to 50% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in marginal loss of resources.
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
Cumulative effect	The impact would result in insignificant cumulative effects
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general

IMPACT TABLE		
	integrity (some impact on integrity).	
Significance Rating	Prior to mitigation measures: There will be a negative low impact i.e. the anticipated impact will have negligible negative effects and will require little to no mitigation. After mitigation measures: After mitigation measures, the negative low impact is persists.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-6 (low negative)
Mitigation measures	▪ Existing indigenous vegetation must be retained where possible. ▪ Demarcation of sensitive areas prior to construction activities starting. ▪ The contractor should be responsible for implementing a programme of weed control (particularly in areas where soil has been disturbed); and grassing of any remaining stockpiles to prevent weed invasion. ▪ The spread of exotic species occurring throughout the site should be controlled. ▪ Rehabilitation must take place as soon as construction is complete. ▪ Rehabilitation process must make use of species indigenous to the area. Seeds from surrounding seed banks can be used for re-seeding.	

Potential impacts during the construction phase can include edge erosion. This is evaluated in Table 27 below.

Table 27: Rating of Impacts Related to Erosion during the Construction Phase

IMPACT TABLE		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Erosion	
Extent	The impact is only expected to affect the site.	
Probability	Impact will certainly occur (Greater than a 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources.	
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).	
Cumulative effect	The impact would result in insignificant cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	2	1
Irreplaceable loss	2	1

IMPACT TABLE		
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative
Mitigation measures	▪ Rehabilitation must take place as soon as construction is complete to avoid soil erosion around the study area.	

Potential impacts during the construction phase can include loss of red data species. This is evaluated in Table 28 below.

Table 28: Rating of Impacts Related to Loss of Red Data Species during the Construction Phase

IMPACT TABLE	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Loss of Red Data species
Extent	The impact will only affect the site
Probability	The impact will likely occur (Between a 50% to 75% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in marginal loss of resources.
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
Cumulative effect	The impact would result in insignificant cumulative effects
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

IMPACT TABLE		
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-6 (low negative)
Mitigation measures	▪ Demarcation of sensitive areas prior to construction activities starting as per the sensitivity map. ▪ Use of appropriate construction methods in the sensitive area. ▪ Intensive environmental audits (frequently in sensitive areas) by an independent party during this construction period. ▪ A copy of the Environmental Management Programme and the specialist studies must be present at the construction site for easy reference to specialist recommendations in sensitive areas. ▪ It is recommended that the construction crew be educated about the sensitivities involved in these areas as well as the potential species they could encounter. A poster of sensitive species (compiled by a qualified specialist) should be kept on the construction site for easy reference.	

- Potential Impacts During the Operation Phase

Potential impacts during the operation phase can include edge effect. This is evaluated in Table 29 below.

Table 29: Rating of Related to Edge Effect during the Operation Phase

IMPACT TABLE		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Edge effect	
Extent	The impact is only expected to affect the site.	
Probability	The impact will likely occur (Between a 50% to 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in significant loss of resources.	
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact would result in insignificant cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1

IMPACT TABLE		
Reversibility	2	1
Irreplaceable loss	3	1
Duration	3	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-28 (medium negative)	-6 (low negative)
Mitigation measures	▪ Mitigation measures mentioned for the construction phase above must be implemented for any maintenance of the development that may be undertaken during the operation phase. ▪ Monitoring programme to ensure that rehabilitation efforts are successful to ensure that risks such as erosion and the edge effect are avoided. ▪ Constant maintenance of the area to ensure re-colonisation of floral species. ▪ Regular removal of alien species which may jeopardise the proliferation of indigenous species.	

Potential impacts during the operation phase can include erosion. This is evaluated in Table 30 below.

Table 30: Rating of Impacts Related to Erosion during the Operation Phase

IMPACT TABLE	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Erosion
Extent	The impact is only expected to affect the site.
Probability	The impact will likely occur (Between a 50% to 75% chance of occurrence).
Reversibility	The impact is reversible with implementation of minor mitigation measures
Irreplaceable loss of resources	The impact will result in marginal loss of resources.
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct

IMPACT TABLE		
	human action or by natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact would result in negligible to no cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	3	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-6 (low negative
Mitigation measures	▪ Monitoring must be undertaken to ensure that no erosion is taking place as a result of the development. ▪ Monitoring programme to ensure that rehabilitation efforts are successful to ensure that risks such as erosion are avoided.	

Potential impacts during the operation phase can include poor maintenance. This is evaluated in Table 31 below.

Table 31: Rating of Impacts Related to Poor Maintenance during the Operation Phase

IMPACT TABLE

IMPACT TABLE		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Poor Maintenance	
Extent	The impact will only affect the site	
Probability	The impact may occur (Between a 25% to 50% chance of occurrence).	
Reversibility	The impact is reversible with implementation of minor mitigation measures	
Irreplaceable loss of resources	The impact will result in marginal loss of resources.	
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact would result in insignificant cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	2	1

IMPACT TABLE		
Duration	3	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-6 (low negative
Mitigation measures	▪ Constant monitoring of vegetation height by Eskom.	

10.1.7 Cumulative Impacts

- Construction

Because the pylons occupy limited areas along the route, cumulative impacts are anticipated to be low during construction.

- Operation

If mitigation measures (e.g. rehabilitation, Constant maintenance among others) are implemented, cumulative impacts during the operation phase are expected to be negligible. However should these not be implemented, cumulative impacts as a result of the power lines could result in further impacts on biodiversity in the long term. The implementation of the recommended

10.1.8 Residual Impacts

If rehabilitation of the study area is undertaken efficiently and according to the Environmental Management Plan, no residual impacts on biodiversity are anticipated.

10.2 Avi-Fauna

The Endangered Wildlife Trust conducted the Avifauna Assessment for this project (Appendix 3B).

The proposed development passes through six relevant quarter degree squares (QDGS's), across which a total of 12 Red Data species were recorded, comprising 5 Vulnerable and 7 Near-threatened. The White and Abdim's Storks, which is not listed, but are protected internationally through the Bonn Convention on Migratory species, were also recorded. The focal species for the study were determined, and then, by looking at the relevant species

which could occur in the area, as well as assessing the availability of bird micro habitats, the possible impacts of the development were then assessed.

10.2.1 Background on Bird impacts with Electrical Infrastructure

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 the electrocution of birds (and other animals) and birds colliding with power lines. Other problems include: electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure; and disturbance and habitat destruction during the construction and maintenance activities associated with electrical infrastructure.

10.2.2 Electrocution

Electrocution of birds on overhead lines is an emotional issue as well as an important cause of unnatural mortality of raptors and storks. It has attracted plenty of attention in Europe, USA and South Africa (APLIC 1994; van Rooyen and Ledger 1999). Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen, 2004).

10.2.3 Collision

Collision is the biggest single threat posed by power lines to birds in southern Africa (van Rooyen, 2004). Collision refers to the scenario where a bird collides with the conductors or earth wires of overhead power lines. This occurs because the birds cannot see the cables whilst in flight. Most heavily impacted species are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines. Unfortunately, many of the collision-sensitive species are considered threatened (Red Data status) in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. These species have not evolved to cope with high adult mortality, with the result that consistently high adult mortalities over an extensive period could have a serious negative effect on a population's ability to sustain itself in the long or even medium term. It is therefore imperative to reduce

any form of unnatural mortality in these species, regardless of how insignificant it might seem at the present moment in time.

10.2.4 Habitat destruction

During the construction phase and maintenance of power lines and substations, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat.

10.2.5 Disturbance

During the construction and maintenance of electrical infrastructure, a certain amount of disturbance results. For shy, sensitive species this can impact on their usual daily activities, particularly whilst breeding.

10.2.6 Impact of the birds on the proposed power line

There are a number of mechanisms through which birds are able to cause electrical faults on power lines. In the case of a bird streamer induced fault, the fault is caused by the bird releasing a “streamer” of faeces which can constitute an air gap intrusion between the conductor and the earthed structure. Bird pollution is a form of pre-deposit pollution. A flashover occurs when an insulator string gets coated with pollutant, which compromises the insulation properties of the string. Bird nests may also cause faults through nest material protruding and constituting an air gap intrusion. Crows in particular often incorporate wire and other conductive material into their nests. When nests cause flashovers, the nesting material may catch fire. This in turn can lead to equipment damage or a general veld fire. Apart from the cost of replacing damaged equipment, the resultant veld fire can lead to claims for damages from landowners.

10.2.7 Potential Impacts during Construction

The potential impacts on avifauna during the construction phase include destruction of habitat, as well as disturbance, and have been discussed above, and are rated in Table 32 and Table 33 below.

Table 32: Rating Matrix for the destruction of habitat during the Construction phase

IMPACT TABLE FORMAT		
Environmental Parameter	**Various bird species.**	
Issue/Impact/Environmental Effect/Nature	**Destruction of habitat used by relevant bird species.**	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal Loss of resources*	
Duration	*Long term*	
Cumulative effect	*Negligible*	
Intensity/magnitude	*Medium*	
Significance Rating	*Negative Low Impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	**-26 (low negative)**	**-26 (low negative)**

IMPACT TABLE FORMAT	
Mitigation measures	Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. It is difficult to mitigate properly for this as some habitat destruction is inevitable.

Table 33: Rating Matrix for the disturbance of birds during the Construction phase

IMPACT TABLE FORMAT		
Environmental Parameter	**Various bird species.**	
Issue/Impact/Environmental Effect/Nature	**Disturbance relevant bird species.**	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short Term*	
Cumulative effect	*Negligible*	
Intensity/magnitude	*Medium*	
Significance Rating	*Negative Low Impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	2
Duration	2	1
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	**-22 (low negative)**	**-16 (low negative)**

IMPACT TABLE FORMAT	
Mitigation measures	Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. It is difficult to mitigate properly for this as some disturbance is inevitable. **During Construction, if any of the Red-listed species identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted for further instruction.**

10.2.8 Potential Impacts during Operation

The potential impacts on avi-fauna during the operational phase include electrocution, as well as collision, and have been discussed above. These potential impacts are rated in Table 34 and Table 35 below

Table 34: Rating Matrix for Electrocution during the Operation phase

IMPACT TABLE FORMAT		
Environmental Parameter	**Large raptors and vultures (e.g. African White-backed Vulture and Martial Eagle).**	
Issue/Impact/Environmental Effect/Nature	**Electrocution of birds on the power lines and in the substations.**	
Extent	*Site*	
Probability	*Unlikely*	
Reversibility	Completely reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Long term	
Cumulative effect	Low Cumulative Impact	
Intensity/magnitude	High	
Significance Rating	*Negative Low Impact*	
	Pre-mitigation impact rating	Post mitigation impact rating

IMPACT TABLE FORMAT		
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	4	2
Duration	3	3
Cumulative effect	2	1
Intensity/magnitude	3	3
Significance rating	-39 (Medium negative)	-27 (Low negative)
Mitigation measures	It is highly recommended that the steel monopole design be used and that this incorporates the standard bird perch. If this is the case then most raptors and birds of high electrocution risk will perch well above the conductors and out of harm's way. **In addition, it is critical that all clearances between live and earth components are greater than 1.8 meters, as this is the dimension of the largest birds wing span. If this is the case then the impact of bird electrocution will be very minimal. The illustrations in Figures 4 and 5, do not clearly show whether or not this is the case.** Electrocutions in the proposed substation yard should not affect the sensitive bird species as they are unlikely to use the substation yards for perching or roosting. Should this become an issue the impact can be mitigated reactively using a range of insulation devices that exist and are approved by ESKOM.	

Table 35: Rating Matrix for Collision during the Operation phase

IMPACT TABLE FORMAT	
Environmental Parameter	**Large, heavy flying birds (e.g. Cranes, Storks, Flamingoes and Bustards)**
Issue/Impact/Environmental Effect/Nature	**Collisions of birds with the earth wires**
Extent	*Site*
Probability	*Possible*

IMPACT TABLE FORMAT		
Reversibility	*Partly*	
Irreplaceable loss of resources	*Marginal*	
Duration	*Long Term*	
Cumulative effect	Low	
Intensity/magnitude	High	
Significance Rating	*Negative Medium Impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	3	3
Significance rating	-39 (Medium negative)	-33 (Medium negative)
Mitigation measures	Line routing is critical to mitigate for this and as such the power line route should avoid crossing any highly sensitive microhabitats, for example wetland, dams, rivers, etc. Fortunately on this project there are very few areas of large concern and there are also existing power lines that the proposed new line will follow. It is best practice to follow any existing lines as electrical infrastructure grouped together generally mitigates for the impact of collision by making the lines more visible. Mark the identified sections of line with anti collision marking devices on the earth wire to increase the visibility of the line and reduce likelihood of collisions. Marking devices should be spaced 10m apart. **The sections of line that pose a concern and require marking should be finalised in a site "walkthrough" by EWT once final route is decided and towers/pylons pegged.**	

10.2.9 Confidence in Impact Assessment

The Impact assessment contained in this report, has been conducted with a moderate level of confidence. Predictions in this study are based on experience of these and similar species in different parts of South Africa. Bird behavior cannot be reduced to formulas that will hold true under all circumstances. However, power line impacts can be predicted with a fair amount of certainty, based on experience gained by the EWT through the investigation of hundreds of localities in southern Africa where birds have interacted with power lines since 1996.

10.2.10 Conclusion

In general terms, the impacts that could be associated with a project of this nature include: collision of birds with the overhead cables; electrocution; destruction of habitat; and disturbance of birds. Electrocution (especially of African White-backed Vultures in the north of the study area) is a major concern, however, should bird-friendly monopole structures be used (as described in this report), this impact would be mitigated to acceptable levels. Collisions then would be expected as the largest impact of this project and thorough line marking is required to mitigate for this. Provided that the high risk sections of line are mitigated in the form of marking, the impact should be contained. Provided that a bird-friendly structure is used, as discussed elsewhere in the report, the impact of electrocution should be contained.

10.3 Surface Water

The surface water assessment was conducted by Paul da Cruz of SSI (Appendix 3C).

10.3.1 Surface Water Occurrence and Implications for Development

All surface water resources were delineated by desktop methodologies during the scoping phase. A GIS shapefile of identified wetlands were accordingly created. The shapefile has been updated based on the field-based verification in the EIR phase of the project. The following maps indicate the surface water features that are present within the study area:

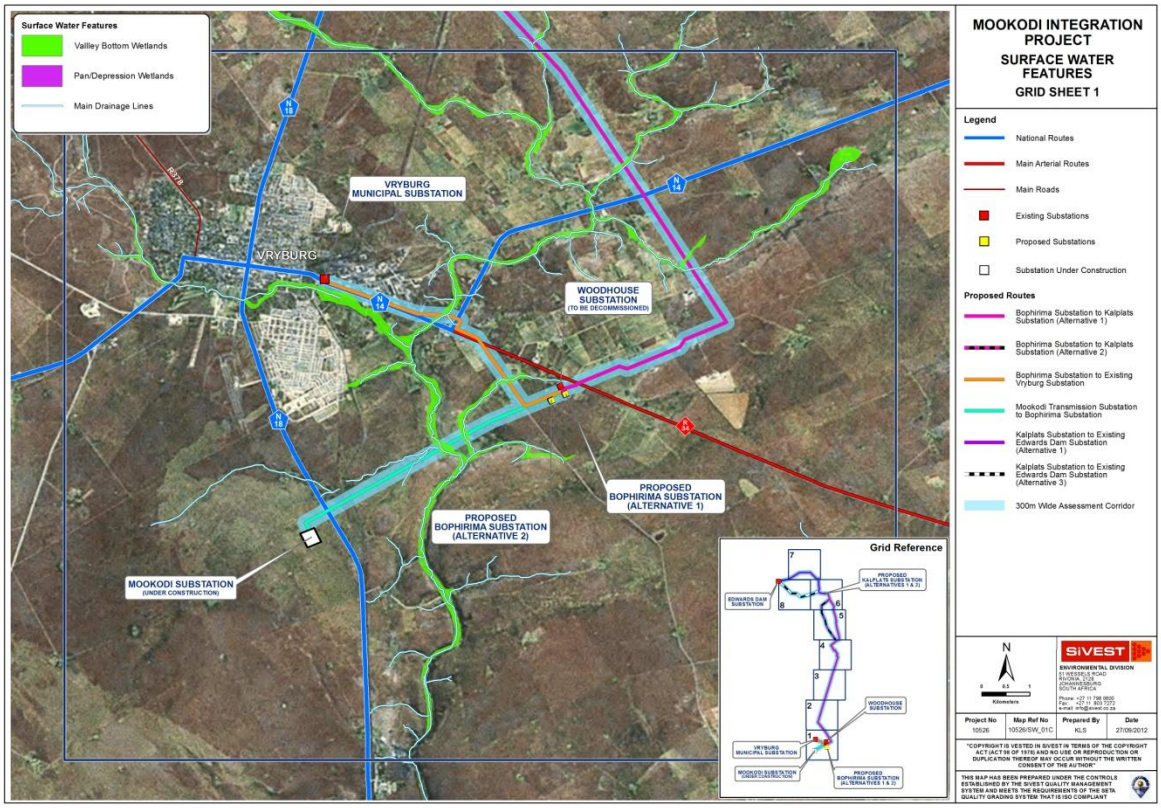


Figure 49: Surface Water features present within the Study Area: Grid Sheet 1

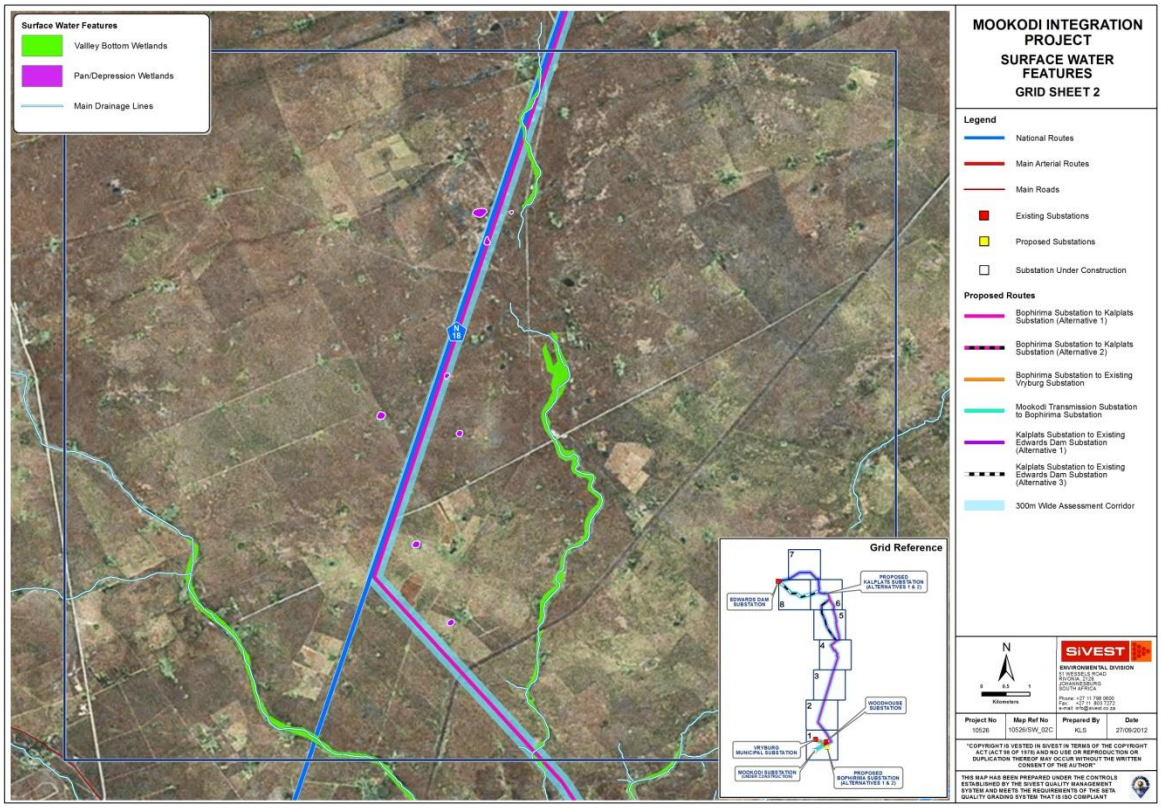


Figure 50: Surface Water features present within the Study Area: Grid Sheet 2

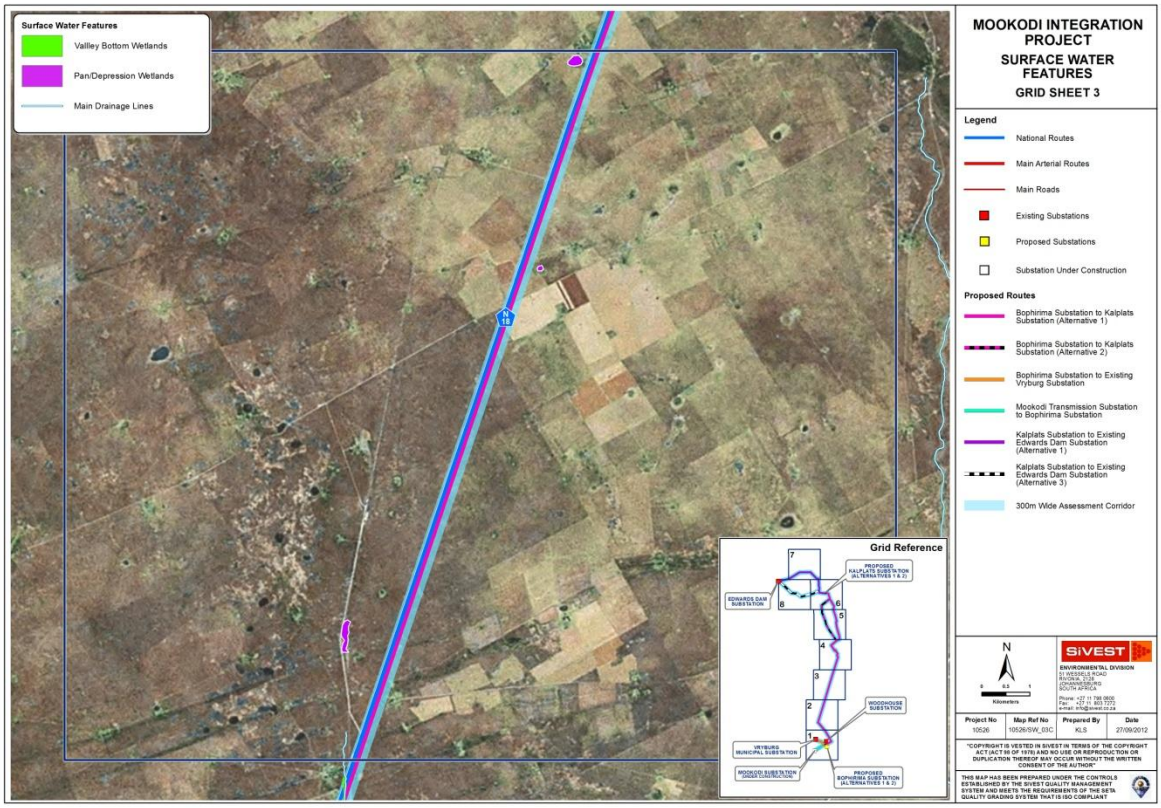


Figure 51: Surface Water Features present within the Study Area: Grid Sheet 3

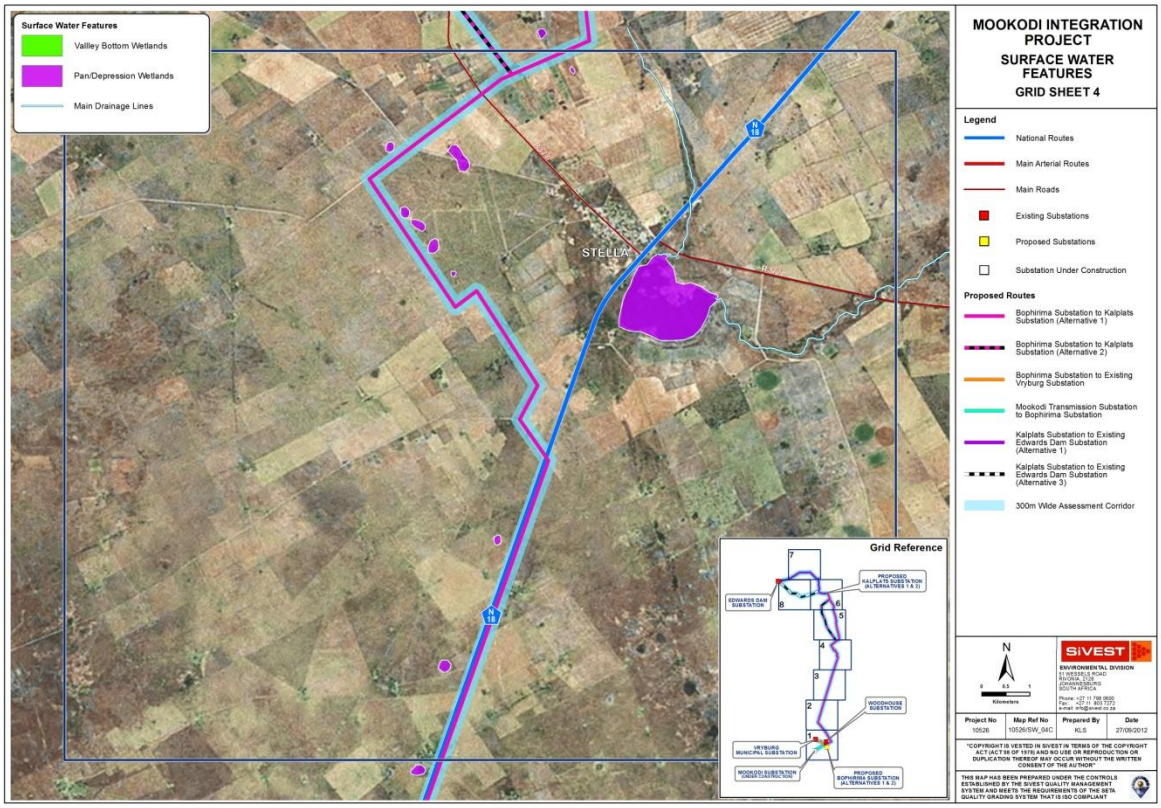


Figure 52: Surface Water Features present within the Study Area: Grid Sheet 4

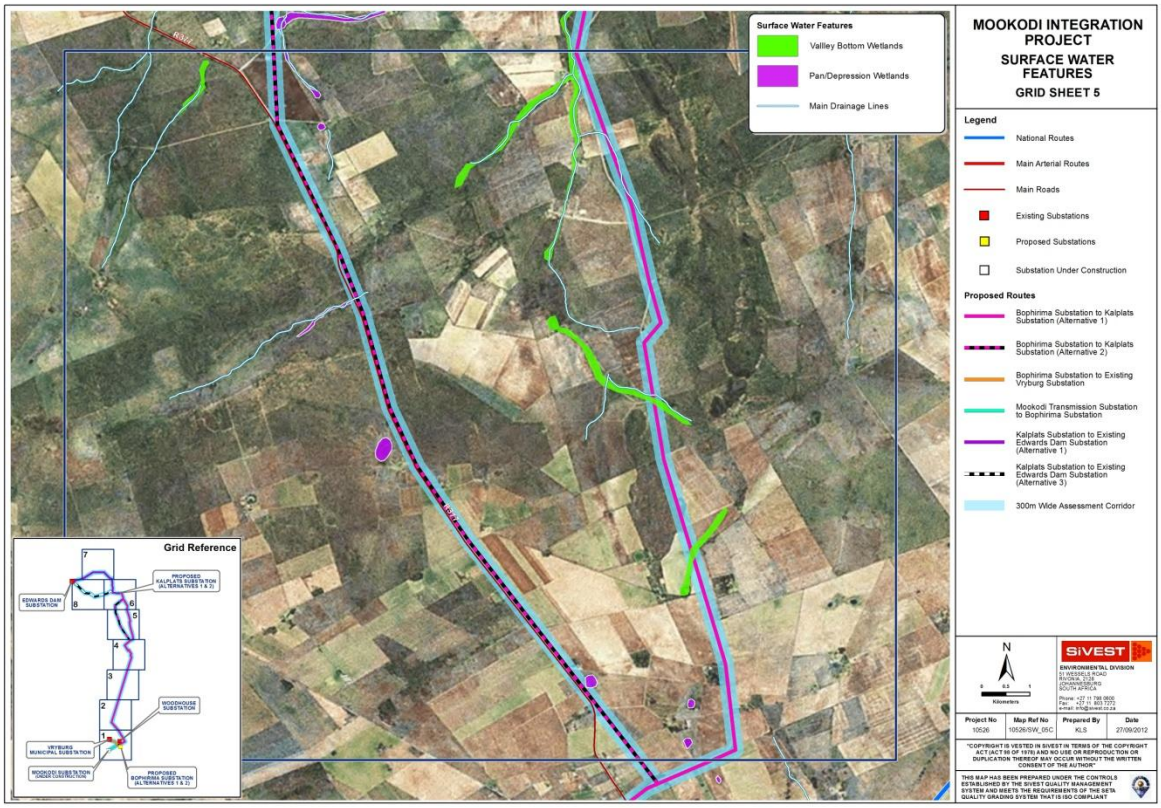


Figure 53: Surface Water features present within the Study Area: Grid Sheet 5

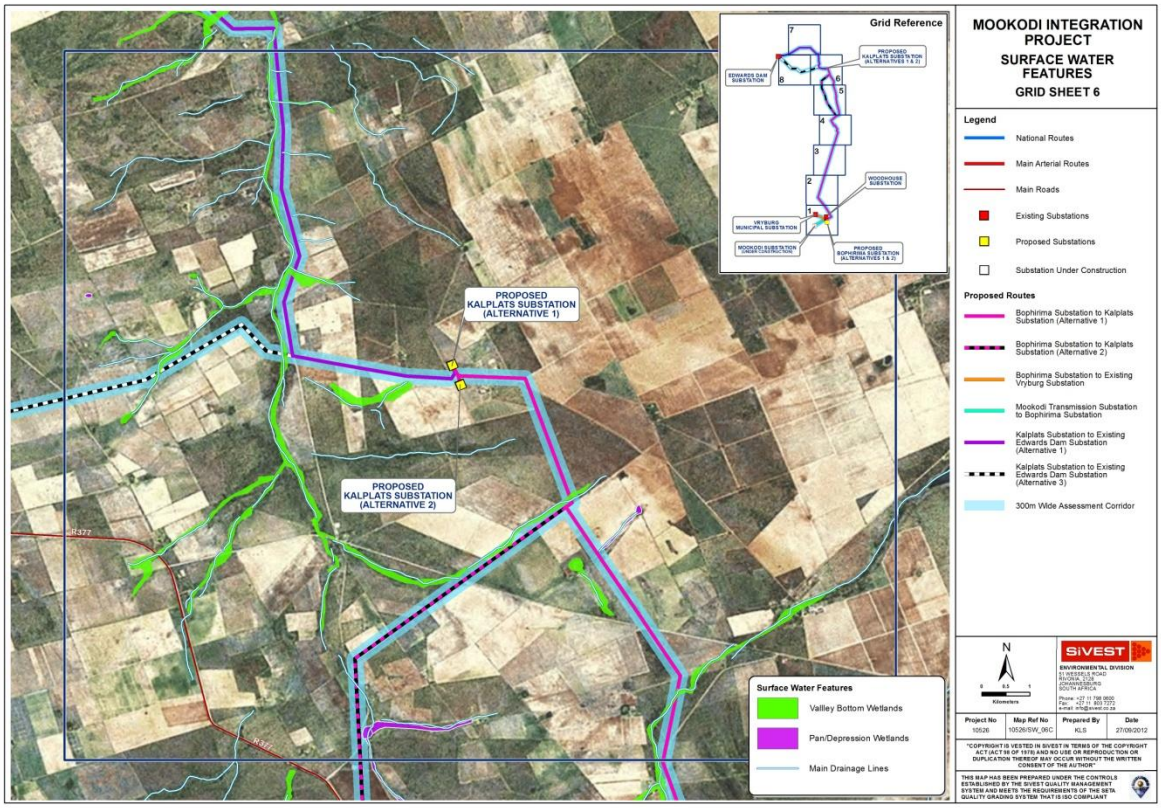


Figure 54: Surface Water features present within the Study Area: Grid Sheet 6

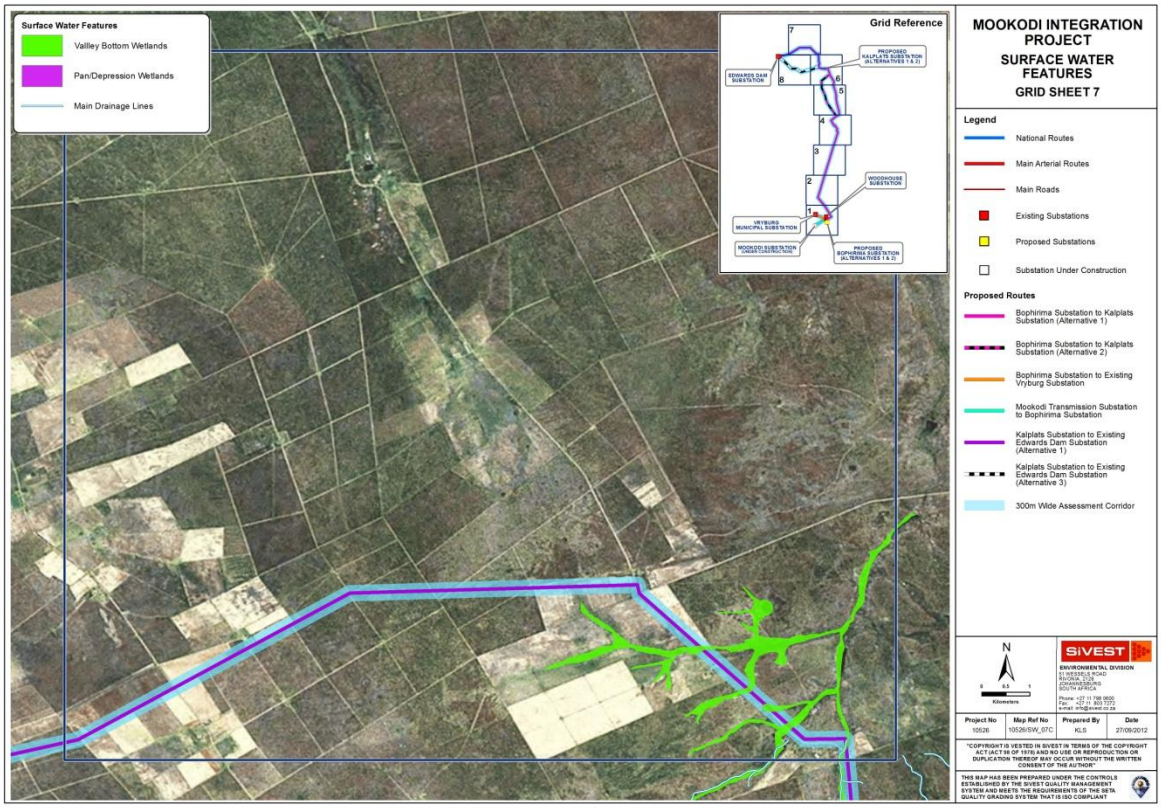


Figure 55: Surface Water features present within the Study Area: Grid Sheet 7

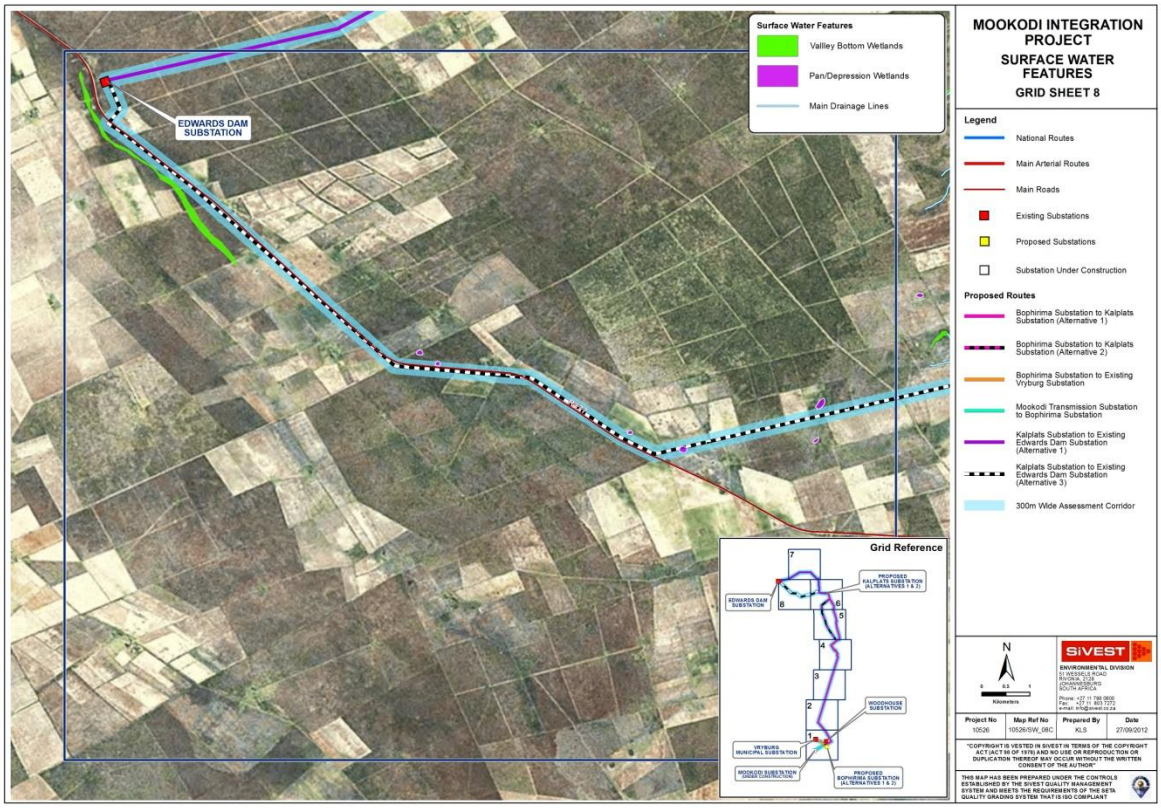


Figure 56: Surface Water features present within the Study Area: Grid Sheet 8

As described above there is not a high density of surface water drainage in the study area, and thus there are not areas of extensive surface water occurrence that could pose problems for the placing of power lines. The lines are largely aligned in a north-south orientation, and in one part of the study area are aligned in the same direction as the north-south aligned drainage of the upper parts of the Mosita se Laagte system. In this area, Alternative 1 of the Kalplats-Bophirima section of the proposed route is aligned relatively close to the wetland, and the wetland area certainly falls within the corridor on either side of the centreline. This could potentially entail that power line towers would be placed within wetland areas, thus being responsible for impacts on the wetland and associated riparian zone of the wetland (as described below). This impact is taken into account in the comparative assessment of alternatives as undertaken below.

With the exception of this part of the line, there are a few surface water crossings that are greater than 200m in length, which would entail that towers may need to be placed within the wetland. These are listed in Table 36 below:

Table 36: Wetland Crossings > 200m

Wetland Location	Route Portion	Crossing Length
North of Klippan Farmstead	Kalplats-Edwardsdam Alt 1	235m

North of Die Anker Farmstead	Bophirima-Kalplats Alt 1	230m
Near Stillelewe Farmstead	Bophirima-Kalplats	245m

As can be seen, these three crossings are marginally longer than 200m. It is recommended that the design be altered so as to lengthen the span and not affect the wetlands by placing towers within them.

In terms of the other surface water features along the routes, provided that care is taken to avoid indirect impacts on surface water features, all surface water features should be able to be avoided by the proposed power lines.

In the context of the two proposed substation sites, at Bophirima and Kalplats, there are no surface water features within, or close to the physical footprint of the two sites.

Power lines are not typically associated with impacts on surface water resources, as the power lines do not have a physical footprint over the length of the power line other than the footprint of each tower position. As the lines are strung above the ground and as the towers are spread approximately 200m apart, most wetlands and rivers are able to be 'spanned' by the power lines and thus avoided from being physically affected. Power lines can however be associated with impacts on surface water resources if the towers are placed within a river or wetland. The process of constructing the power line can also cause impacts on surface water resources, especially if certain mitigation measures and procedures are not followed. These potential impacts are listed below (for greater detail with regards to the nature of surface water impacts see Appendix 3C for more detail):

- Placing towers within a surface water feature
- Removal of Vegetation from the Riparian Zone
- Other Construction-related impacts
- Impacts related to access roads

10.3.2 Overall Impact Rating Table

An overall impact rating for potential negative surface water impacts is provided in Table 37 below.

Table 37: Overall surface water impact rating for the construction phase.

IMPACT TABLE	
Environmental Parameter	Surface Water Impacts: Construction Phase
Issue/Impact/Environmental Effect/Nature	The construction of the power lines could result in both direct and indirect impacts on surface water features. These activities could result in the physical transformation of surface water features, as well as indirect impacts such as alteration of hydrology regimes, erosion and associated downstream siltation and pollution.

Extent	Local / District (2)	
Probability	Possible (2)	
Reversibility	Partly reversible (2)	
Irreplaceable loss of resources	Marginal loss of resources (2)	
Duration	Medium term (2)	
Cumulative effect	Low cumulative impact (2)	
Intensity/magnitude	Medium (2)	
Significance Rating	Medium Negative Impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-12 (low negative)	-10 (low negative)
Mitigation measures	As specified below in section 5.7.	

10.3.3 Mitigation Measures

There are a number of general mitigation measures that are specified for all river and wetland crossings:

- Firstly, as the vast majority of the wetlands and rivers along the line are sufficiently narrow to be spanned, no towers must be placed within the boundaries of any wetland or within the riparian zone of any watercourse.
- The clearing of riparian vegetation has been identified to be a potentially significant cause of localised impact on watercourses and rivers, thus clearing of riparian vegetation should be limited as far as possible. Clearing / felling of woody vegetation should be limited to trees / shrubs above the maximum permitted clearance height, and the understory should not be cleared.
- All wetlands, rivers and watercourses and their associated riparian zones should be treated as highly sensitive areas, and be strictly maintained as 'no-go' areas, except in the case of construction activities

such as stringing of the lines. No lay down areas should be placed within riparian zones, and no construction right of ways should be created through or across watercourses (other than where existing roads / accesses cross watercourses).

- Where surface water is encountered within rivers or watercourses, this should not be utilised for abstraction, or washing of equipment, etc., in order to minimise the risk of pollution of the water by construction activities. All abstraction of water from any surface water feature must be authorised as prescribed by the National Water Act and be subject to the provisions of any water use licence or general authorisation.
- No temporary roads or construction accesses must be constructed through any wetland or other surface water feature (the mitigation measures for permanent access roads are discussed below).
- In general roads and accesses along the line should avoid crossing surface water features. This applies in particular to wetlands, which are highly sensitive features. No permanent accesses along and to the power line must aligned through / across a surface water feature.

10.3.4 Pre-Construction Design Phase Specifications

During the pre-construction design phase, the placement of towers must take into account the wetland shapefile created during this assessment. All wetland areas must be avoided by towers, and all wetlands spanned.

It is recommended that a wetland specialist be part of the power line walkdown (during the placing of final tower positions) to ensure that no towers are unnecessarily placed in wetlands.

If for any reason a tower needs to be placed in a wetland, this activity must be authorised under the National Water Act prior to the tower being constructed at that location.

10.3.5 Conclusion

The proposed Mookodi Integration Project power line components traverse a large area and thus traverse a large number of surface water features. The predominant surface water features in the study area are small pans, with much of the area being characterised by endoreic drainage. A number of morphologically poorly-defined valley bottom wetland systems also occur in the study area, particularly in the northern parts. In spite of the relatively arid climate of the area, these systems are classified as wetlands and display hydric soils and associated hydrophitic vegetation. A typical feature of the vast majority of surface features in the study area is the presence of a riparian zone that is distinct from the surrounding non-wetland shrubveld vegetation in terms of its structure and species composition. These riparian zones are ecologically very important, and play an important role in terms of the morphological state of the watercourse.

The proposed power lines could result in a number of potential impacts on the identified surface water features in the area, which have been detailed above. Most surface water features and their associated riparian zones are sufficiently narrow in width to be able to be singly spanned by the proposed power lines, thus not affecting the feature(s).

10.4 Geotechnical

The geotechnical assessment was conducted by Mike Clements of Geopractica and can be found in Appendix 3D. Given the length of the proposed power line and the impracticality of undertaking field verification for the entire proposed corridors, the focus of the detailed fieldwork for the geotechnical study centered on the foundation conditions at the proposed alternative substation sites at Bophirima and Kalplats.

Summary of the soil profile from test pits excavated at the Bophirima Alternative sites 1 and 2 are displayed in Table 38 below. Importantly, the residual basaltic lava horizon at Bophirima Substation Alternative site 1 was considered not a suitable medium for any structures. Should this alternative be chosen, foundation design solutions will be required. The same horizon at Bophirima Substation Alternative site 2 however, can be considered a suitable founding medium for light structures due to the degree of calcification.

Table 38: Summary Soil Profile Test Pits for Bophirima Alternative Sites 1 and 2

Horizon	Ave Thickness (m)	Ave depth to top of horizon (m)	Ave depth to bottom of horizon (m)	Material	Consistency
Bophirima Alternative Site 1					
Topsoil	0.25	0.00	0.25	Silty sand	Loose
Course colluvium	0.40	0.25	0.55	Silty sand as infilling for abundant coarse gravels and boulders	Medium dense to dense
Reworked Residual Basaltic Lava	0.20	0.55	0.75	Fine gravelly clayey silt	Stiff
Residual Basaltic Lava	1.75	0.75	2.50	Clayey silt with scattered hard corestones	Stiff to very stiff
Bophirima Alternative Site 1					
Topsoil	0.45	0.00	0.45	Silty sand	Loose
Course colluvium	0.30	0.45	0.75	Silty sand as infilling for	Medium dense to dense

				abundant coarse gravels and boulders	
Reworked Residual Basaltic Lava	0.40	0.75	1.10	Fine gravelly clayey silt with abundant calcrete nodules	Stiff
Residual Basaltic Lava	1.90	1.10	3.00	Clayey silt with scattered hard corestones with abundant calcrete nodules	Stiff

Summary of the soil profile from test pits excavated at the Kalplats Alternative sites 1 and 2 are displayed in Table 39 below. Significantly, due to the variable and significant collapse potential of these soils in various parts of both the alternative sites, they are not considered as a suitable founding medium for any of the structures, in its present state and foundations design solutions will need to be implemented.

Table 39: Summary Soil Profile Test Pits for Kalplats Alternative Sites 1 and 2

Horizon	Ave Thickness (m)	Ave depth to top of horizon (m)	Ave depth to bottom of horizon (m)	Material	Consistency
Kalplats Alternative Site 1					
Topsoil	0.35	0.00	0.35	Silty sand	Loose
Aeolian Sands	1.40	0.35	1.75	Silty sand	Medium dense to dense
Pebble Marker	0.40	1.70	1.95	Silty sand as infilling for abundant sub-rounded coarse gravels	Medium dense to dense
Reworked Residual Granite	0.35	1.90	2.25	Fine gravelly sand	Medium dense to dense
Residual Granite	0.75	2.00	2.80	Highly weathered, highly fractured, medium to coarse gravels	Generally dense to very dense
Very Dense to very soft rock Granite	0.65	1.95	2.60	Highly weathered, highly fractured,	Very dense to very soft rock

				medium to coarse gravels	
Kalplats Alternative Site 2					
Topsoil	0.25	0.00	0.25	Silty sand	Loose
Aeolian Sands	1.75	0.25	2.00	Silty sand	Medium dense to dense
Reworked Residual Granite	0.35	2.00	2.35	Silty sand as infilling for abundant sub-rounded coarse gravels	Medium dense to dense
Residual Granite	0.75	2.50	3.30	Fine gravelly sand	Medium dense to dense
Very Dense to very soft rock Granite	1.20	1.95	3.15	Fine gravelly sand	Generally dense to very dense

10.4.1 Potential Impacts during the Construction Phase

Potential impacts during the construction phase from a geotechnical perspective mainly relates to the loss of vegetation soils during the construction of the substations. Table 40 and Table 41 provide the rating for these impacts and recommended mitigation measures.

Table 40: Loss of vegetation and topsoil at the Bophirima Substation Sites

IMPACT TABLE	
Environmental Parameter	*Vegetation and topsoil*
Issue/Impact/Environmental Effect/Nature	*Removal of topsoil from the "footprint" of the substation site including the access road*
Extent	*Site*
Probability	*Definite*
Reversibility	*Partially reversible with removal and relocation of plants and tress where possible. In addition stockpiled soils can be used for landscaping purposes after construction*
Irreplaceable loss of resources	*Marginal loss of resources (soil and vegetation in the footprint of the substation)*

Duration	*Short term as the earthworks phase of construction is likely to be 3 months or less. Rehabilitation around the proposed development should be complete within 2 years of completion of construction*	
Cumulative effect	*Low cumulative effect*	
Intensity/magnitude	*Low*	
Significance Rating	*Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-12 (low negative)	-6 (low negative)
Mitigation measures	*The following mitigation measures can be applied:-* *- Removal of vegetation to be monitored and those species worth saving can be carefully removed and re-plated at a later stage.* *- The topsoil should be stockpiles and reused for landscaping upon completion of the project.* *- Earthworks to be undertaken during winter to avoid erosion by rainwater* *- Terrace slopes to be kept as low as possible to avoid erosion during heavy or prolonged rainfall* *- The clients representative to monitor the contractor during construction in order to limit addition un-necessary impacts.*	

Table 41: Loss of vegetation and topsoil at the Kalplats Substation Sites

IMPACT TABLE	
Environmental Parameter	*Vegetation and topsoil*
Issue/Impact/Environmental Effect/Nature	*In order to facilitate the construction of the substation, the site will need to "cleared and grubbed" which entails the removal of all the vegetation within the proposed "footprint" of the development (including the access road) in addition approximately 200mm of topsoil will need to be removed, which can be stockpiled for later*

	use in landscaping. Additional subsoil will need to be removed below the foundations to a depth of 2.0m. This subsoil has no commercial or engineering value and will need to be carted to spoil	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Partially reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Short term as the earthworks phase of construction is likely to be 3 months or less. Rehabilitation around the proposed development should be complete within 2 years of completion of construction*	
Cumulative effect	*Low cumulative effect*	
Intensity/magnitude	*Medium*	
Significance Rating	*Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-6 (low negative)
Mitigation measures	*The following mitigation measures can be applied:-* *- Removal of vegetation to be monitored and those species worth saving can be carefully removed and re-plated at a later stage.* *- The topsoil should be stockpiles and reused for landscaping upon completion of the project.* *- The contractor must source a dump site in the local area, which will accept the subsoil, without incurring an additional impact on the dump site.* *- Similarly the contractor must source engineering fill from a commercial source which does not impact upon the environment* *- Earthworks to be undertaken during winter to avoid erosion by rainwater*	

	- Terrace slopes to be kept as low as possible to avoid erosion during heavy or prolonged rainfall *- The clients representative to monitor the contractor during construction in order to limit addition un-necessary impacts.*

10.5 Geohydrology

The geohydrological assessment was conducted by Reinhard Meyer and is included in Appendix 3E.

10.5.1 Potential Impacts during Construction Phase

The following potential impacts were identified during the scoping phase:

- *Existing boreholes directly underneath the power line.* The power line and towers will not pose any direct impact to the ground water resources of the area. Where existing operational or potentially useable boreholes are positioned directly underneath the overhead power lines, arrangements with the owner may have to be made to either close or replace the boreholes as future servicing of these boreholes is not allowed under existing safety regulations.
- *Construction camps, storage areas and workshops.* Adequate provision needs to be made that no spillages of oil, diesel and other harmful effluents occur and provision has to be made to contain any spillages should these occur.
- *Transformer oils at existing and new substations.* Many transformers contain toxic fluids that need replacement and servicing from time to time. Provision has to be made that no spillages of such fluids occur during servicing of these transformers within substations or other storage facilities. The same conditions apply when substations and transformers will be decommissioned.
- *Domestic and industrial waste disposal.* Provision has to be made for the responsible collection and disposal of waste generated at construction sites and substations. Such waste has to be disposed of at waste disposal facilities approved to accept the specific type of waste.

The above listed impacts were accordingly taken forward into the EIA assessment and the results are displayed below in Table 42 to Table 45 below.

Table 42: Rating Matrix for impacts in the Construction phase: Continued borehole availability

IMPACT TABLE	
Environmental Parameter	Continued borehole availability
Issue/Impact/Environmental Effect/Nature	No environmental impact, but possible impact on long term sustainability of water supply from boreholes

IMPACT TABLE		
	directly under power lines. Existing boreholes directly underneath high voltage overhead power lines may not be serviced by drilling rigs or any form of high lifting crane. Safety regulations prohibit the erection of drilling rigs or cranes below high voltage power lines to, for example service boreholes or the pumping equipment installed in a borehole.	
Extent	Only applicable to existing or operating boreholes directly below the overhead distribution lines.	
Probability	A replacement borehole with a similar minimum sustainable yield could be drilled outside the restricted area.	
Reversibility	No environmental impact, but a possible impact on the continued availability of groundwater from that specific borehole to provide water for the original use.	
Irreplaceable loss of resources	Unlikely that groundwater resource will be irreplaceably lost.	
Duration	Within approximately 2 to 4 weeks a replacement borehole could be sited, drilled, tested and equipped.	
Cumulative effect	The provision of an alternative borehole (or source) for groundwater could be done before existing borehole is to be decommissioned.	
Intensity/magnitude	Only a temporary service interruption from the water resource could be expected.	
Significance Rating	As mitigation, a replacement of an existing borehole could be expected where a borehole is located exactly below the transmission line.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	20 (Negative low impact)	6 (Negative low impact)

IMPACT TABLE	
Mitigation measures	Replacement of borehole(s) with a new borehole to the same status (in terms of installed equipment and delivering similar or higher yield) as the one being replaced.

Table 43: Rating Matrix for impacts in the Construction phase: Construction camps

IMPACT TABLE		
Environmental Parameter	*Construction camps, storage areas and workshops.* Adequate provision needs to be made that no spillages of oil, diesel and other harmful substances and/or effluents do occur that could potentially contaminate the soil and groundwater resources.	
Issue/Impact/Environmental Effect/Nature	Potential of soil and groundwater contamination.	
Extent	In such cases, the area impacted is usually small.	
Probability	Low	
Reversibility	Contaminated soil can be recovered and treated before the deeper groundwater aquifer may be impacted	
Irreplaceable loss of resources	Unlikely that soil and groundwater resources will be lost.	
Duration	Short term	
Cumulative effect	Possible impact will not impact negatively on existing groundwater quality.	
Intensity/magnitude	No temporary or permanent negative impact on groundwater expected.	
Significance Rating	Low significance.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	1	1
Intensity/magnitude	2	1

IMPACT TABLE		
Significance rating	20 (Negative low impact)	6 (Negative low impact)
Mitigation measures	Vehicle service bays have to be provided with oil collection traps. All storage facilities for fuel, oil, solvents and other chemicals, and possibly also herbicide, that can potentially contaminate groundwater, have to be provided with collection trays to contain spillages or leakages.	

Table 44: Rating Matrix for impacts in the Construction phase: Transformer oil

IMPACT TABLE	
Environmental Parameter	*Transformer oils at existing substations that will be decommissioned.* Transformers contain toxic fluids that may possibly be drained before dismantling and/or transport. Provision has to be made that no spillages of such fluids occur during draining such transformers within substations or other storage facilities.
Issue/Impact/Environmental Effect/Nature	Soil and/or groundwater contamination.
Extent	Low, provided provision is made to contain possible spillages.
Probability	Should a spillage occur, all affected soil must be immediately removed and stored for future proper disposal or rehabilitation. This will ensure minimal impact to soil and groundwater resources.
Reversibility	Soil and groundwater quality.
Irreplaceable loss of resources	Unlikely that irreplaceable resources will be lost.
Duration	For shallow soils, contamination will be immediate, while groundwater contamination will depend on the depth of the water table and the migration path characteristics. Groundwater contamination is expected to manifest itself only after a relatively long period following a spill.
Cumulative effect	Unlikely that the impact will substantially increase with further spills.
Intensity/magnitude	Impact not expected to impact the soil and groundwater quality permanently.

IMPACT TABLE		
Significance Rating	Should the groundwater in the immediate vicinity of the spill be used extensively, groundwater quality will be jeopardised and immediate remediation would be required.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	18 (Negative low impact)	6 (Negative low impact)
Mitigation measures	During servicing of or oil replacement at transformers provision should be made to collect all oil in suitable containers and to contain any accidental spillage.	

Table 45: Rating Matrix for impacts in the Construction phase: Domestic and industrial waste disposal

IMPACT TABLE	
Environmental Parameter	*Domestic and industrial waste disposal.* Provision has to be made for the responsible collection and disposal of waste generated at construction sites and substations.
Issue/Impact/Environmental Effect/Nature	Such waste has to be disposed of at waste disposal facilities approved to accept the specific type of waste. Uncontrolled disposal could result in groundwater contamination over the long term.
Extent	Area likely to be impacted is small due to the small volume of waste that is expected to be generated.
Probability	Likelihood of groundwater contamination is low and with regular groundwater recharge the groundwater quality is expected to return to its long term natural quality.
Reversibility	Groundwater quality may only be slightly negatively impacted, but this should return to an acceptable quality in a relatively short period.
Irreplaceable loss of resources	Contamination of groundwater to the extent that the resource will be permanently lost is unlikely.

IMPACT TABLE		
Duration	Contamination could occur over a few years, but will depend on local geohydrological conditions.	
Cumulative effect	Impact mot expected to increase significantly over the duration of the construction period.	
Intensity/magnitude	Only a slight and temporary negative impact on the groundwater quality could be expected.	
Significance Rating	The impact is expected to be of low significance.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	1	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	8 (Negative low impact)	6 (Negative low impact)
Mitigation measures	All waste products (domestic, general and hazardous waste) have to be collected in suitable containers for disposal at licences waste disposal facilities registered to accept the specific waste type.	

10.5.2 Potential Impacts during Operation and Decommissioning

The following potential impact was identified during the scoping phase:
Transformer oils at existing and new substations. Transformers contain toxic fluids that need replacement and servicing from time to time. Provision has to be made that no spillages of such fluids occur during servicing of these transformers within substations or other storage facilities.

The above listed impacts were accordingly taken forward into the EIA assessment and the results are displayed below in Table 46 and Table 47 below.

Table 46: Rating Matrix for impacts in the Operation phase: Transformer maintenance at substations.

IMPACT TABLE	
Environmental Parameter	*Transformer oils at existing substations to be decommissioned.* Transformers contain toxic fluids that

IMPACT TABLE		
	may possibly be drained before dismantling and/or transport. Provision has to be made that no spillages of such fluids occur during draining such transformers within substations or other storage facilities. Suitable containers should be used to collect, remove and transport the collected oil.	
Issue/Impact/Environmental Effect/Nature	Potential soil and groundwater contamination in the vicinity of transformers when an oil spill occurs during the required replacement of oil or servicing of transformers at substations during the regular maintenance intervals.	
Extent	Transformers used in substations contain toxic PCBs or other suitable hydrocarbons which can cause soil and ground and surface water contamination if servicing of transformers is not responsibly done or inadequate storage and containment facilities are not provided.	
Probability	Low, provided provision is made to contain possible spillages.	
Reversibility	Should a spillage occur, all affected soil must be immediately removed and stored for future proper disposal or rehabilitation. This will ensure minimal impact to soil and groundwater resources.	
Irreplaceable loss of resources	Soil and groundwater quality.	
Duration	Unlikely that irreplaceable resources will be lost.	
Cumulative effect	For shallow soils, contamination will be immediate, while groundwater contamination will depend on the depth of the water table and the migration path characteristics. Groundwater contamination is expected to manifest itself only after a relatively long period following a spill.	
Intensity/magnitude	Unlikely that the impact will substantially increase with further spills.	
Significance Rating	Impact not expected to impact the soil and groundwater quality permanently. If groundwater in the immediate vicinity of the spill is used extensively, groundwater quality may be jeopardised and immediate remediation could be required.	
	Pre-mitigation impact	Post mitigation impact

IMPACT TABLE		
	rating	rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	18 (Negative low impact)	6 (Negative low impact)
Mitigation measures	During servicing of or oil replacement at transformers provision should be made to collect all oil in suitable containers and to contain any accidental spillage.	

Table 47: Rating Matrix for impacts on Decommissioning phase: Decommissioning of transformers at substations

IMPACT TABLE	
Environmental Parameter	Transformer oils at existing substations to be decommissioned. Transformers contain toxic fluids that may possibly be drained before dismantling and/or transport. Provision has to be made that no spillages of such fluids occur during draining such transformers within substations or other storage facilities. Suitable containers should be used to collect, remove and transport the collected oil.
Issue/Impact/Environmental Effect/Nature	Potential soil and groundwater contamination in the vicinity of transformers when an oil spill occurs during the required replacement of oil or servicing of transformers at substations during the regular maintenance intervals.
Extent	Transformers used in substations contain toxic PCBs or other suitable hydrocarbons which can cause soil and ground and surface water contamination if servicing of transformers is not responsibly done or inadequate storage and containment facilities are not provided.
Probability	Low, provided provision is made to contain possible spillages.
Reversibility	Should a spillage occur, all affected soil must be immediately removed and stored for future proper disposal or rehabilitation. This will ensure minimal impact to soil and groundwater resources.

IMPACT TABLE		
Irreplaceable loss of resources	Soil and groundwater quality.	
Duration	Unlikely that irreplaceable resources will be lost.	
Cumulative effect	For shallow soils, contamination will be immediate, while groundwater contamination will depend on the depth of the water table and the migration path characteristics. Groundwater contamination is expected to manifest itself only after a relatively long period following a spill.	
Intensity/magnitude	Unlikely that the impact will substantially increase with further spills.	
Significance Rating	Impact not expected to impact the soil and groundwater quality permanently. If groundwater in the immediate vicinity of the spill is used extensively, groundwater quality may be jeopardised and immediate remediation could be required.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	18 (Negative low impact)	6 (Negative low impact)
Mitigation measures	During decommissioning of transformers, all oil should be removed from the transformer and collected in suitable containers for future storage and transport. Provision should also be made to contain all accidental and other possible spillages during the oil removal process.	

10.5.3 Confidence in Impact Assessment

The overall risk to impact on groundwater resources during the construction and operational phases of the project is relatively low and therefore the confidence in the impact assessment described in the preceding sections is high. Proposed mitigation measures are practical believed to be easily attainable.

10.5.4 Cumulative Impacts

No cumulative impacts to the groundwater environment are foreseen during the construction, operation and decommissioning phase of the project of the new distribution line and associated infrastructure.

10.5.5 Reversibility of Impacts

All identified possible impacts are generally considered to be of low impact. Should such impacts occur, the impact should be easily remediated when and if acted upon as soon as it has been noticed or reported.

10.5.6 Achievability of Mitigation Measures

The proposed mitigation measures described are practical and should be easily achievable.

10.5.7 Conclusion

All the above mentioned potential impacts were rated as having a Negative Low impact score (8 - 20) and therefore, these are considered to have negligible negative effects that will require little to no mitigation. The mitigation measures proposed are also of a practical nature and should be easily achievable should these be required.

10.6 Heritage

The Heritage Assessment was conducted by Johnny van Schalkwyk and is included in Appendix 3F.

Impact analysis of cultural heritage resources under threat of the proposed development, are based on the present understanding of the development. The evaluation and rating of the potential negative impacts on heritage resources are presented in Figure to Figure below.

Table 48: Rating Matrix for impacts on Stone Age sites.

IMPACT TABLE		
Environmental Parameter	**Stone Age**	
Issue/Impact/Environmental Effect/Nature	Many sites are still unknown. Their potential and significance therefore unknown. The impact will be the physical disturbance of the material and its context. Impact will be focused on a particular node, i.e. if the trench cut through a site.	
Extent	Local	
Probability	Possible	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss	
Duration	Medium term	
Cumulative effect	Low cumulative effect	
Intensity/magnitude	Medium	
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	3	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	34 (Negative low impact)	6 (low negative)
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. Sites that cannot be avoided should be excavated in full by an archaeologist qualified in Stone Age archaeology.	

Table 49: Rating Matrix for impacts on Iron Age sites.

IMPACT TABLE	
Environmental Parameter	**Iron Age**
Issue/Impact/Environmental Effect/Nature	Many sites are still unknown. Their potential and significance therefore unknown. The impact will be the physical disturbance of the material and its context. Impact will be focused on a particular node, i.e. if the trench cut through a site.
Extent	Local
Probability	Possible
Reversibility	Partly reversible

Irreplaceable loss of resources	Marginal loss	
Duration	Medium term	
Cumulative effect	Low cumulative effect	
Intensity/magnitude	Medium	
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	3	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	34 (Negative low impact)	6 (low negative)
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. Sites that cannot be avoided should be excavated in full by an archaeologist qualified in Iron Age archaeology.	

Table 50: Rating Matrix for impacts on Colonial Period farmsteads.

IMPACT TABLE		
Environmental Parameter	**Colonial Period – farmsteads**	
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole	
Extent	Local	
Probability	Possible	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss	
Duration	Medium term	
Cumulative effect	Low cumulative effect	
Intensity/magnitude	Medium	
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1

Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	24 (Negative low impact)	6 (low negative)
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed. If the route change and the line is to cross such a feature, total documentation (mapping, photographing and oral documentation) would be required If older than 60 years, a permit from SAHRA would be required.	

Table 51: Rating Matrix for impacts on Colonial period cemeteries.

IMPACT TABLE		
Environmental Parameter	**Colonial Period – cemeteries**	
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole	
Extent	Local	
Probability	Possible	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss	
Duration	Medium term	
Cumulative effect	Low cumulative effect	
Intensity/magnitude	Medium	
Significance Rating	Sites have a medium significance on a region level – viewed as NHRA Grade III sites.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1

Intensity/magnitude	2	1
Significance rating	24 (Negative low impact)	6 (low negative)
Mitigation measures	All of these sites should be avoided as far as possible. Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed. The site should be avoided at all times. During construction it should be clearly demarcated, e.g. by using danger tape. If retained, no permits are necessary	

10.7 Visual

The Visual assessment was conducted by Paul da Cruz of SSI and is included in Appendix 3G.

10.7.1 Generic Visual Impacts associated with power lines and substations

Transmission power line towers are by their nature very large objects and thus highly visible. The standard tower height of a proposed 132kV power line is 25m (equivalent in height to a 7-storey building). The height of a tower / pylon thus means that the pylon is typically visible from a large radius around the tower. A power line consists of a series of towers spaced approximately 200m apart in a linear alignment. The power line consisting of a number of these tall towers spaced linearly is thus typically highly visible.

The degree of visibility of an object informs the level and intensity of the visual impact, but there are other factors that influence the nature of visual impact. The landscape and aesthetic context of the environment in which the object is placed, as well as the perception of the viewer are also important factors. In the context of power lines, the type of tower used as well as the degree to which the towers would impinge upon or obscure a view is also a factor in the experiencing of visual impacts associated with the power line.

As described above, power lines are not a feature of the natural environment, but are rather representative of human (anthropogenic) intrusion into the natural environment. Thus when placed in a largely natural landscape, power lines can be perceived to be highly incongruous in the context of the setting. The height and linear nature of power lines exacerbate this incongruity with the natural landscape, as the towers can impinge on views within the landscape. In addition, the practice of clearing a strip of vegetation under the power line servitude in certain vegetation types can exacerbate the visibility and incongruity of the power line in a largely natural setting, by causing fragmentation of natural vegetation, thus making the power line more visible, especially from greater distances. The cleared strip of land is often highly visible and draws the viewer's attention to the power line

servitude, especially when it occurs within a context of natural thicket / bushveld vegetation where bushes or trees commonly occur.

Power lines are often perceived to be a source of visual impact if they affect or change the visual quality of a landscape. It is in this context of incongruity with a natural setting that power lines are often perceived to be a source of visual impact. The perception of the viewer /receptor of impact is also very important, as certain receptors may not consider the development of a power line to be a visual impact. The perception of visual impacts is thus highly subjective and thus involves 'value judgements' on behalf of the receptor. The context of the landscape character, the scenic / aesthetic value of an area, and the types of landuse practiced tend to affect the perception of whether power lines are an unwelcome intrusion, and thus the sensitivity of receptors to the erection of power lines in an area. Power lines are often perceived as visual impacts where value is placed on the scenic or aesthetic character of an area, and where activities such as tourism are practised which are based upon the enjoyment of, or exposure to, the scenic or aesthetic features of the area. Sensitivity to visual impacts is typically most pronounced in areas set aside for the conservation of the natural environment (such as protected natural areas or conservancies), or in areas in which the natural character or scenic beauty of the area acts as a draw card for visitors (tourists) to visit the area. Residents and visitors to these areas may perceive power lines to be an unwelcome intrusion that would degrade the natural character and scenic beauty of the area, and which would potentially even compromise the practising of tourism activities in the area.

Conversely, the presence / existence of other anthropogenic objects associated with the built environment may influence the perception of whether a power line is associated with a visual impact. Where buildings and other linear structures such as roads, railways and especially other power lines exist, the visual environment could be considered to be already altered from a natural context and thus the introduction of a new power line into this setting may be considered to be less of a visual impact than if there was no existing built infrastructure visible.

Visual impacts can be experienced by different types of receptors, such as people driving along roads, or people living / working in the area in which the power line is visible. The receptor type in turn affects the nature of the typical 'view' of a potential source of visual impact, with views being permanent in the case of a residence or other place of human habitation, or transient in the case of vehicles moving along a road. The nature of the view experienced affects the intensity of the visual impact experienced. Viewing distance is a critical factor in the experiencing of visual impacts, as beyond a certain distance, even large objects such as power line towers tend to blend in with the landscape. The visibility of an object tends to decrease exponentially with increasing distance away from the object. Other factors, as listed below can impact the nature and intensity of a potential visual impact associated with a power line:

- The location of a power line in the landform setting – i.e. in a valley bottom or on a ridge top. In the latter example the power line would be much more visible and would 'break' the horizon;
- The presence of macro- or micro-topographical features such as buildings or vegetation that would screen views from a receptor position to the power line;
- The number of power lines proposed to run in parallel to each other; and
- Temporary factors such as weather conditions (presence of haze, or heavy mist) which would affect visibility.

It is important to note that visual impacts are only experienced when there are receptors present to experience this impact; thus in a context where there are no human receptors or viewers present there are not likely to be any visual impacts experienced.

10.7.2 Visual Intrusion Matrix

In order to assess the impact of the proposed power lines on the sensitive receptor locations listed above that are potentially affected by the proposed lines, a matrix that takes into account a number of factors to determine the likely level of visual intrusion to which a sensitive receptor location would be subjected has been developed.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the lines (distance banding)
- Primary focus / orientation of the receptor
- Presence of screening factors (topography, vegetation etc.)
- Visual context

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive receptor. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen only as a representation of the likely visual intrusion factor of the lines at a receptor location. An explanation of the matrix follows in

Table 52: Visual Intrusion Matrix Categories.

Factors	Classes and Scores			
Distance of Receptor away from proposed alignment (distance banding)	0-250m Score: 4	250-500m Score:3	500-1000m Score:2	>1km Score:1
Primary Focus / orientation of receptor	'Arc of view' directly towards proposed lines Score:4		'Arc of view' partially towards proposed lines Score:2	'Arc of view' in opposite direction towards proposed lines Score:1
Presence of Screening Factors	No screening factors – lines highly visible Score:4		Screening factors partially obscure power lines Score:2	Screening factors completely block any views towards power lines Score:1
Visual Context	Visual context highly natural; no visually 'degrading' factors Score:4	Visual environment rural / pastoral with typical rural infrastructure Score:3	Partially transformed visual context (e.g. outlying residential areas) with partial presence of industrial-type infrastructure Score:2	Transformed visual context (e.g. industrial) and / or high degree of industrial-type anthropogenic objects present Score:1

Categories of impact:

High Visual Impact = >3-4

Medium Visual Impact = >2-3

Low Visual Impact = 1-2

The distance of the viewer / receptor location away from the power line is the most important factor in the context of the experiencing of visual impacts. Beyond a certain distance, even large structures such as power lines tend to be much less visible, and are difficult to differentiate from the surrounding landscape. The visibility of an object is likely to decrease exponentially with increasing distance away from the object (Figure 57), with maximum impact being exerted on receptors at a distance of 500m or less. The impact decreases exponentially as one moves away from the source of impact, with the impact at 1000m being a quarter of the impact at 500m away (see the figure below). At 5000m away or more, the impact would be negligible.

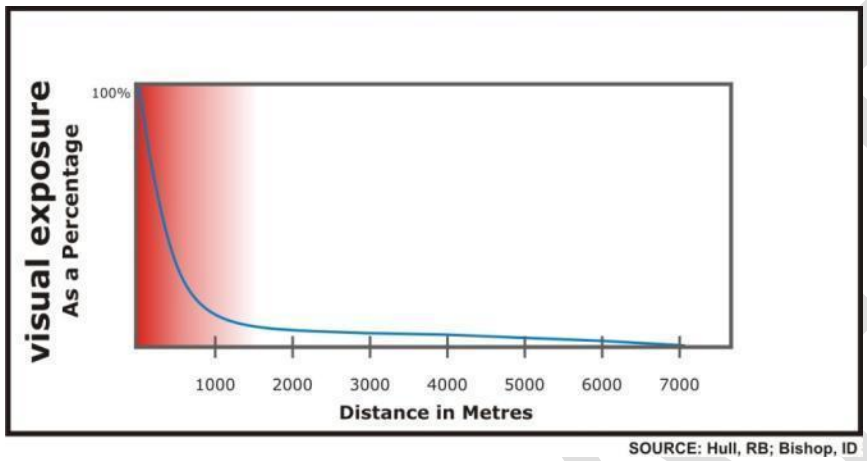


Figure 57: Diagram Illustrating Diminishing Visual Exposure over Distance

The highest rating has thus been assigned to receptor locations that are located within 0-250m of the proposed alignment. Beyond 1km, the visual impact associated with a power line is likely to be minimal, and any receptor location beyond 1km from the proposed corridor has been allocated into the lowest class.

The orientation of a receptor becomes important in many cases, as the receptor location is typically oriented in a certain direction, e.g. with views towards a certain area / part of the landscape from a highly frequented area like a porch or garden. The visual impact of a set of power lines could be potentially much greater if power lines intruded into such a view, and thus the highest rating has been given to a situation where the power lines would cross directly across an 'arc of view / orientation' – i.e. the 180o panorama in a certain direction.

The presence of screening factors is equally as important in this context in many circumstances as the distance away from the power lines. Screening factors can be vegetation, buildings, as well as topography. For example a grove of trees located between a receptor location and a set of power lines could effectively completely shield the lines from the receptor. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is close by, but not in its viewshed. The opposite applies, and tall objects such as power lines that cross a ridge would be highly visible.

Visual context is the last factor considered in the matrix. This factor attempts to bring in the visual environmental context, which is important, as much of the study area is largely natural in character, with the aesthetic quality of

the area and sense of place being an important characteristic in which value is placed. Placing a power line in this context has the potential to adversely affect or degrade the natural visual environment of these areas. Receptors in these areas are typically most sensitive to visual changes that would be brought about by power lines being placed in such a landscape. Many parts of the study area are somewhat visually altered from a completely natural state due to agricultural activities such as crop cultivation, planting of pastures etc. Although there is a relative density of anthropogenic (human) infrastructure (e.g. fences, centre pivots, buildings such as barns and farmhouses) and influence on the landscape (for example the presence of groves of tall exotic trees), this type of 'pastoral' or rural landscape is often perceived as sensitive to visual impacts associated with more industrial or large-scale infrastructure such as power lines. The second most sensitive class is thus assigned to this landscape. The relative degree of intrusion of large-scale or industrial-type infrastructure into a landscape as well as the degree of change of visual environment is reflected in the last two classes of visual context.

Urban settings are typically highly visually transformed, and the presence of power lines in this environment would typically not be seen as intrusive. Residential areas may be associated with more visual sensitivity, especially those areas present in parts of the study area that have views onto surrounding natural areas. This context is captured in the 3rd class of sensitivity. Less built up areas may have a profusion of existing large-scale or industrial infrastructure within them. In these cases, these areas would be assigned to the one of the lower 2 classes due to the existing visual degradation associated with the existing electricity infrastructure.

Through the matrix a 'Visual Intrusion Score average' for each receptor location is calculated. This average score is derived by tallying the scores for each of the four classes and averaging these. The visual impact rating for each receptor location is determined by the range of numbers within which this average score falls as listed above. It should be again noted that this rating matrix is a relatively simplified way to assign a likely representative degree of visual intrusion which allows a number of factors to be considered. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact. The simplified matrix also has certain limitations in that in certain cases the complete screening of the source of the impact from the receptor may not be taken into account. An example of this would be where thick bushveld vegetation completely hides the proposed power line from view at a receptor location. In order to take factors such as this into account, an 'override' function has been introduced to the matrix. The override allows the visual intrusion rating assigned to a receptor location to be either increased or lowered based on the one of the following factors:

- The receptor location is completely screened from the proposed power lines by micro-topographical features such as vegetation or buildings
- The power lines are outside of the viewshed of the receptor location, and thus are not visible

Table 53 below presents the results of the visual intrusion matrix. Receptor locations in those areas beyond the 2km buffer outside of the corridor are too far away from the proposed corridors to be likely to be impacted by the proposed power lines. Thus the visual impact on these receptor locations is considered to be negligible or non-existent.

A challenge is posed by the potential ability of the power lines to be placed in a number of potential alignments across the corridor. The permutations for aligning the power line within the corridor make it impractical to model or

rate all of these permutations in this report. Thus for the purposes of the impact rating matrix and the visual modelling, the centreline alignment as presented to the EIA Team (as proposed) by the proponent has been used as the basis on which to undertake the assessment.

The matrix is presented in the table below.

Table 53: Visual Intrusion Matrix

Receptor Location	Distance	Orientation	Screening	Visual Context	Total Score	Visual Impact Score Average	Visual Impact Rating	Overriding Factors?	Corrected Visual Rating
Helpmekaar Farmstead	3	4	4	3	15	**3.75**	**HIGH**		
Present Farmstead	4	2	2	3	11	**2.75**	**MODERATE**		
James le Roux Boskamp	1	2	1	4	8	**2.00**	**LOW**	**Vegetation Screening**	**LOW**
Wildeasput Farmstead	3	1	4	3	11	**2.75**	**MODERATE**		
Erfenis Farmstead	1	4	4	3	12	**3.00**	**MODERATE**		
Standhope Farmstead	2	2	1	3	8	**2.00**	**LOW**	**Vegetation Screening**	
Kinderdam Farmstead	1	1	2	3	7	**1.75**	**LOW**		
Heeferslust Farmstead	3	1	1	3	8	**2.00**	**LOW**		
Klippan North Farmstead	3	1	1	3	8	**2.00**	**LOW**	**Vegetation Screening**	**LOW**
Klippan South Farmstead	4	4	1	3	12	**3.00**	**MODERATE**	**Vegetation Screening**	**LOW**
Vrede Farmstead	1	1	1	3	6	**1.50**	**LOW**		
Gemsbokpan Farmstead	4	2	2	3	11	**2.75**	**MODERATE**		
Memel Farmstead	1	1	2	3	7	**1.75**	**LOW**		
Rustig Farmstead	4	2	2	3	11	**2.75**	**MODERATE**	**Immediate proximity of lines**	**HIGH**
Kudu Hills Lodge and Owners House	1	2	2	4	9	**2.25**	**MODERATE**	**Topography obscures closest**	**LOW**

Receptor Location	Distance	Orientation	Screening	Visual Context	Total Score	Visual Impact Score Average	Visual Impact Rating	Overriding Factors?	Corrected Visual Rating
								lines	
Doorndam Farmstead	2	1	2	3	8	**2.00**	**LOW**		
Waterval Farmstead North	3	2	2	3	10	**2.50**	**MODERATE**		
Waterval Farmstead	2	4	4	4	14	**3.50**	**HIGH**		
Taaiboschhoek Farmstead	1	1	2	3	7	**1.75**	**LOW**		
Alleskop Farmstead	2	2	1	3	8	**2.00**	**LOW**		
Geelhoutkoppie Farmstead	1	1	1	3	6	**1.50**	**LOW**		
Dankbaar Farmstead	1	2	2	3	8	**2.00**	**LOW**		
Scholtzrus Farmstead	1	1	1	3	6	**1.50**	**LOW**		
Plankplaas Farmstead	1	2	1	3	7	**1.75**	**LOW**	**Vegetation Screening**	
Smitsrus Farmstead	3	2	4	3	12	**3.00**	**MODERATE**		
Morestêr Farmstead	3	4	4	3	14	**3.50**	**HIGH**		
Kromdraai Farmstead	1	1	1	3	6	**1.50**	**LOW**	**Vegetation Screening**	**LOW**
Oppie Koppie Farmstead	3	1	1	3	8	**2.00**	**LOW**		
Oppie Koppie Farmstead west	2	2	2	3	9	**2.25**	**MODERATE**		
Robyn Farmstead East	3	2	2	3	10	**2.50**	**MODERATE**		
Robyn Farmstead West	2	2	1	3	8	**2.00**	**LOW**		
Lushof Farmstead	4	2	2	3	11	**2.75**	**MODERATE**		

Receptor Location	Distance	Orientation	Screening	Visual Context	Total Score	Visual Impact Score Average	Visual Impact Rating	Overriding Factors?	Corrected Visual Rating
Goudkop Farmstead	4	2	1	3	10	**2.50**	**MODERATE**		
De Neute Dop guesthouse and homestead	3	1	4	3	11	**2.75**	**MODERATE**		
Poppiesdale Farmstead - Bowmans Estate	1	1	2	4	8	**2.00**	**LOW**		
Bowmans Estate - stand 1	1	2	4	4	11	**2.75**	**MODERATE**		
Bowmans Estate - Stand 13-4	1	2	4	4	11	**2.75**	**MODERATE**		
Bowmans Estate - Stand 23-24	1	2	4	4	11	**2.75**	**MODERATE**		
N14-R34 Homestead	4	4	4	2	14	**3.50**	**HIGH**		

10.7.3 Implications of the visual intrusion factor of the power lines for receptors and associated degree of visual impact

Examining the relative number of receptor locations subject to high, moderate and low degrees of visual intrusion is useful in gauging the degree of visual impact associated with the proposed power lines, however due to the presence of certain route segments along which there are alternative alignments, this is not completely realistic, as the matrix above represents a worst-case scenario for each receptor point, and does not represent a scenario in which one of each of the alternatives is discarded. Five (5) receptor locations have been assessed to be subject to be high level of visual intrusion. Three of these receptor locations are located close to alternative line components. Thus in these three cases the high visual intrusion rating would be negated if the other alternative were selected. The comparative degree of visual intrusion associated with different alternatives has an important bearing on the overall degree of visual impact that would be associated with the lines, as discussed below.

Ideally, as many receptor locations as possible should be subject to a low level of visual intrusion and thus it is useful to examine the reasons why certain locations are subject to a greater degree of visual intrusion, and what measures can be taken to ameliorate or reduce the intensity of these impacts.

The common factor that emerges when one examines the list of receptor locations that are likely to be subject to a high visual intrusion factor is the very close proximity of the proposed alignment to the receptor location that would make the lines highly visible. In many cases at other receptor locations screening factors in the form of vegetation around the farmstead or vegetation between the farmstead and the proposed alignment help to minimise the potential visibility of the line from the receptor location. Conversely the absence of screening factors can elevate the visual intrusion factor associated with the lines.

An important question which needs to be posed is to what degree a moderate or high level of visual intrusion would be associated with visual impact. As discussed above, the experiencing of visual impact is subject to the perception of the person exposed to the view. The aesthetic quality of the landscape and visual sensitivity of the area also plays an important role. In the parts of the study area with the most natural visual character (the parts of the study area north of Stella) a moderate or high degree of visual intrusion is likely to be associated with the experiencing of a visual impact. It is in these areas that a game farm and private nature reserve (Kudu Hills) exist, at which hunting and nature based tourism activities respectively are practised. In the wider area the presence of large areas of woodland vegetation and the presence of the iconic Camel Thorn Tree in the area engender it with a natural bushveld character that is highly valued by its inhabitants. It is thus important that, as a mitigating factor, the line alternatives with the least

degree of visual intrusion be selected. In this context it is useful to examine each of the line components where alternatives have been presented. This is undertaken in Section 15.

10.7.4 EIA Impact Rating Matrix

The EIA requires that an overall rating for visual impact be provided to allow visual impact to be assessed alongside other environmental parameters. Table 54 below presents the impact matrix for visual impacts associated with the proposed development.

Table 54: EIA Impact Rating Matrix

IMPACT TABLE		
Environmental Parameter	Visual Impact	
Issue/Impact/Environmental Effect/Nature	The proposed power lines could exert a visual impact by altering the visual environment of the study area. They could be perceived as an unwelcome visual intrusion by sensitive receptors in the area, in particular those receptors within a natural or rural visual setting in the northern parts of the study area. The nature of the degree of visual intrusion associated the power lines is dependent on factors such as the orientation of the receptor location, distance of the lines away from the proposed receptor and the nature of the visual environment.	
Extent	Local / District (2)	
Probability	Probable (3)	
Reversibility	Partly reversible (2)	
Irreplaceable loss of resources	Marginal loss of resources (2)	
Duration	Long term (3)	
Cumulative effect	Low cumulative impact (2)	
Intensity/magnitude	Medium (2)	
Significance Rating	Low Negative Impact	
	Pre-mitigation impact rating	Post mitigation impact

		rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-12 (low negative)
Mitigation measures	Avoid areas of visual sensitivity Selection of Bophirima-Kalplats Alternative 2 and Kalplats-Edwardsdam Alternative 1	

10.8 Social

The social assessment was conducted by Nonka Byker of MasterQ (Appendix 3H).

10.8.1 Introduction

The following section outlines the various change processes and related impacts that could be expected because of the project. The various social impacts have been categorised according to change processes (cf. Vanclay, 2002). A change process is defined as a change that takes place within the receiving environment due to a direct or indirect intervention. Impacts follow because of the change processes taking place. However, a change process can only result in an impact once it is experienced as such by an individual/community on a physical and/or cognitive level.

The various change processes associated with the proposed construction and operation of the two substations and the various distributions power lines include the following:

- Geographical processes, which refer to the processes that affect the land uses of the local area.
- Demographical processes, which refer to the composition and structure of the local community.
- Economic processes, which refer to the movement of money between industries and between industries and consumers.

- Institution and Legal processes, which refer to the processes that affect service delivery to the local area.
- Socio-cultural processes, which refer to the processes that affect the local culture, i.e. the way in which the local community live (however, sometimes different cultural groups occupy the same geographical area and these groups are seldom homogenous).

10.8.2 Pre-construction Potential Impacts

During the pre-construction phase the site location for the substations and the alignment of the distribution line route corridors have to be finalised so that these can be submitted to the relevant department for environmental authorisation and so that negotiations with affected landowners can commence. During the pre-construction phase, two social change processes are likely to occur, namely:

- Geographical processes, i.e. the location of houses and other infrastructure and how this will influence the final siting of the substations and the alignments of the various distribution line route corridors; and
- Institutional and legal processes, i.e. the actual negotiation process between Eskom Land & Rights and the affected landowner. This will include issues of compensation, rehabilitation, etc. (Please refer to Social Specialist Study in Appendix 3H for greater detail on this aspect).

Substation Sites

- Proposed Bophirima Distribution Substation

The proposed Bophirima Distribution Substation alternatives are located beyond the south-eastern outskirts of Vryburg close to the Bernauw smallholdings. The substation sites are located to the south of the R34 road (Figure 58), relatively close to the farmstead Constantia and the existing Woodhouse Substation, which will be decommissioned in the near future. According to the Northwest Spatial Development Framework (SDF), the substation sites fall within a zone of extensive agricultural development in the form of maize, cattle, game and wheat farming. From a social perspective the area surrounding the proposed Bophirima substation sites are characterised by smallholdings consisting of scattered residential households and light industrial/commercial mixed land use. No relocation is foreseen and therefore no impacts will occur during this phase of the project in terms of land use changes.

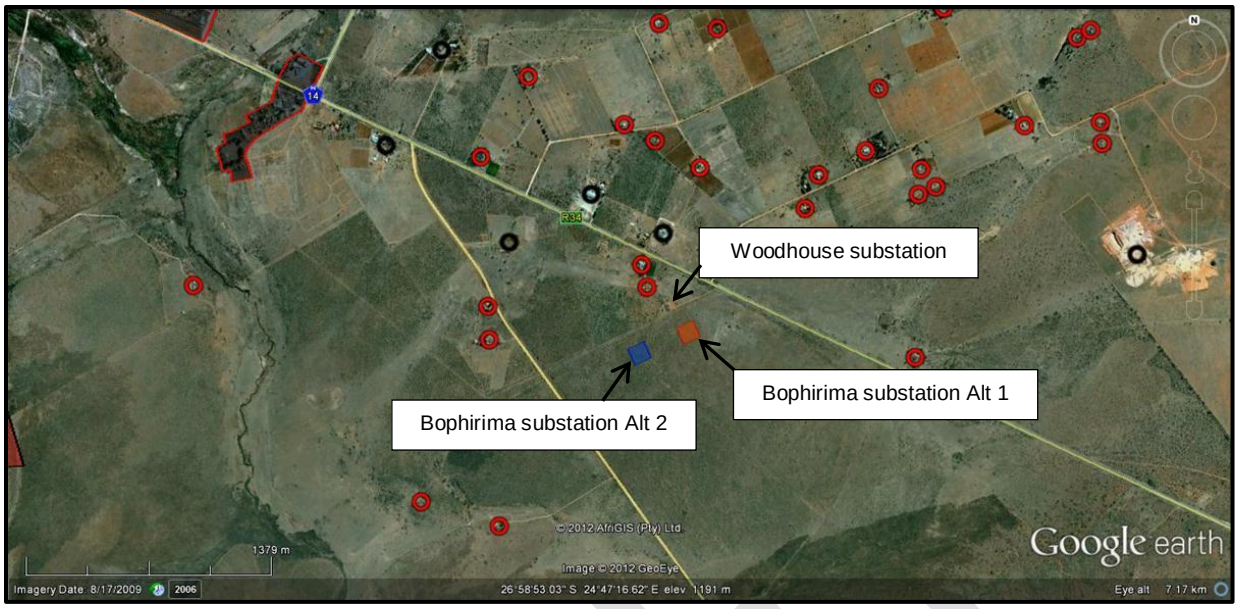


Figure 58: Baseline land use surrounding Bophirima substation site alternatives

- Proposed Kalplats Distribution Substation

The proposed Kalplats Distribution Substation alternatives are located approximately 28.5km to the north of the town of Stella. The nearest settlement is the hamlet of Papiesvlakte located 8km to the south-east. The substation site alternatives are located on agricultural land on the farm Gemsbokpan, to the west of the Môrester farmstead and to the north of a district road (Figure 59). To the east and west of the substation sites there are a number of scattered households. According to the Northwest SDF, the site falls within an agricultural zone consisting of cattle and game farming. No relocation is foreseen and therefore no impacts are expected during this phase of the project in terms of land use changes.

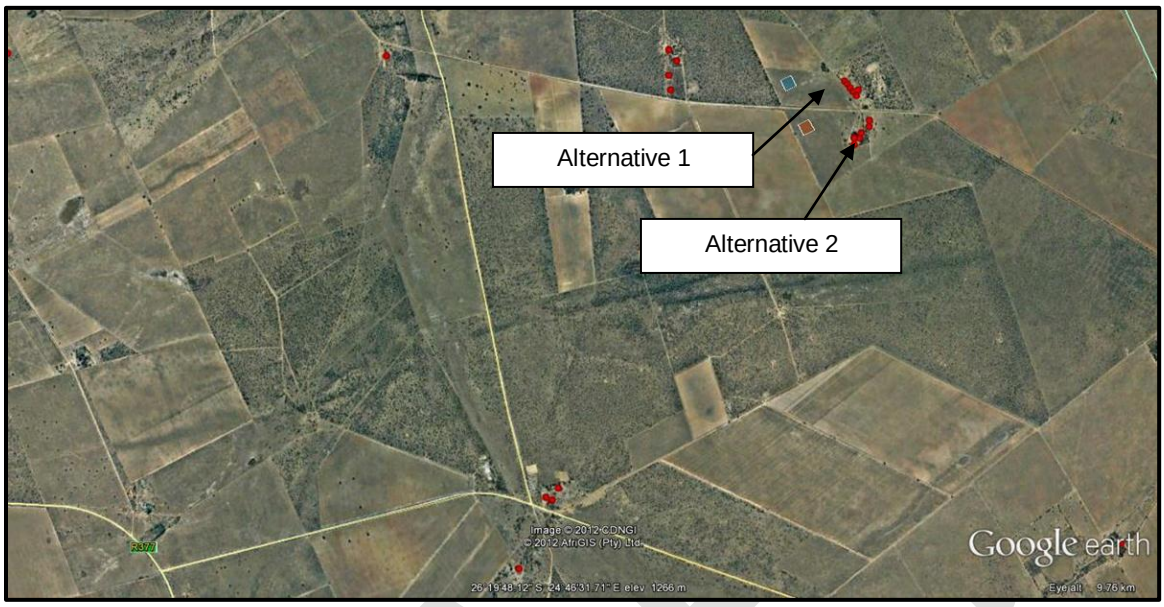


Figure 59: Baseline land use surrounding Kalplats substation site alternatives

Route Corridors

- Mookodi – Bophirima

The Mookodi – Bophirima 300m wide route corridor (Figure 60) runs across vacant land within an agricultural zone (according to the Northwest SDF). A number of scattered households can be found, mostly to the north and northeast of the corridors. To the southwest lies Huhudi and of concern are the informal settlements that are expanding southwards towards the route corridor (one of these informal settlement 'legs' runs parallel to the N18).

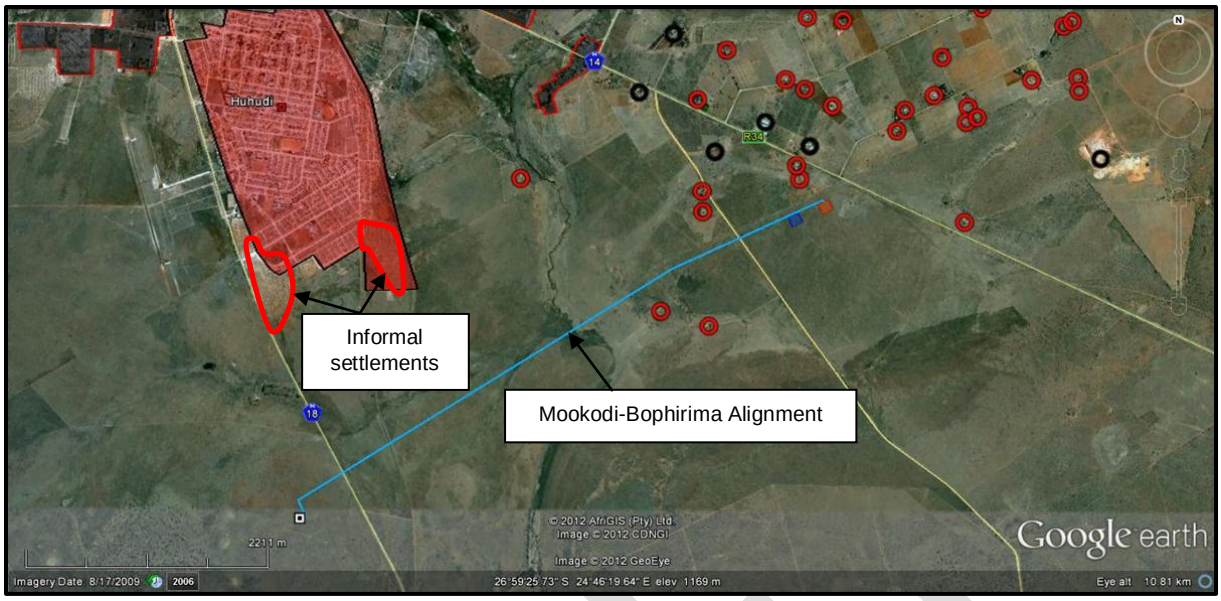


Figure 60: Baseline land use surrounding Mookodi – Bophirima Route Corridor

- Bophirima – Vryburg

Important to note is that the section of this proposed line close to the Vryburg Municipal Substation that was proposed to be buried underground will no longer be buried. The entire length of the overhead lines will now be overhead lines. This can lead to space constraints between Faktoria Way and the Vryburg Municipal Substation as the required 31m servitude might not be available throughout this section.

This route corridor (Figure 61) is largely located within the industrial area of Vryburg and mostly runs parallel to the N14 on its northern border. A number of scattered households can be found along the route corridor around the Bophirima substation site, but these diminish as the corridor enters the industrial area. Huhudi lies approximately 500m southwest of the Vryburg substation, whereas the town of Vryburg lies the same distance northwest of the substation.

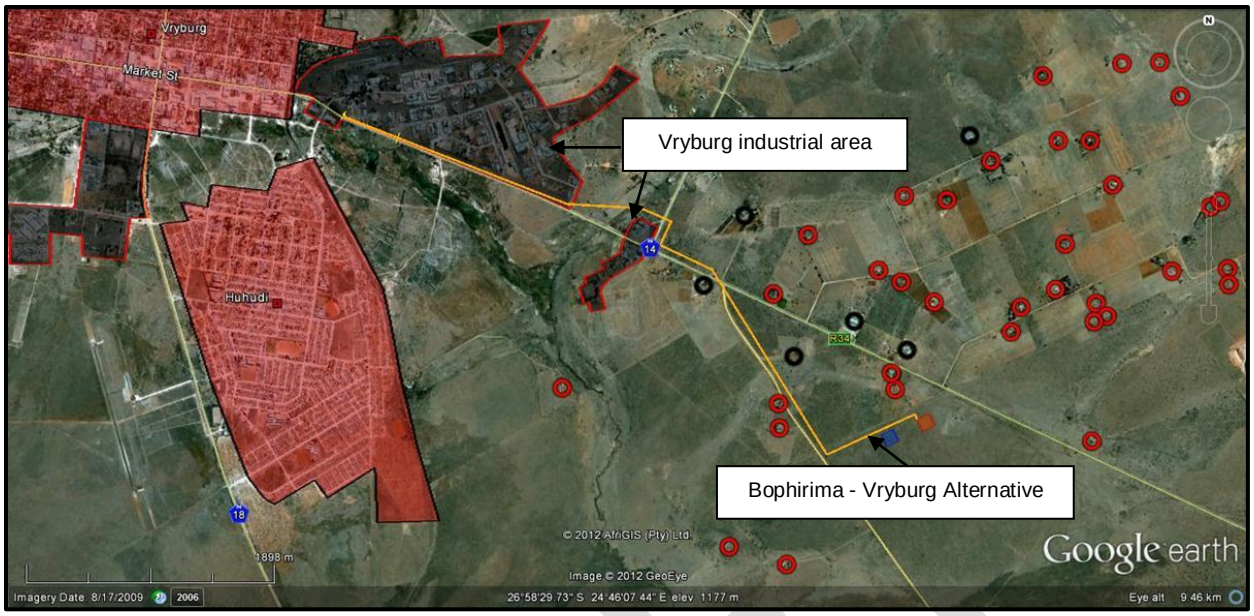


Figure 61: Baseline land use surrounding Bophirima – Vryburg Route Corridor

- Bophirima - Kalplats

Two alternative alignments have been provided for comparative assessment between the proposed Bophirima substation and the proposed Kalplats substation. Both alternatives follow the same alignment between Vryburg (Bophirima) and Stella where it is proposed to run parallel to a set of existing distribution power lines across mostly open vacant grazing land. An overview of the route corridors is presented in Figure 62, after which it is broken down in sub-sets () to illustrate the current land use better.

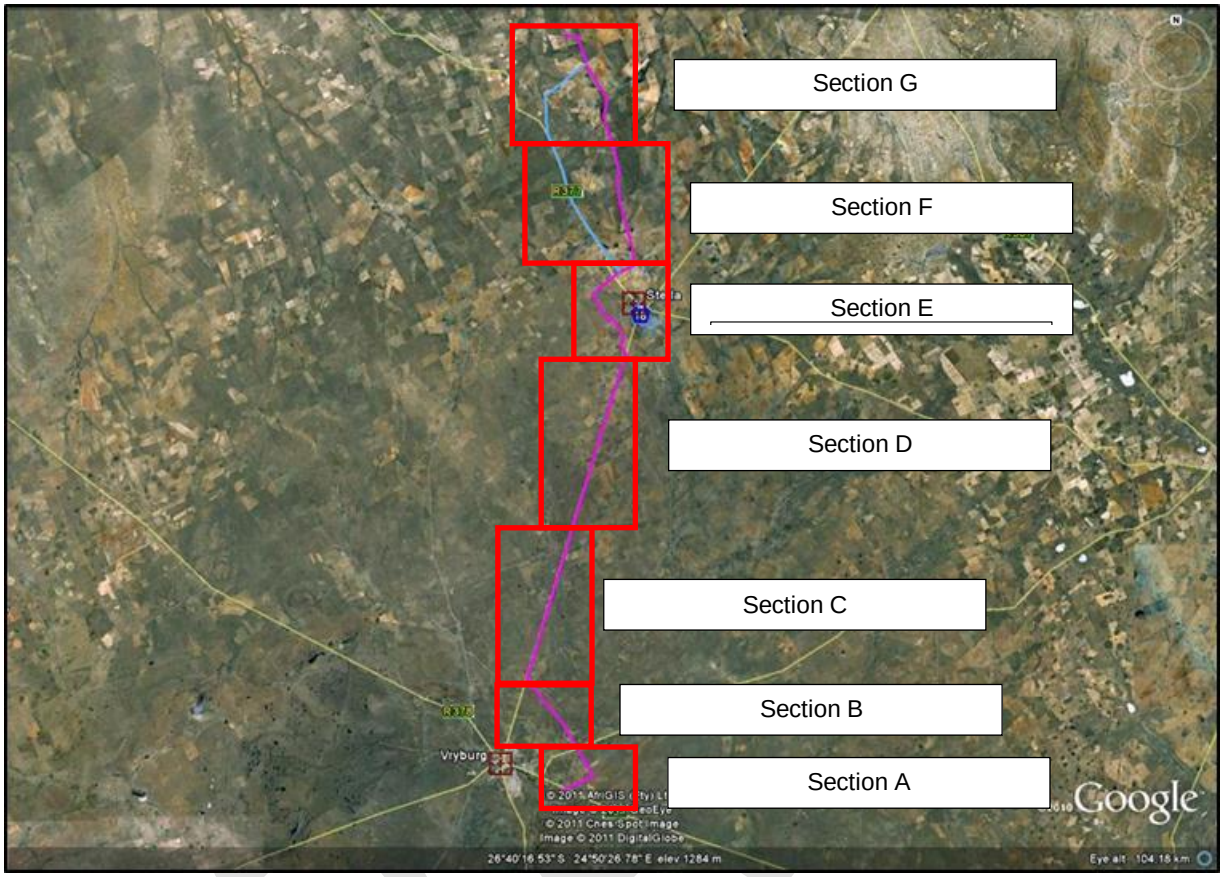


Figure 62: Overview of Bophirima – Kalplats Route Corridors

There are a number of household (red circles) and industrial/business (black circles) structures located within section A (Figure 63). At 133m, the two houses closest to the line (1) fall within the corridor. Structures 2, 3 and 4 falls directly within the corridor with virtually no separation distance, these areas have therefore been flagged as relocation should be avoided as far as possible. If the line indicated is the central line of the corridor, structure 5 would fall within the corridor at a distance of 142m from the central line. The line might be visible to most structures at distance ranging between 300-2,000m – depending on their vantage point.

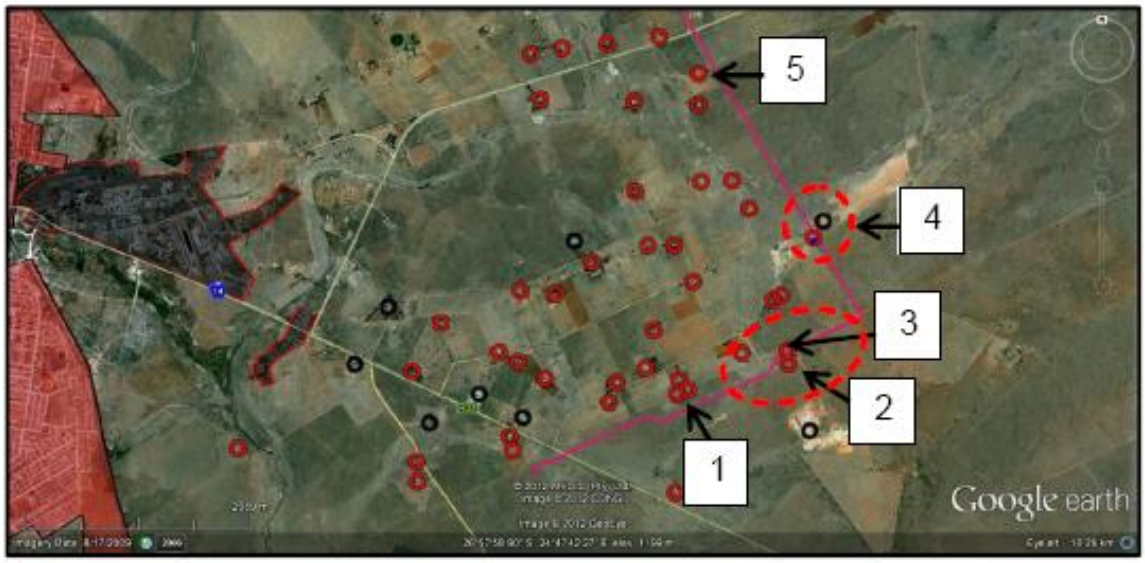


Figure 63: Section A

Section B (Figure 64) contains fewer structures than Section A, but again contains structures that can potentially fall within the route corridor. Structure 1 is located 156m from the line. Structure 2 is located 176m west of the line, whereas structure 3 lies closer at 147m. Of concern is the centre pivot that falls either within the corridor or just outside it with a separation distance of 50m.

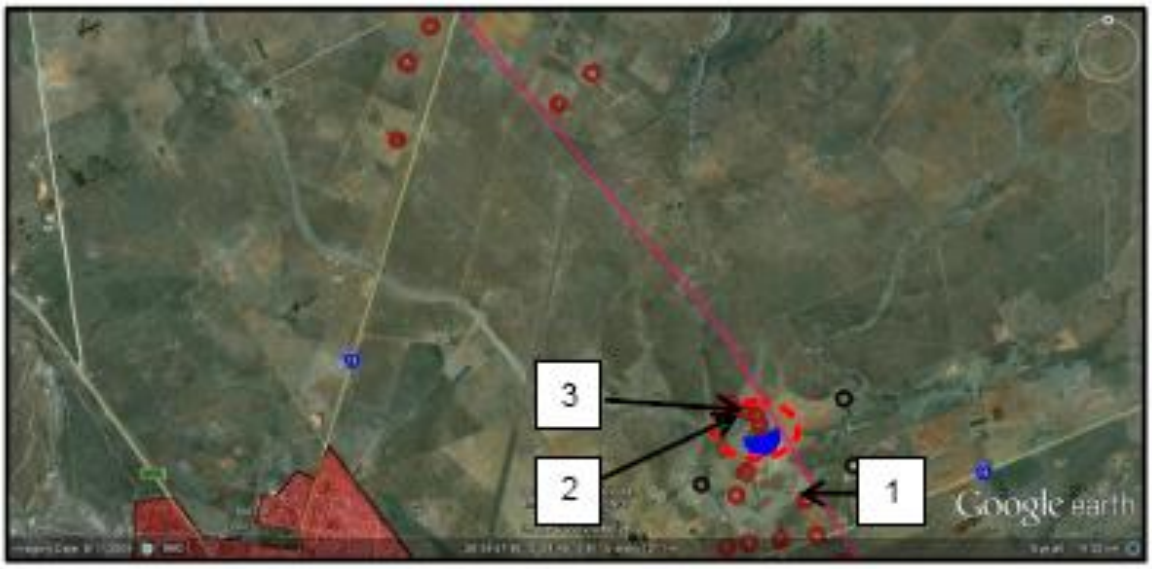


Figure 64: Section B

A number of houses are located within Section C (Figure 65), all in close proximity to the N18. If the N18 is taken as the central line of the route corridor, two houses would fall within the corridor: house 1 lies 106m west of the N18 and house 2 lies 151m east of the N18. If the N18 was the eastern border of the corridor, house 3 would be located in the corridor at 266m west of the N18 along with house 1, whereas house 2 would then be excluded from the corridor. All the other marked houses fall outside the corridor, although the distribution line would be visible to these houses at a distance ranging between 300-600m.

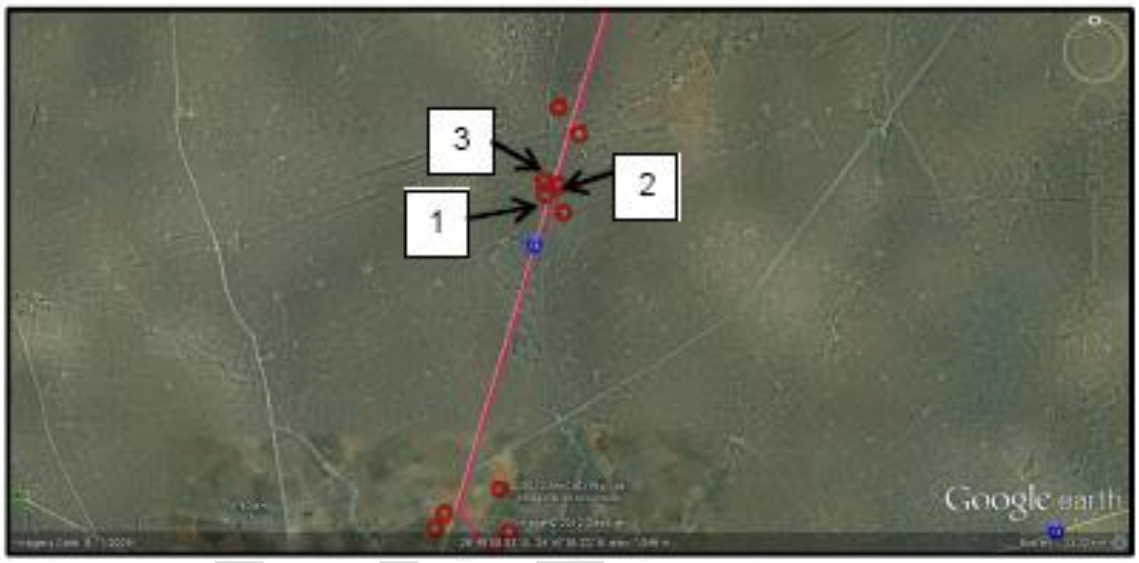


Figure 65: Section C

Again there are a number of scattered household structures along the section D (Figure 66). If the N18 was taken as the western border of the corridor, structure 1 would fall just inside the corridor at 299m. At 160m from the N18, the structures and operations at number 2 fall within the corridor whether the N18 is the central line or the eastern border of the corridor. This particular area (2) is therefore flagged from a social perspective, as relocation should be avoided as far as possible. If the N18 is taken as the western border of the corridor, number 3 would fall within the corridor at 206m east of the N18, and so would the compound of houses at 4 if the N18 was the eastern border (at a distance of 278m west of the N18). Both these points would fall outside the corridor if the N18 was the central point. No other structures would be directly affected in this section, but given the topography of the area, the line might be visible to households at distances ranging between 500-1,200m.

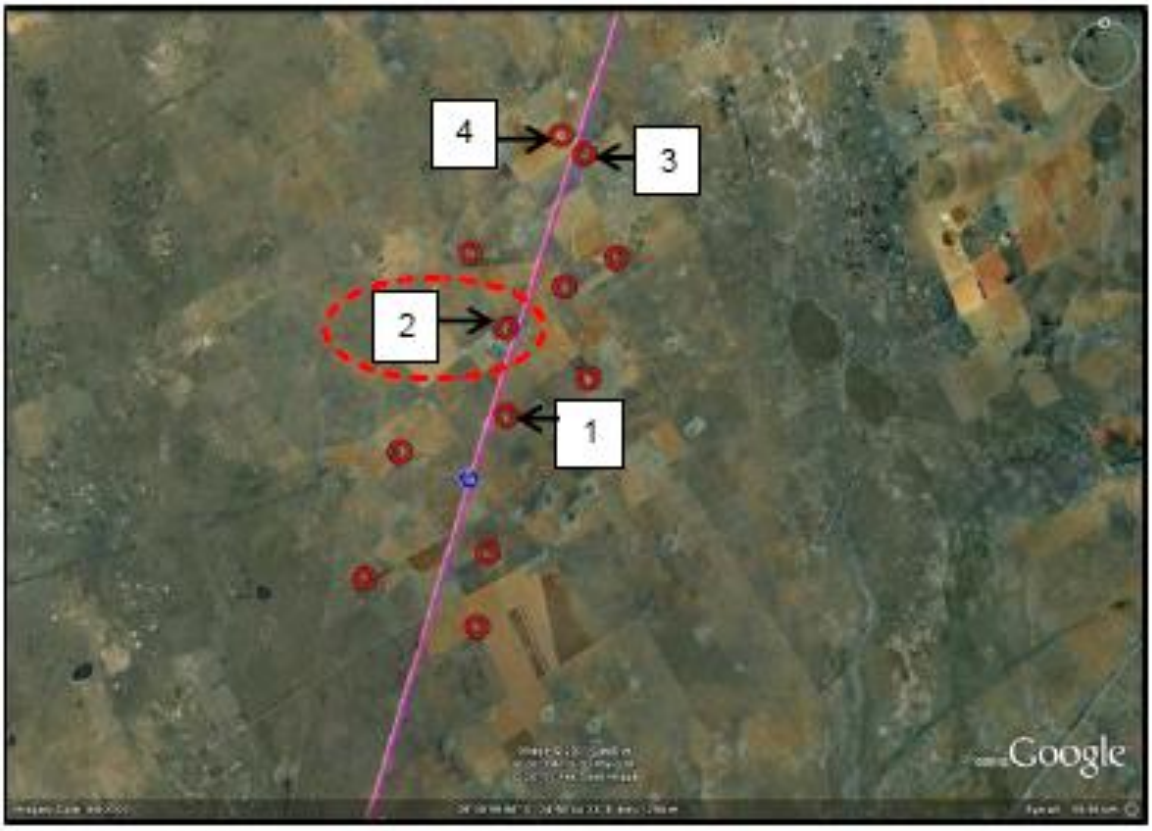


Figure 66: Section D

Structure 1 falls directly within the corridor, with no separation distance in Section E (Figure 67). The same holds true for structures 2, 3 and 4, although structure 2 might fall outside the corridor at a distance of 151m from the central line. Structures 3 and 4 are located 40m and 66m from the centre line, respectively. All of these areas have been flagged to avoid relocation.

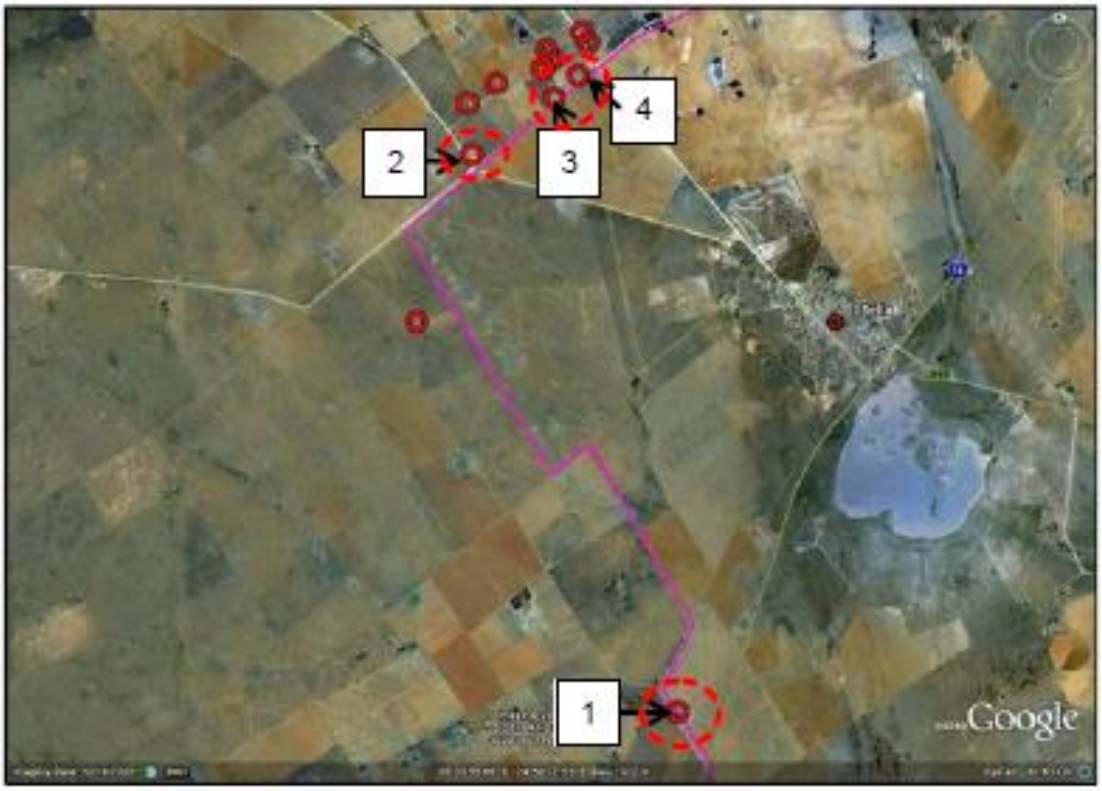


Figure 67: Section E

Structure 1 in Section F (Figure 68) is located 150m from the central line and would therefore be located within the corridor. All other structures are located at a distance greater than 150m and would therefore in all probability fall outside the corridor. In this instance, Alternative 1 (pink line) affects fewer households and structures and would therefore be a preferred alternative if other land uses were not taken into consideration.

Figure 68: Section F

Section G (Figure 69) contains a few scattered households, with structure 1 being located within 60m of Alternative 1. This area has been flagged.

Figure 69: Section G

- Kalplats – Edwards Dam

Two alternative route corridors are proposed for 132kV distribution power line between the proposed new Kalplats substation and the existing Edwards Dam substation.

Both alternative route corridors cross mostly agricultural/cultivated land. In addition to this land use, a number of scattered households are found along both alternatives (Figure 70). Although the line would be visible to most of these households (irrespective of the alternative implemented, given the topography of the area), a number of households could be more directly affected by the alternatives as they currently stand (i.e. without variations to the alignments). These are:

- Structure 1 is 100m within the 300m corridor of Alternative 1;
- Structure 2 is 150m within the 300m corridor of Alternative 1;
- Structure 3 is 190m within the 300m corridor of Alternative 1;
- Structure 4 is 206m within the 300m corridor of Alternative 3;
- Structures 5 are 135m within the 300m corridor of Alternative 3;
- Both structures 6 and 7 are 179m on either side of the 300m corridor of Alternative 3; and
- Structure 8 is 200m within the 300m corridor of Alternative 3.

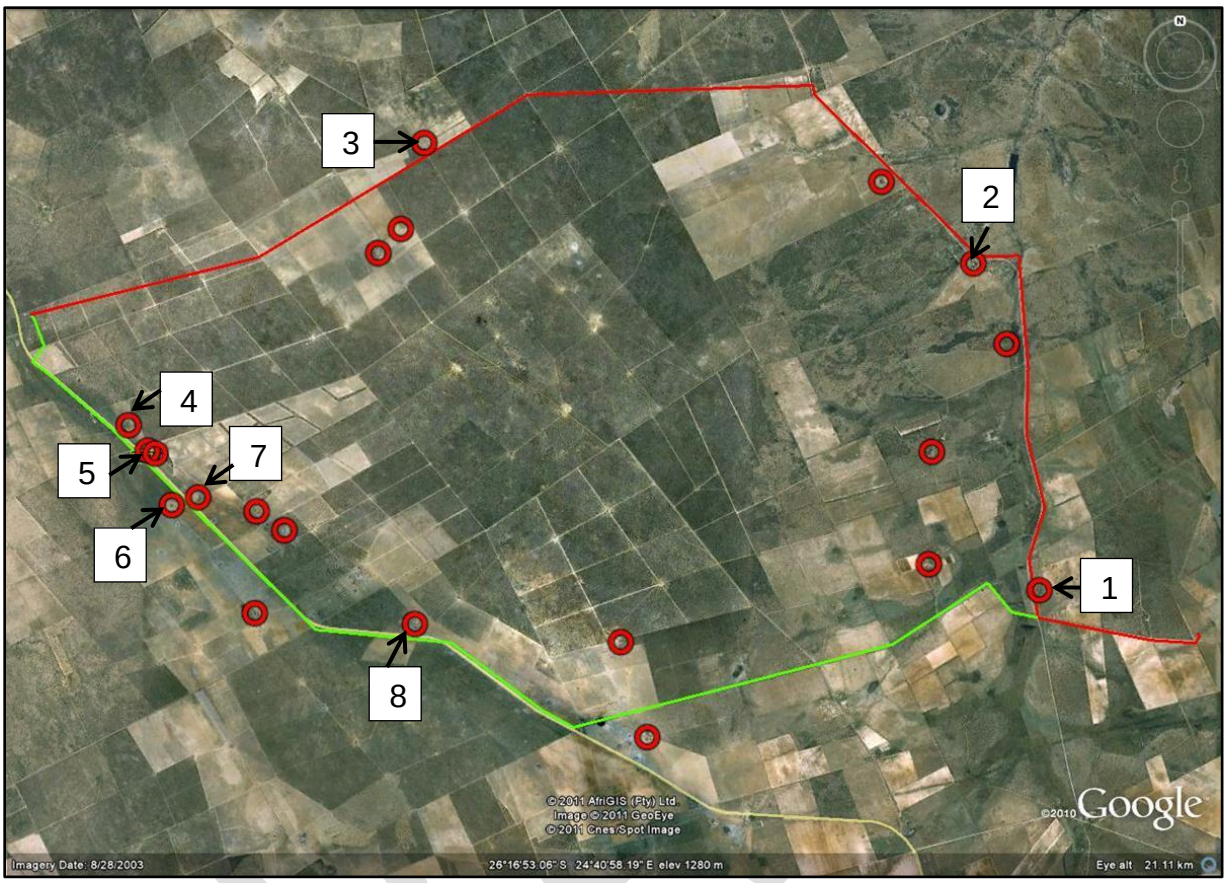


Figure 70: Overview of Kalplats – Edwards Dam Route Corridor Alternatives

In light of the number of households identified along the proposed corridor routes, displacement and relocation of households due to health and safety concerns is a likely potential issue (please refer to the Social Specialist Study in Appendix 3H for more detail on this aspect).

10.8.3 Potential Impacts during Construction

The categories of expected change processes and resultant impacts during the construction period are as follows:

- Geographical processes refer to the processes that affect the land uses of the local area, of which most would be temporary in nature, in isolated pockets as the construction team moves along the line, and confined to the servitude and construction laydown areas. The same would hold true for the substation sites, but in this regard the land loss is expected to be of a more permanent nature and therefore has been assessed in more detail under the operational phase of the project.

- Demographical processes refer to the structure of the local community, of which most impacts would be due to the influx of people to the area in the form of the construction team and the in-migration of unemployed job seekers, if any.
- Economic processes refer to the livelihood of people in the area, and could entail a number of impacts, but during the construction period this would mostly be limited to employment opportunities.
- Institution and Legal processes refer to the processes that affect service delivery to the local area and could entail a change in housing needs, which in turn could cause an additional demand on municipal services.
- Socio-cultural processes refer to the processes that affect the local culture of an affected area, i.e. the way in which the local community live (however, sometimes different cultural groups occupy the same geographical area and these groups are seldom homogenous). During the construction phase changes would mostly be limited to possible conflict situations between local residents and newcomers to the area, most notably where there is a marked dissimilarity in social practices.

- **Geographical Change Processes**

As a result of the physical space required for the construction activities associated with a distribution power line, a temporary loss of cultivated and grazing land can be expected during the construction phase of the project. This implies that a farmer would not have access to a part of his/her land for the cultivation and/or harvesting of crops for the duration of the construction activities, which in turn could result in a temporary loss of income associated with the affected portion of the land. Where crops are cleared for the servitude, this would have an economic impact on the farmer as a result of a reduced harvest. However, normally the loss of cultivated land is considered during the negotiation process and included in the compensation amount payable to the landowner.

- **Demographical Change Processes**

It is expected that the construction of the substations and the transmission power lines would lead to a temporary change in the number and composition of the population within the affected local area during the construction period, which in turn could lead to economic, land use, and socio-cultural change processes. In line with the results of the Scoping study, the influx of construction workers and increase of in-migration of job seekers comprise the main demographical change processes expected (please refer to the Social Specialist Study in Appendix 3H for greater detail).

- **Economic Change Processes**

Economic change processes relate to the changes brought about to the employment and general economic profile of an area as a result of the introduction of any development. For example, job opportunities might be created as a result of the construction and maintenance of the proposed substation, distribution power lines, and associated infrastructure. During the construction period this would mostly be limited to employment opportunities.

To understand the possibility of job creation, it is first necessary to have a basic understanding of the distribution power line construction process. The construction process normally starts at one point of the line and then follows a linear approach where one activity follows on the other with different teams involved at different points along the line, thereby forming a chain of events. On average there are some 35 days of construction at any point, but there might also be days in between where there are no construction activities taking place. In total the whole process can take up to year before the line is ready for commissioning.

Table 55 below details the following information per construction activity:

- The approximate team size per contractor, i.e. the number of people that are likely to be involved per construction activity;
- The approximate duration that will be spent at a construction point, i.e. an indication of the time that the construction team will spend at a given point (typically a tower location) as they move along the route. It must be noted that these times may vary depending on the local conditions of the area; and
- The skills required for each activity and the likelihood of local employment.

Table 55: Power Line Construction Process per Activity

Activity	Team Size	Duration	Skills Level	Local employment
1. Pegging of the centre line	3	1 day	Skilled	No
2. Access negotiations a. Develop access plan in consultation with landowner b. Agree on rehabilitation measures with landowner c. Photographs are taken of status quo	1	1 day	Skilled	No
3. Pegging of the tower points a. Surveyor appointed by contractor b. Footing of towers are set out c. Contractor reports back to Eskom if tower location is unsuitable for	5	1 day	Skilled	No

Activity	Team Size	Duration	Skills Level	Local employment
whatever reason so that tower can be moved accordingly				
4. Installation of new gates along the servitude	5-10	1 day	Unskilled	Yes
5. Nominations for the foundations of main structures and anchors a. Soil types are tested to determine foundation requirements b. Trial pits are dug at main foundation points - usually mechanically, but in some instances manual labour might be used	5	2 days	Skilled	No (But possible if manual labour is required on pits)
6. Foundation excavation a. Foundations of approximately 2m x 2m x2m deep are excavated, depending on the local soil conditions - usually mechanically, but in some instances manual labour might be used b. The foundation pit is the covered and fenced off until the foundation concrete can be poured	10	2 days	Semi-skilled	No (But possible if manual labour is required on excavation)
7. Foundation steelwork a. The steelwork is normally made up at the base camp and trucked to the site b. All fitting and wiring is done on site	10	2 days	Skilled	No
8. Foundation laying (concrete pouring) a. A normal concrete truck is used, but if it is difficult for the truck to access the site, concrete can might be mixed on site b. A 28-day period is required after the concrete has been laid for it to	20	2 days	Skilled	No

Activity	Team Size	Duration	Skills Level	Local employment
set				
9. Delivery of the steelwork for the tower a. Every tower is individually designed for its specific location and transported directly from the factory to the site b. The steelwork is delivered in sections and assembled on site c. The access roads are clearly marked to ensure that the correct tower is delivered to the correct location	5	1 day	Skilled	No
10. Tower assembly a. The tower steelwork is assembled on the ground b. Nuts are punched into the steelwork and painted with non-corrosive paint	10	3 days	Skilled	No
11. Erection a. The tower are lifted with cranes to complete the assembly	20	2 days	Skilled	No
12. Stringing a. Cable on the back of small trucks are placed next to each other within the servitude b. A pilot tractor places the pilot cable on the ground and is pulled up through the use of a pulley. The conductors can never touch the ground. c. Stringing can take place in both directions from each drum – up to 4km can be strung in both directions	50	7 days	Skilled	No
13. Sag and tension a. The line is tensioned from each	10	3 days	Skilled	No

Activity	Team Size	Duration	Skills Level	Local employment
of the cable stations to ensure minimum ground clearance				
14. Rehabilitation a. Rehabilitation takes place continuously throughout the construction process b. It will typically commence after the first few towers have been strung c. The contractor must offer a one year guarantee and will only be paid in full once rehabilitation has been concluded	5-15	2-10 days, depends on site conditions	Unskilled	Yes

Source: Generic Environmental Technical Notes – Power Line Construction Process (PBA SA, 2006)

As illustrated by Table 55 above, the unskilled job opportunities that might be directly created by the distribution power lines would be in the order of 25 at most.

Larger, stationery teams will be utilised at the substations sites. Although less information was available at the time of the study on the construction process of a substation (and with decommissioning in the case of Woodhouse it was assumed that more or less the same process would be followed as the construction process, but only in reverse), Table 56 details the following:

- The approximate team size per contractor, i.e. the number of people that are likely to be involved per construction activity; and
- The skills required for each activity and the likelihood of local employment.

Table 56: Substation Construction Process

Activity	Team Size	Skills Level	Local Employment
Vegetation clearance	40	Unskilled	Possible
Bulk earthworks	150	Skilled	No
Foundation team	120	Skilled	No
Assembly team	120	Skilled	No
Erection team	90	Skilled	No
Stringing team	90	Skilled	No
Commissioning team	30	Skilled	No
Rehabilitation team	45	Unskilled	Possible

In the case of the substations, 85 temporary job opportunities might therefore be available during the construction phase. As Woodhouse is being decommissioned, it might be possible that the size of the rehabilitation team might be bigger than 15 people.

The presence of the construction team and construction camp often also leads to the development of informal self-employment businesses such as domestic services, food stalls, etc. at either the construction camp or the construction site. Construction workers purchase goods and services from nearby towns, in this case Vryburg, thereby enhancing the local economy on a small scale for a short while.

- **Institutional and Legal Change Processes**

Institutional and Legal Change Processes assesses the way in which a development of this nature could change the face of service delivery in the affected area, the power relationships between groups and how people are able to negotiate through situations that might affect their lives. During the construction phase the most significant expected change to occur is the need to accommodate construction workers as it is expected that the servitude negotiation process with landowners would have been concluded in the pre-construction phase.

The contractor is responsible for supplying accommodation to the construction team, normally in the form of a construction camp. The location of the construction camp is selected by the contractor in consultation and per agreement with the landowner and based on factors such as access to the construction site(s), access to municipal services, and access to materials, etc.

It should be noted that the construction camp in itself does not pose a social impact, but rather that its presence tends to lead to a number of potential socio-cultural problems, which in turn then causes social impacts. Some of the most common problems associated with construction camps are:

- Disempowered and desperate local women often view construction workers as financially well-off. This can lead to an increase in prostitution, usually at the construction camp. Other women just enter into normal (sexual) relationships with construction workers believing that they will be supported financially. These situations have the potential to lead to an increase in pregnancies within the local community and eventually single parent households without financial support.
- In addition, casual sexual relationships can also pose health implications such as an increase in sexually transmitted infections, including HIV. Humans are transportable; therefore these infections can be spread when the construction worker migrates to a new area and perpetuates old behaviour (i.e. engage in a new casual sexual relationship).
- Infrastructure and services (e.g. water and sanitation) that are not managed and maintained properly within a construction camp can lead to waterborne diseases such as

cholera. Within concentrated living conditions, diseases are easily spread - not only within the confines of the camp, but also to surrounding communities.

- Construction workers seldom spend their free time in the camp, but would rather venture into town in search of entertainment, which normally results in alcohol abuse leading to an increase in conflict and violence, as well as an increase in causal sexual relationships as outlined above.

Unfortunately the contractor has very little control over most of the social problems mentioned above, apart from ensuring a healthy and safe environment within the camp and advocating safer sexual behaviour through preventative campaigns at the camp (and possibly extending these to local communities where construction workers will likely spend their free time).

- **Socio-Cultural Change Processes**

Socio-cultural change processes in turn looks at the way in which the proposed developments can alter the interactions and relationships within the local community. In line with the results of the scoping study, the following socio-cultural change processes might be expected:

- Conflict situations on various levels, of which the most notable would be:
  - Between construction workers and local community members; and
  - Between private landowners and the project proponent (Eskom).
- Health issues, most notably life threatening infections such as HIV/AIDS.

10.8.4 Potential Impacts during Operations and Maintenance

The categories of expected change processes and resultant impacts during the construction period are as follows:

- Geographical processes refer to the processes that affect the land uses of the local area, and in this case would be the restoring of agricultural land on the one side through the decommissioning of the Woodhouse substation, and a permanent change in cultivated and grazing land on the other hand through the presence of the newly commissioned substations and distribution power line towers.
- No further impacts are foreseen as part of demographical change processes during the operations and maintenance phase as the maintenance teams are too small to warrant a significant change to the size and composition of the local community.
- Economic processes refer to the livelihood of people in the area, and could entail a number of impacts. During the operations and maintenance phase this would mostly relate to a change in property values (micro impacts for private landowners along the

distribution lines and on substation sites) and on a more regional scale it would speak to economic growth through an enhanced electricity supply.

- No further impacts are foreseen as part of the institution and legal change processes during the operations and maintenance phase.
- Socio-cultural processes refer to the way in which the local community live and therefore the visual presence of the substations and the distribution lines can affect their sense of place, especially where the landscape of an area went from 'pristine' to 'spoilt'.

- **Geographical Change Processes**

The identification and assessment of social impacts arising from geographical change processes within a social context, focuses on how the proposed development might impinge on the behaviour and/or lives of landowners and/or land users in the affected area. In line with the results of the Scoping Report, sterilisation of agricultural land and permanent loss of land to accommodate substation are the two main geographical change processes are expected during the operations and maintenance phase (please refer to the Social Specialist Study in Appendix 3H for greater detail).

- **Economic Change Processes**

Economic processes refer to the livelihood of people in the area, and could entail a number of impacts. During the operations and maintenance phase this would mostly relate to a change in property values (micro impacts for private landowners along the distribution lines and on substation sites) and on a more regional scale it would speak to economic growth through an enhanced electricity supply (please refer to the Social Specialist Study in Appendix 3H for greater detail).

- **Socio-Cultural Change Processes**

The most important socio-cultural change during the operation and maintenance phase relates to a change in sense of place (please refer to the Social Specialist Study in Appendix 3H for greater detail).

10.8.5 Construction Phase Impact Ratings

Construction phase impact ratings for temporary loss of agricultural land, temporary employment, conflict impacts, health and safety impacts are provided in Table 57 to Table 60 below.

Table 57: Temporary loss of agricultural land

TEMPORARY LOSS OF AGRICULTURAL LAND	
Environmental Parameter	Restrict the area of temporary loss of agricultural land to the servitude width and pre-agreed laydown areas.
Issue/Impact/Environmental Effect/Nature	During the construction phase a temporary loss of agricultural land will occur due to the construction activities taking place along the servitude on farms. Loss of land will occur due to servitude clearance and restrictions placed on the land within the immediate construction area. This implies that the landowner cannot access that portion of his/her land while construction takes place on his/her property. The temporary loss of agricultural land is only applicable to the distribution line corridors, as land loss associated with the substation sites are more permanent and would therefore fall under the operations and maintenance phase of the project.
Extent	If managed properly, the impact should be restricted to the construction site.
Probability	As the bulk of the route corridors are located on agricultural land, there is a greater than 75% chance that the impact will occur.
Reversibility	The impact is completely reversible, but will require more intense mitigation measures to ensure that the land is restored to the same standard as before the construction of the line.
Irreplaceable loss of resources	If managed properly, the construction process should only lead to a marginal loss in resources, i.e. the crops that was cleared as part of the servitude and not any land loss beyond that.
Duration	The loss of agricultural land will only be temporary in nature and will last for the duration of the construction phase. It will however require direct human action to restore the land.
Cumulative effect	No cumulative effects foreseen
Intensity/magnitude	Although the servitude area will be affected, the remainder of the farming activities will be able to continue unabated.
Significance Rating	Negative Low
Although the temporary loss of agricultural land is strictly speaking a category 2 impact, the difference in the severity of the impacts along the various route corridors are not expected to vary extensively as all of the route corridors traverse agricultural land. The issue has therefore been assessed as if it were a category 1 impact.	

	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Probability	n/a	n/a	n/a	n/a	4	4	4	4	4	4
Reversibility	n/a	n/a	n/a	n/a	2	2	2	2	2	2
Irreplaceable loss	n/a	n/a	n/a	n/a	2	2	2	2	2	2
Duration	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Cumulative effect	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Intensity / magnitude	n/a	n/a	n/a	n/a	2	2	2	2	2	2
Significance rating	**n/a**	**n/a**	**n/a**	**n/a**	**-22**	**-22**	**-22**	**-22**	**-22**	**-22**
Mitigation measures	• Build a 'good neighbour' relationship with landowners by informing them upfront of when and where construction will take place on their property and stick to agreed timeframes and places. • To avoid taking up too much space and causing unnecessary damage to crops or harm to game and cattle, the construction area should be restricted to the servitude and laydown areas and properly fenced off. • Construction teams, construction vehicles and construction material should only access the construction site via demarcated access roads and should not be allowed to cut across fields or vacant (agricultural) land. Where this does occur, damages should be restored immediately.									
POST-MITIGATION										
Extent	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Probability	n/a	n/a	n/a	n/a	3	3	3	3	3	3
Reversibility	n/a	n/a	n/a	n/a	2	2	2	2	2	2
Irreplaceable loss	n/a	n/a	n/a	n/a	2	2	2	2	2	2
Duration	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Cumulative effect	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Intensity / magnitude	n/a	n/a	n/a	n/a	1	1	1	1	1	1

Significance rating	**n/a**	**n/a**	**n/a**	**n/a**	**-10**	**-10**	**-10**	**-10**	**-10**	**-10**

Table 58: Temporary employment impacts

TEMPORARY EMPLOYMENT	
Environmental Parameter	Where possible unskilled temporary employment should be afforded to locals. Locals are regarded as permanent residents from Huhudi, Dithakwaneng, Vryburg or Stella.
Issue/Impact/Environmental Effect/Nature	Although most of the construction activities on the substations and distribution power lines require semi-skilled to highly skilled individuals, certain work packages might require unskilled labour. Where such labour is required, it should be sourced from within one of the four local communities closest to the construction site as employment creates income, albeit on a temporary basis.
Extent	The extent of employment cannot be measured on a geographical scale as it would mostly relate to a few individuals in as far as temporary employment is concerned.
Probability	Due to the mechanical nature of the construction process and the skills required, it is highly unlikely that large numbers of unskilled jobseekers from local communities will find employment on the project.
Reversibility	Not applicable.
Irreplaceable loss of resources	Not applicable.
Duration	In the unlikely event that unskilled labour is required, these will only be utilised for very short periods of time and would therefore be in a span shorter than the construction phase. Temporary employment might be offered post construction in the rehabilitation of the servitude.
Cumulative effect	The perception or expectation (even it if is unrealistic on the part of locals) that the project will offer employment often results in locals informing family and friends from elsewhere that there are jobs available in the area, which in turn then leads to the in-migration of jobseekers. This can make it difficult to distinguish between a permanent resident and an opportunistic jobseeker, which in turn can complicate a fair job allocation system should unskilled labour be required – even more so where there is very little demand, but an oversupply of labour.

Intensity/magnitude	Very few local job opportunities will be created, if any.									
Significance Rating	Positive Low									
The creation of temporary local employment opportunities is a category 1 impact, as these impacts will occur regardless of the alternative chosen. The impact table below therefore reflects the same numerical value for each of the impact variables as no distinction was made between alternatives.										
	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	1	1	1	1	1	1	1	1	1	1
Probability	1	1	1	1	1	1	1	1	1	1
Reversibility	1	1	1	1	1	1	1	1	1	1
Irreplaceable loss	1	1	1	1	1	1	1	1	1	1
Duration	1	1	1	1	1	1	1	1	1	1
Cumulative effect	2	2	2	2	2	2	2	2	2	2
Intensity / magnitude	1	1	1	1	1	1	1	1	1	1
Significance rating	**+7**	**+7**	**+7**	**+7**	**+7**	**+7**	**+7**	**+7**	**+7**	**+7**
Mitigation measures	• Local communities should be informed upfront and in no uncertain terms that the possibility of local employment is most unlikely so that unrealistic expectations are not created in terms of job opportunities – this would also aid in minimising the in-migration of jobseekers from elsewhere. • Where unskilled labour is required, it should be sourced from the local communities. Locals should be permanent residents from either Huhudi, Dithakwaneng, Vryburg or Stella, whichever is the closest to the construction site. As so far that it is within the contractors' control, unskilled jobs should not be allocated to jobseekers from elsewhere. • Where project activities lead to the creation of informal job opportunities such as food stalls, contractors should be encouraged to allow such activities as long as it does not interfere with the construction activities itself or the safety of the construction site, the informal vendor and/or the construction workers.									
POST-MITIGATION										
Extent	2	2	2	2	2	2	2	2	2	2
Probability	1	1	1	1	1	1	1	1	1	1

Reversibility	1	1	1	1	1	1	1	1	1	1
Irreplaceable loss	1	1	1	1	1	1	1	1	1	1
Duration	1	1	1	1	1	1	1	1	1	1
Cumulative effect	2	2	2	2	2	2	2	2	2	2
Intensity / magnitude	2	2	2	2	2	2	2	2	2	2
Significance rating	**+16**	**+16**	**+16**	**+16**	**+16**	**+16**	**+16**	**+16**	**+16**	**+16**

Table 59: Conflict impacts

CONFLICT	
Environmental Parameter	Note: As it would be difficult for the contractor to control conflict situations where they occur when construction workers spend their free time in the local community, this assessment focuses on conflict situations that the contractor can control. Conflict between Eskom (or its contractors) and landowners should be avoided by abiding to terms and conditions set out during negotiation process, especially in terms of current problem areas such as access to properties, fencing and security.
Issue/Impact/Environmental Effect/Nature	Conflict situations that can delay the project and prolong the duration of impacts, which in turn would affect local residents' quality of life and result in economic impacts.
Extent	Where conflict occurs with regard to the issues mentioned above, Eskom (or its contractors) should aim to restrict it to the landowner in question to prevent problems from extending along the length of the construction servitude.
Probability	The chance of occurrence is dependent on how the construction servitude is managed, which is difficult to predict – it might therefore be possible that the impact will occur, just as it might be possible that it will not occur.
Reversibility	Conflict situations are for the most part completely reversible if problems are rectified.
Irreplaceable loss of resources	A loss of resources might be the cause for conflict (e.g. a gate left open lead to missing cattle) – again this will be difficult to gauge at this stage and therefore the safest option would be to say that there might be a marginal loss of resources.

Duration	Conflict situations for the most part will be limited to the construction phase.
Cumulative effect	One conflict situation with a particular landowner can spread to other landowners so that they are antagonistic against the contractor even before they arrive on site. Other conflict situations can also arise in other areas as outlined in the body of the report, i.e. between jobseekers and construction workers, between construction workers and the local community and between the local community and Eskom. Although all of these conflict situations might have small centralised points, collectively the local community as a whole can start resenting the presence of the construction team.
Intensity/magnitude	Conflict can range from barely perceptible (e.g. a contained conflict situation with one landowner that gets resolved quickly) to dispersed conflict situations that lead to high costs of remediation (e.g. community members refusing to further house construction workers out of protest thereby forcing the contractor to erect a construction village).
Significance Rating	Negative Low impact on the Kalplats substations and all route alignments Negative Medium impact on the Bophirima substations
Apart from the Woodhouse and Bophirima substations, there is an equal chance for conflict situations to occur on any one of the alternative route alignments and at the Kalplats substation site and therefore it has been assessed as a category 1 impact. It is not expected that conflict situations will occur at the Woodhouse substation as the substation is being decommissioned. It is highly likely that conflict will occur at the Bophirima substation as there is already conflict with the particular landowner on another Eskom project which has resulted in expropriation.	

	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	1	1	1	1	1	2	1	1	1	1
Probability	3	3	2	2	2	2	2	2	2	2
Reversibility	3	3	2	2	2	2	2	2	2	2
Irreplaceable loss	2	2	2	2	2	2	2	2	2	2

Duration	2	2	1	1	1	1	1	1	1	1
Cumulative effect	3	3	2	2	2	2	2	2	2	2
Intensity / magnitude	3	3	2	2	2	2	2	2	2	2
Significance rating	**-42**	**-42**	**-20**	**-20**	**-20**	**-20**	**-20**	**-20**	**-20**	**-20**
Mitigation measures	• Problem areas that are brought under the attention of the contractor should be rectified immediately. If the contractor is unable to so, this should be communicated to the landowner along with a plan on how and when the problem will be addressed. The landowner should be given regular feedback on the matter. • Locals should be informed upfront that it is unlikely that the project will directly employ community members to work on the project so that there are no unrealistic expectations on the part of the community or situations created where they demand jobs as it was promised to them on previous occasions. • All mitigation measures contained in the EMP should be implemented and monitored by an ECO. Remedial action should be taken where the contractor fails to comply with the EMP.									
POST-MITIGATION										
Extent	1	1	1	1	1	1	1	1	1	1
Probability	2	2	1	1	1	1	1	1	1	1
Reversibility	2	2	1	1	1	1	1	1	1	1
Irreplaceable loss	1	1	1	1	1	1	1	1	1	1
Duration	1	1	1	1	1	1	1	1	1	1
Cumulative effect	2	2	2	2	2	2	2	2	2	2
Intensity / magnitude	2	2	2	2	2	2	2	2	2	2
Significance rating	**-18**	**-18**	**-14**	**-14**	**-14**	**-14**	**-14**	**-14**	**-14**	**-14**

Table 60: Health and Safety impacts

HEALTH AND SAFETY IMPACTS	
Environmental Parameter	Reduce the risk spreading Sexually Transmitted Infections including HIV.
Issue/Impact/Environmental Effect/Nature	HIV/AIDS has numerous impacts ranging from the obvious health impacts to the less obvious economic impacts as result of a reduced workforce, loss of breadwinners resulting an alteration in family structures.

Extent	For the duration of the project the impact of HIV infections might be restricted to the local area, but as people move to other areas, so too does the virus.
Probability	The probability that construction workers will engage in sexual relationships with locals is quite high. This is beyond the control of the contractor, but the contractor can supply condoms and information material to reduce the probability of HIV and other STI infections.
Reversibility	Once infection has occurred, the impact is irreversible. It is therefore important to develop and implement a Health and Safety Plan, including a HIV/AIDS prevention plan during the construction phase.
Irreplaceable loss of resources	HIV/AIDS will eventually lead to the loss of human resources, which would have an economic impact on the contractor who would have to spend time and money on training new employees
Duration	Until such time that a cure is found, HIV infection is permanent
Cumulative effect	Humans are transportable; therefore these infections can be spread when the construction worker migrates to a new area and perpetuates old behaviour (i.e. engage in a new casual sexual relationship). The death of parents and breadwinners alters family structures so that children become heads of households, restricting them from completing their education, holding them in downward poverty cycles.
Intensity/magnitude	HIV infections can severely impair the functionality of the construction process due to illness and absenteeism.
Significance Rating	Negative High impact (pre-mitigation) to Negative Low impact (post-mitigation)

The health and economic impacts as result of STI and HIV infection is a category 1 impact, as these impacts will occur regardless of the alternative chosen. The impact table below therefore reflects the same numerical value for each of the impact variables as no distinction was made between alternatives.

	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										

Extent	4	4	4	4	4	4	4	4	4	4
Probability	3	3	3	3	3	3	3	3	3	3
Reversibility	4	4	4	4	4	4	4	4	4	4
Irreplaceable loss	3	3	3	3	3	3	3	3	3	3
Duration	2	2	2	2	2	2	2	2	2	2
Cumulative effect	4	4	4	4	4	4	4	4	4	4
Intensity / magnitude	3	3	3	3	3	3	3	3	3	3
Significance rating	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**	**-60**
Mitigation measures	• Eskom or its contractor should appoint a service provider or local NGO to develop, implement and manage an HIV/AIDS prevention programme. The service provider or NGO should specialise in the field of HIV/AIDS. • The HIV/AIDS prevention programme should extend to the local community and should pay special attention to vulnerable groups such as women and youth.									
POST-MITIGATION										
Extent	2	2	2	2	2	2	2	2	2	2
Probability	2	2	2	2	2	2	2	2	2	2
Reversibility	3	3	3	3	3	3	3	3	3	3
Irreplaceable loss	2	2	2	2	2	2	2	2	2	2
Duration	2	2	2	2	2	2	2	2	2	2
Cumulative effect	3	3	3	3	3	3	3	3	3	3
Intensity / magnitude	2	2	2	2	2	2	2	2	2	2
Significance rating	**-28**	**-28**	**-28**	**-28**	**-28**	**-28**	**-28**	**-28**	**-28**	**-28**

10.8.6 Operations and Maintenance Phase

Operation and maintenance phase impact ratings for temporary loss of agricultural land, temporary employment, conflict impacts, health and safety impacts are provided in Table 61 to Table 64 below.

Table 61: Sterilisation of agricultural land impacts

STERILISATION OF AGRICULTURAL LAND	
Environmental Parameter	Restrict the sterilisation of agricultural land to the distribution line towers.
Issue/Impact/Environmental Effect/Nature	The sterilisation of agricultural land implies a reduced crop, which in turn will have an economic impact on the landowner in question. Most agricultural activities can continue underneath the power line, with the exception of high growing crops – where these occur a 31m wide strip in the form of the servitude will be cleared for which the landowner will be compensated. Grazing can continue unhindered underneath power lines and around towers.
Extent	Apart from the fact that the sterilisation of agricultural land should be restricted as far as possible to the distribution line towers, the land surrounding the line should be left viable as far as possible. It is therefore preferable to place lines on farm boundaries or within exiting corridors as opposed to cutting across farms. The amount of land loss will be determined by the number of towers on a particular farm and therefore it is difficult to determine the extent of the impact on a particular farm as the location of the towers will only be known during the pre-construction phase when the central line is pegged.
Probability	It is quite likely that some land loss will occur to accommodate the distribution line towers, but the alignment can be planned in such a way that land loss is restricted to a minimum.
Reversibility	The economic impact of land loss will be partly reversible as the landowner will receive a once-off amount for compensation. As part of rehabilitation, the construction servitude also has to be restored to its previous standard, which would imply that crops would be replanted if such crops are permitted in the servitude.
Irreplaceable loss of resources	There might be some permanent loss of land around the towers, but this should be minimal.
Duration	The landowner will not be able to use the immediate area around the towers for the entire operational lifespan of the project.

Cumulative effect	The presence of a distribution line can set an unintended precedent for further land use change. If additional lines are required in future it is oftentimes preferred to place such lines next to existing lines as the corridor area is already regarded as disturbed.
Intensity/magnitude	The significant of the extent of land loss is dependent on the number of towers on the farm, the location of the line on the farm, whether or not there are other lines present, and the type of farm (crop cultivation, grazing, etc.)
Significance Rating	Negative Medium impact (pre-mitigation) to Negative Low impact (post-mitigation)

Although the sterilisation of agricultural land is strictly speaking a category 2 impact, the difference in the severity of the impacts along the various route corridors are not expected to vary extensively as all of the route corridors traverse agricultural land. The issue has therefore been assessed as if it were a category 1 impact. The impact only relates to the distribution lines, as the substation will lead to more permanent land loss (assessed in the following table).

	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Probability	n/a	n/a	n/a	n/a	3	2	3	3	3	3
Reversibility	n/a	n/a	n/a	n/a	2	2	2	2	2	2
Irreplaceable loss	n/a	n/a	n/a	n/a	3	2	3	3	3	3
Duration	n/a	n/a	n/a	n/a	3	1	3	3	3	3
Cumulative effect	n/a	n/a	n/a	n/a	4	2	4	4	4	4
Intensity / magnitude	n/a	n/a	n/a	n/a	3	2	3	3	3	3
Significance rating	**n/a**	**n/a**	**n/a**	**n/a**	**- 48**	**-20**	**- 48**	**- 48**	**- 48**	**- 48**
Mitigation measures	• Lines should be placed on farm boundaries as far as possible, away from productive farm land. The placement of the line should be done in consultation with the affected landowner during the negotiation process. • Compensation should be paid to landowner for production losses during the construction phase and to enable landowner to replant crops in the servitude, where such crops are permitted. Again this should be agreed									

	upon with the landowner during the negotiation process.									
POST-MITIGATION										
Extent	n/a	n/a	n/a	n/a	1	1	1	1	1	1
Probability	n/a	n/a	n/a	n/a	2	1	2	2	2	2
Reversibility	n/a	n/a	n/a	n/a	2	1	2	2	2	2
Irreplaceable loss	n/a	n/a	n/a	n/a	2	1	2	2	2	2
Duration	n/a	n/a	n/a	n/a	3	1	3	3	3	3
Cumulative effect	n/a	n/a	n/a	n/a	4	1	4	4	4	4
Intensity / magnitude	n/a	n/a	n/a	n/a	2	1	2	2	2	2
Significance rating	**n/a**	**n/a**	**n/a**	**n/a**	**- 28**	**-6**	**- 28**	**- 28**	**- 28**	**- 28**

Table 62: Permanent loss of agricultural land

PERMANENT LOSS OF AGRICULTURAL LAND	
Environmental Parameter	Plan the siting of the substation so that the loss of agricultural land brings the least amount of disruption to the farming activities as a whole.
Issue/Impact/Environmental Effect/Nature	The physical space required for the substation will lead to a permanent loss of agricultural land for the duration of the operational life of the project. This means a reduced farming area which will have an economic impact on the farmer.
Extent	The impact will be restricted to the farm on which the substation is located.
Probability	The impact will definitely occur.
Reversibility	It will only be possible to restore the land once the substation is decommissioned, which will now happen in the case of Woodhouse.
Irreplaceable loss of resources	The loss of resource is dependent on the total size of the farm on which the substation will be located. The smaller the farm, the more significant the loss of agricultural resources.
Duration	The impact will last for the operational lifetime of the project.

Cumulative effect	Apart from the substation, distribution power lines will also feed into and out of the substation and therefore these installations will also be located on the farm. In addition to the loss of agricultural land to the substation, the farmer will also experience some sterilisation of agricultural land as discussed in the table above.
Intensity/magnitude	The impact will be restricted to one landowner.
Significance Rating	Negative Low Impact in the case of the Bophirima substations, as the area is characterised by power generation and distribution infrastructure rather than pristine agriculture. Negative Medium Impact (pre-mitigation) in the case of the Kalplats substations, as the area is characterised by productive agricultural land ('greenfields' site) to a Low Medium Impact.

As there are no alternative site locations proposed for the substation sites, the permanent loss of land has been assessed as a category 1 impact. In the case of the Woodhouse substation, the impact has been assessed as a 'reverse' impact, i.e. 'restoration of land'.

	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	1	1	1	1	n/a	n/a	n/a	n/a	n/a	n/a
Probability	2	2	3	3	n/a	n/a	n/a	n/a	n/a	n/a
Reversibility	2	2	3	3	n/a	n/a	n/a	n/a	n/a	n/a
Irreplaceable loss	2	2	3	3	n/a	n/a	n/a	n/a	n/a	n/a
Duration	3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a
Cumulative effect	3	3	4	4	n/a	n/a	n/a	n/a	n/a	n/a
Intensity / magnitude	2	2	2	2	n/a	n/a	n/a	n/a	n/a	n/a
Significance rating	**-26**	**-26**	**-34**	**-34**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
Mitigation measures	• The final siting of the substations should be done in consultation with the respective affected landowners, to prevent fragmentation of farmland.									
POST-MITIGATION										
Extent	1	1	1	1	n/a	n/a	n/a	n/a	n/a	n/a

Probability	2	2	2	2	n/a	n/a	n/a	n/a	n/a	n/a
Reversibility	1	1	2	2	n/a	n/a	n/a	n/a	n/a	n/a
Irreplaceable loss	2	2	2	2	n/a	n/a	n/a	n/a	n/a	n/a
Duration	3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a
Cumulative effect	2	2	3	3	n/a	n/a	n/a	n/a	n/a	n/a
Intensity / magnitude	1	1	2	2	n/a	n/a	n/a	n/a	n/a	n/a
Significance rating	**-11**	**-11**	**-15**	**-15**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**

Table 63: Change in property values impacts

CHANGE IN PROPERTY VALUES	
Environmental Parameter	Minimise the impact that the presence of the distribution lines and substations can have on rural/agricultural and residential property values.
Issue/Impact/Environmental Effect/Nature	Previous research by MasterQ Research (2007a, 2007b and 2009b) indicated that rural/agricultural property that derives its primary value from having a pristine or natural character may suffer some reduction in value when developments of an industrial nature (specifically transmission/distribution power lines) occur. This has an economic impact on the landowner in question.
Extent	It can be expected that the impact will occur along the length of the distribution line and at the Kalplats substation sites as a greenfields area. It is unlikely that the impact will occur around the Bophirima site as the area surrounding this site is characterised by distribution power infrastructure, which makes it safe to assume that the site area does not derive its value from a pristine character, but rather from its ability to enable economic activity through power generation and distribution.
Probability	The probability for land devaluation is dependent on the distance from the line, the topography of the area and the visual landscape as discussed. This will differ from property to property.

Reversibility	In some instances the impact might be partly reversible, whereas in others even intense mitigation measures would not improve the value of the property. The latter are houses within a short distance from the line that directly face the line with no visual screening.
Irreplaceable loss of resources	The loss of resources depends on the increment of devaluation experienced.
Duration	The impact will continue for the operational lifetime of the project.
Cumulative effect	None foreseen
Intensity/magnitude	Again the intensity of the impact is dependent on the location of the house in relation to the line as discussed above. The positioning of the line on the farm boundary will also reduce the intensity of the impact to some extent as opposed to the line cutting across a farm which would heighten the intensity of the impact.
Significance Rating	Negative Low impact on the Bophirima substations as land is already characterised by power generation and distribution infrastructure Negative Medium impact (pre-mitigation) on all alternative route corridors, but this will only be applicable to houses in direct line of sight and within a short distance from the line, to negative low impact (post-mitigation) – also see the explanatory note below

Apart from the Bophirima-Vryburg line, all the other distribution lines mostly traverse agricultural land characterised by scattered households. The scope of this study precludes a detailed assessment of property devaluations on each of these houses and/or farmlands in relation to the route corridors as an accurate assessment can only be done once a final route alignment has been pegged. Even then a property valuer would be required to do a valuation on the property. This assessment therefore only serves as a possible indication of the economic impact that the presence of the distribution line might have on a property given the visibility of the line and the way in which it affects the land use of the property. As such, the impact has been assessed as a category 1 impact on a macro level.

	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	1	1	1	1	1	1	1	1	1	1

Probability	1	1	2	2	2	2	2	2	2	2
Reversibility	1	1	2	2	2	2	2	2	2	2
Irreplaceable loss	1	1	3	3	3	2	3	3	3	3
Duration	1	1	3	3	3	3	3	3	3	3
Cumulative effect	1	1	1	1	1	1	1	1	1	1
Intensity / magnitude	1	1	3	3	3	2	3	3	3	3
Significance rating	**-6**	**-6**	**-36**	**-36**	**-36**	**-22**	**-36**	**-36**	**-36**	**-36**
Mitigation measures	• Route distribution power lines as far away from homesteads, buildings and irrigation system as possible. • Route distribution power lines close to farm boundaries. • Minimise visual profile of the distribution power line by choosing routes where topography allows for visual reduction. • Make maximum use of undeveloped routings to place towers and avoid intensively developed properties when possible. • Stay at least 200m away from residential areas within the urban zone whenever possible. • Compensate at market rates for property value loss as indicated by an independent valuations expert once exact route is known.									
POST-MITIGATION										
Extent	1	1	1	1	1	1	1	1	1	1
Probability	1	1	2	2	2	2	2	2	2	2
Reversibility	1	1	2	2	2	1	2	2	2	2
Irreplaceable loss	1	1	2	2	2	1	2	2	2	2
Duration	1	1	1	1	1	1	1	1	1	1
Cumulative effect	1	1	1	1	1	1	1	1	1	1
Intensity / magnitude	1	1	1	1	1	1	1	1	1	1
Significance rating	**-6**	**-6**	**-9**	**-9**	**-9**	**-7**	**-9**	**-9**	**-9**	**-9**

Table 64: Sense of place impacts

SENSE OF PLACE

Environmental Parameter	Much of what is valuable in a culture is embedded in place, which cannot be measured in monetary terms.
Issue/Impact/Environmental Effect/Nature	The presence of substations (particularly the Kalplats substation) and the distribution power lines would change the landscape of the area from open spaces to 'spoilt' which could affect the way in which people related to the land and the sense of connectedness they have with the area, in short, their sense of place.
Extent	The impact on sense of place should be considered in the context of the study area as a whole, as the impact on sense of place per farm portion will depend on a number of variables, such as the visual impact, the biodiversity impact, the placement of the line in relation to dwellings, the activities on the land, the attachment of the landowner to the land, etc.
Probability	Apart from the southern quadrant, most of the study area is currently 'unspoiled' with vast open spaces; the negative impact on sense of place is highly probable.
Reversibility	The impact on sense of place can be reversed after decommissioning, provided that rehabilitation is done to a satisfactory level.
Irreplaceable loss of resources	It is not foreseen that an impact on sense of place would lead to any loss of resources.
Duration	The impact will be experienced during the lifetime of the project, but it can be expected that the lines will eventually become part of the landscape and absorbed as part of the cultural landscape.
Cumulative effect	The presence of such infrastructure can also set an unintended precedent for further land use change in future, which could further alter people's sense of place.
Intensity/magnitude	The impact on sense of place will be different for different people and will also depend on the way the land is utilised.
Significance Rating	Positive Low impact for the Woodhouse, Bophirima and Bophirima-Vryburg line as these are located within areas that share the same characteristics and close to groups that will experience the development and job opportunities as positive Negative Medium impact for the Kalplats substation and all other route corridors as these are all located in undisturbed areas that will scar the landscape and bear economic impacts on landowners.

As discussed in the body of the report, sense of place differs for different groups. This is reflected in the significant rating above and below. Apart from the Bophirima-Vryburg line, all route corridors traverse agricultural open land; therefore the impact on sense of place is expected to be the same along these corridors.										
	Bophirima Substation Alt 1	*Bophirima Substation Alt 2*	*Kalplats Substation Alt 1*	*Kalplats Substation Alt 2*	*Mookodi-Bophirima*	*Bophirima-Vryburg*	*Bophirima-Kalplats Alternative 1*	*Bophirima-Kalplats Alternative 2*	*Kalplats-Edwards dam Alternative 1*	*Kalplats-Edwards dam Alternative 3*
PRE-MITIGATION										
Extent	1	1	2	2	2	1	2	2	2	2
Probability	1	1	3	3	3	1	3	3	3	3
Reversibility	1	1	3	3	3	1	3	3	3	3
Irreplaceable loss	1	1	2	2	2	1	2	2	2	2
Duration	3	3	3	3	3	3	3	3	3	3
Cumulative effect	1	1	4	4	4	1	4	4	4	4
Intensity / magnitude	1	1	2	2	2	1	2	2	2	2
Significance rating	**+8**	**+8**	**-38**	**-38**	**-38**	**+8**	**-38**	**-38**	**-38**	**-38**
Mitigation measures	• Implement mitigation measures detailed in the Visual Impact Assessment • The impact on livelihoods should be monitored and evaluated before and after the construction of the line. • As far as possible, the distribution power line should follow existing infrastructure, such as roads and existing transmission power lines as this type of environment is already regarded as “stained.” • A pre- and post-valuation should be conducted for properties during the negotiation process.									
POST-MITIGATION										
Extent	1	1	2	2	2	1	2	2	2	2
Probability	1	1	2	2	2	1	2	2	2	2
Reversibility	1	1	2	2	2	1	2	2	2	2
Irreplaceable loss	1	1	2	2	2	1	2	2	2	2
Duration	2	2	2	2	2	2	2	2	2	2

Cumulative effect	1	1	1	1	1	1	1	1	1	1
Intensity / magnitude	1	1	2	2	2	1	2	2	2	2
Significance rating	**+7**	**+7**	**-22**	**-22**	**-22**	**+7**	**-22**	**-22**	**-22**	**-22**

11 SAFETY MEASURES FOR POWER LINE STRUCTURES AND SUBSTATIONS

A concern was raised during the scoping phase regarding high voltage power lines falling over as this has been experienced with the old wooden lines which are present in the study area. This resulted in loss of cattle and could lead to loss of life with the exposure of live wires.

Eskom have confirmed that the risk of high voltage power lines falling over is extremely low as they are well secured metal structures and are not affected by fire. They are larger than the current lines found within the study area and their modern design means that they are very unlikely to collapse.

The substations will pose a health and safety risk to the public if the following measures are not put in place. These include:

- Fully fenced perimeter
- Fire hydrants and extinguishers in prominent places
- Emergency evacuation plan placed in prominent places
- Regular maintenance of transformers and associated equipment
- Bunds must be regularly mainlined to ensure they are sealed and can accommodate any transformer oil spills
- The oil holding dam must be regularly maintained to ensure that it is sealed from both above and below.

Safety must be addressed during the construction phase, and measures such as the marking of any excavations and adherence to the Occupational Health and Safety Act, as detailed in the EMP must be implemented.

Electric and magnetic fields exist wherever electric current flows - in power lines and cables, residential wiring and electrical appliances. Electric fields arise from electric charges, are measured in volts per metre (V/m) and are shielded by common materials, such as wood and

metal. Magnetic fields arise from the motion of electric charges (World Health Organisation Information Sheet, 2007).

11.1 Power line electric fields

Further to the information provided in the Scoping Report, the following section highlights the current information available with regards to Electric and Magnetic Fields (EMF's). This information has been extracted from the Eskom information booklet about EMF's.

The electric fields caused by overhead power lines are generated by the voltage on the conductors of the line. The level of the electric field is dependent on the voltage of the line, the tower configuration and the height of the conductors above ground.

Figure **71** below illustrates a typical electric field profile measured at head height above the ground. Because the voltage of power lines is kept fairly constant, the electric field at ground level is fairly constant.

Figure 71: Extent of Electric field

Table 65 below indicates typical electric field values measured in the vicinity of overhead power lines. Electric fields drop rapidly to lower levels with an increase in distance from the line. These levels are still considerably lower than the maximum limit of 5kV/m which is suggested for continuous general public exposure by the International Radiation Protection Association (IRPA), which forms part of the World Health organisation.

Table 65: Typical electric field values

Voltage (kV)	Max E-Field (kV/m)	E-Field at Servitude Boundary(kV/m)	Servitude Width (m)
765	7,0	2,5	40,0
400	4,7	1,5	23,5
275	3,0	0,5	23,5
132	1,3	0,5	15,5
88	0,8	0,3	15,5

11.2 Power line magnetic fields

The magnetic fields caused by overhead power lines are generated by the current flowing on the conductors of the line. The level of the magnetic field is dependent on the current flowing on the line, the tower configuration and the height of the conductors above ground.

Figure **72** below illustrates a typical magnetic field profile measured at head height above the ground.

Figure 72: Extent of Magnetic field

Magnetic fields fall rapidly to lower levels with an increase in distance from the line. Table 66 below indicates typical magnetic field values measured in the vicinity of overhead power lines. The suggested IRPA limit for continuous general public exposure is 100μT.

Table 66: Typical magnetic field values

Voltage (kV)	**Current (A)**	**Max M-Field (μT)**	**M-Field at Servitude Boundary (μT)**	**Servitude Width (m)**
765	560	6,0	1,5	40,0
400	650	10,5	2,5	23,5

275	350	6,0	1,0	23,5
132	150	4,0	1,0	15,5
88	60	1,3	0,2	15,5

Because the magnetic field is dependent on the line current, the magnetic field will vary as the demand for power (current on the line) varies.

11.3 Fields outside substations

Measurements have indicated the magnetic field levels outside the outer perimeter of various substations to be less than 1μT. The field levels close to power lines entering or leaving the substation will be dominated by the power line magnetic fields as indicated in Table 66 above.

11.4 Potential effects of electric and magnetic fields

According to the World Health Organisation, several health conditions have been investigated for possible association with electric and magnetic field exposure. These include:

- Childhood leukaemia
- Other childhood cancers,
- Cancers in adults,
- Depression,
- Suicide,
- Cardiovascular disorders,
- Reproductive dysfunction,
- Developmental disorders,
- Immunological modifications,
- Neurobehavioural effects and
- Neurodegenerative disease.

The WHO Task Group concluded that scientific evidence supporting an association between electric and magnetic field exposure and all of these health effects is relatively weak. Evidence for an association with the occurrence of childhood leukaemia is greater than other diseases however still weak. In some instances (i.e. for cardiovascular disease or breast cancer) the evidence suggests that these fields do not cause them.

12 LANDOWNER NEGOTIATION PROCESS

A question that is often raised by Interested and Affected Parties relates to the process that is followed with regards to servitude negotiation and compensation with landowners. The process has been covered at length in the Social Specialist Study (Appendix 3H), however due to this issue being a major comment that has been received this section has been included to simplify the process for I&AP's.

All **landowners** that are **directly** affected by the proposed project will enter into negotiations with the Eskom Lands and Rights Division. Figure 73 below highlights the process that would be followed in this regard.

Once the landowners have been identified, an EIA (the process currently being followed) must be completed during which further consultation takes place. Route refinements if required would take place during this stage. Upon completion of the EIA, and given that environmental authorisation is granted, the affected properties undergo a valuation process to determine the compensation amount for each section of the servitude along the route.

Once the valuation process has been completed, the servitude is then included in the title deeds for each property and registered at the deeds office. Upon registration, the agreed upon compensation is paid to the relevant land owners. It is important to note that **only** the **property owner** receives compensation and not tenants occupying land. This then concludes the negotiation process.

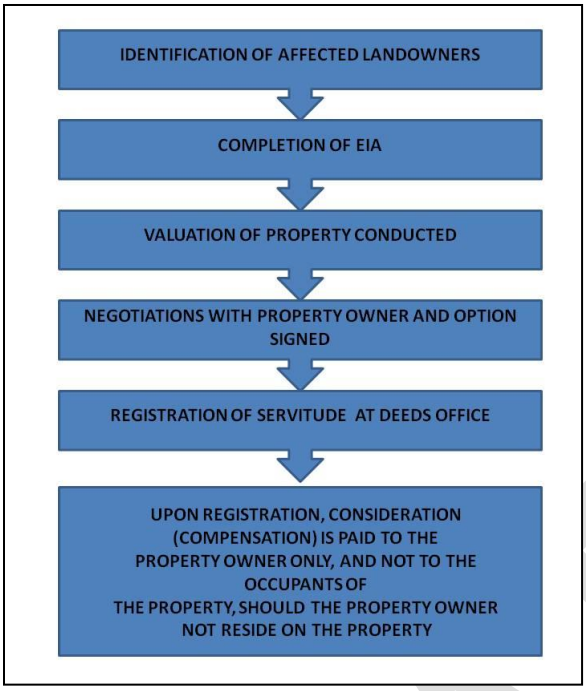


Figure 73: Negotiation procedure

13 LOCATION OF SITE OFFICE, STORAGE CAMPS AND STAFF ACCOMMODATION

A property within the local community of Vryburg and Stella is likely to be rented for the duration of the construction phase for the storage of equipment and materials as well as the site office. The area adjacent to the substation sites included in the 300m corridor which has been assessed could also be utilised for this purpose. Mitigation measures to manage the construction camps have been included in the EMP.

Staff will be transported to and from the site and will be encouraged to make use of local accommodation. No establishment of informal housing must be tolerated in this regard.

14 EMPLOYMENT OPPORTUNITIES

Limited permanent employment opportunities will exist as a result of the proposed project. The social report details the amount of jobs that will be generated. The contractor who is appointed to carry out the construction process will be obliged in terms of the Eskom's procurement policies which encourage the use of local unskilled labour.

Further social upliftment, as alluded to in the scoping phase of this project, is carried by Eskom's Social and Economic Development Department and the requests received have been forwarded to this department for further assessment. These relate to provision of schools, hospitals, jobs and work experience etc which require detailed investigation by this department.

It is not within the ambit of an Environmental Impact Assessment and Engineering Contract to provide these services. The requests made are approached holistically and involve more than one project in a geographical area.

15 DESCRIPTION AND COMPARATIVE ASSESSMENT OF ALL ALTERNATIVES IDENTIFIED

Two alternative power line routes are proposed for the project. Each route falls within a 300m corridor in order to allow for minor flexibility during construction. In addition to the two alternative power line routes, two substation alternatives are proposed for the project.

Table 67 to Table 70 below highlights the issues associated with each alternative and if concerns are related to these. Additionally, it is identified whether fatal flaws were identified from each specialist perspective.

Table 67: Bophirima Substation to Kalplats Substation Corridor Alternatives Assessment

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments and Concerns	Fatal Flaws (Yes/No)
Bophirima Substation to Kalplats Substation Corridor Alternative 1	Biodiversity	Preferred	A large amount of transformation has taken place however areas of natural vegetation are present. Suitable mitigation measures can be implemented to reduce impacts. Furthermore, a section of the route runs along an existing road and another section along an existing power line. **Alternative 1 is therefore preferred**.	No
	Avi-fauna	Not preferred	Shares the same routing as Alternative 1 for the majority of its length. North of Stella, this option runs more to the east. All potential negative avi-fauna impacts identified are of concern. Vulture electrocution is of particular concern. **Alternative 1 is therefore not preferred**.	No
	Surface Water	Not preferred	There are relatively few surface water crossings along the Bophirima Substation to Kaplats Substation power line route. Therefore, surface water is not a significant factor. However, Alternative 1 crosses three linear drainage features. In the context of this, **Alternative 1** crosses a greater number of surface water features and is **not preferred** as a result.	No
	Geotechnical	No preference	Removal of poor quality soil and replacement with engineered fill due to poor foundation conditions. Blasting of rock at surface to install foundations. **No preference** from a geotechnical perspective.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the alternative power line routes, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	No preference	None	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments and Concerns	Fatal Flaws (Yes/No)
	Visual	Not preferred	All receptor locations except one would be subject to a low degree of visual intrusion. Importantly, the Kudu Hills property is most closely located to Alternative 1. Although the visual intrusion of the lines at the lodge has been assessed to be low, the reserve's boundary is located close to the lines, and views of the lines from the edge of the property would be much more greatly affected by the proposed power lines (guided game drives are conducted on the property). The lodge (and owner's house) is situated on a ridge that enjoys wide-ranging views of a mix of natural rangeland and pastures to the north and the west. This is thus considered a critical view, and the presence of power lines within this view would be incongruous, even if they were located some distance away. This lends weight to the need to run the power line along Alternative 2, as the lines would then be located at a distance away from the lodge and the wider property that would make them visually inconsequential. For this reason, **Alternative 1 is not preferred.**	No
	Social	No preference	Although there are a number of alternative route corridors proposed, these corridors all affect similar land uses and therefore it is not expected that any of the social impacts would be more severe on one corridor as opposed to another corridor. In light of this, the social study has **no preference** in terms of a route corridor, but again stresses the fact that the alignment of the power line within the corridor must be done in consultation with the affected landowners to minimise the impact on the property and surrounding land use.	No

Bophirima Substation to Kalplats Substation Corridor Alternative 2	Biodiversity	Not preferred	Transformation observed but like alternative 1, areas of natural vegetation are present. In addition based on SANBI Biodiversity GIS, (2007), the route is aligned close to a slightly larger wetland compared to those available in other parts of the route. Suitable mitigation measures can be implemented to reduce impacts. This alternative also route runs along an existing road (R377) but then turns north eastwards traversing cultivated land and a few patches of relatively intact vegetation. **Alternative 2 is therefore not preferred**.	No
	Avi-fauna	Preferred	Shares the same routing as Alternative 1 for the majority of its length. North of Stella, this option runs more to the west. North of Stella, it is associated with existing telephone lines and roads for much of its length. **Alternative 2 is therefore slightly preferred.** All potential negative avi-fauna impacts identified are of concern. Vulture electrocution is of particular concern.	No
	Surface Water	Preferred	There are relatively few surface water crossings along the Bophirima Substation to Kaplats Substation power line route. Therefore, surface water is not a significant factor. **Alternative 2 (West) is preferred** however since there is only one surface water crossing that may be required.	No
	Geotechnical	No preference	Removal of poor quality soil and replacement with engineered fill due to poor foundation conditions. Blasting of rock at surface to install foundations. **No preference** from a geotechnical perspective.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the alternative power line routes, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	No preference	None	No

	Visual		Two of the receptor locations that would be exposed to a high degree of visual impact would be completely unaffected if Alternative 2 of the Bophirima-Kalplats alignment were selected. Alternative 2 of the Bophirima-Kalplats alignment would only expose one receptor location to a moderate degree of visual intrusion, with the other receptor locations being exposed to a low level of visual intrusion, thus this alternative is unlikely to be associated with visual impacts. For this reason, **Alternative 2 is strongly preferred**.	
	Social	No preference	Although there are a number of alternative route corridors proposed, these corridors all affect similar land uses and therefore it is not expected that any of the social impacts would be more severe on one corridor as opposed to another corridor. In light of this, the social study has **no preference** in terms of a route corridor, but again stresses the fact that the alignment of the power line within the corridor must be done in consultation with the affected landowners to minimise the impact on the property and surrounding land use.	No

Table 68: Kalplats Substation to Existing Edwards Dam Substation Corridor Alternatives Assessment

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
Kalplats Substation to Existing Edwards Dam Substation Corridor Alternative 1	Biodiversity	Not preferred	This section of the corridor illustrates a large degree of transformation from the natural state. Portions of the route in this section follow existing power lines. Moreover majority of vegetated areas present sparse vegetation. These are relatively natural vegetation in character. **Alternative 1 is therefore not preferred**.	No
	Avi-fauna	Not preferred	This is the more northerly route option. Follows existing roads for much of its length. Area appears less disturbed, and better habitats available to birds (based on specialist opinion following the site visit). Follows an existing HV power	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
			line for approximately 15km. All potential negative avi-fauna impacts identified are of concern. Vulture electrocution is of particular concern. **Alternative 1 is therefore not preferred**.	
	Surface Water	Not preferred	Alternative 1 (North) has many more crossings than Alternative 3, as it traverses the catchment of the Mosita se Laagte drainage system. Most importantly however the much of the corridor between the farms Gemsbokpan and Klippan extends into a wetland system. The lines would run parallel to the wetland system. Thus if placed to the west of the district road (alongside which the lines run in this alternative), a number of towers could encroach into the wetland, thus impacting it. For this reason **Alternative 1 (North) is not preferred.**	No
	Geotechnical	No preference	Removal of poor quality soil and replacement with engineered fill due to poor foundation conditions. **No preference** from a geotechnical perspective.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the alternative power line routes, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	Preferred	None	No
	Visual	Preferred	Importantly the northern alternative (Alternative 1) would subject only one receptor location to a moderate degree of visual intrusion with the remainder of the sensitive receptor locations being exposed to a low level of visual intrusion, and no receptor locations being assessed to be likely to experience a high degree of visual intrusion.	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
			Along Alternative 1 many of the receptor locations are slightly set back from the road along which the lines are proposed to run, or if located closer to the lines, are very well screened by vegetation around the farmhouse itself or along the nearby drainage line. Alternative 1 would be responsible for a much lower degree of visual intrusion and thus visual impact, with only one receptor location being assessed to be subject to more than a low level of visual intrusion. Choosing this alternative would avoid the northern-most part of the study area which is highly visually sensitive, as attested to be a number of comments from landowners in this regard. For these reasons, **Alternative 1 is strongly preferred.**	
	Social	No preference	Although there are a number of alternative route corridors proposed, these corridors all affect similar land uses and therefore it is not expected that any of the social impacts would be more severe on one corridor as opposed to another corridor. In light of this, the social study has **no preference** in terms of a route corridor, but again stresses the fact that the alignment of the power line within the corridor must be done in consultation with the affected landowners to minimise the impact on the property and surrounding land use.	No

Kalplats Substation to Existing Edwards Dam Substation Corridor Alternative 3	Biodiversity	Preferred	A portion of this alternative crosses cultivated lands and a few uncultivated lands but exhibiting sparse vegetation. Furthermore, about 50% of alternative 3 runs along R377 and also crosses cultivated land and sparsely vegetated areas. **Alternative 3 is therefore preferred** since potential impacts are likely to be limited.	No
	Avi-fauna	Preferred	More southerly route option follows existing roads for much of its length Follows existing MV power lines, as well as Telkom lines for much of its length. **Alternative 3 is slightly preferred.** All potential negative avi-fauna impacts identified are of concern. Vulture electrocution is of particular concern.	No
	Surface Water	Preferred	Alternative 1 (North) has many more crossings than Alternative 3, as it traverses the catchment of the Mosita se Laagte drainage system. Most importantly however the much of the corridor between the farms Gemsbokpan and Klippan extends into a wetland system. The lines would run parallel to the wetland system. Thus if placed to the west of the district road (alongside which the lines run in this alternative), a number of towers could encroach into the wetland, thus impacting it. For this reason **Alternative 3 (South) is strongly preferred.**	No
	Geotechnical	No preference	Removal of poor quality soil and replacement with engineered fill due to poor foundation conditions. **No preference** from a geotechnical perspective.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the alternative power line routes, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	Not preferred	Small informal farm cemetery. Contains grave of Willem van Holk, a Dutch teacher, who was buried here in 1896. **Alternative 3 is therefore not preferred** from a heritage perspective.	No

	Visual	Not preferred	The Kalplats-Edwards dam line component would exert a high degree of visual intrusion on only one receptor (Helpmekaar). This receptor location is located in close proximity to Alternative 3. In addition, the R371 along which Alternative 3 would run forms part of the Kalahari Raptor Tourism Route. Although it is not a tourism route that is solely based on the aesthetic quality of the area, this does promote the appreciation of a part of the country that is known for its low human footprint. There is also the presence of hunting farms along this corridor. **Alternative 3 is therefore not preferred.**	No
	Social	No preference	Although there are a number of alternative route corridors proposed, these corridors all affect similar land uses and therefore it is not expected that any of the social impacts would be more severe on one corridor as opposed to another corridor. In light of this, the social study has **no preference** in terms of a route corridor, but again stresses the fact that the alignment of the power line within the corridor must be done in consultation with the affected landowners to minimise the impact on the property and surrounding land use.	No

Table 69: Bophirima Substation Alternatives Assessment

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
Bophirima Substation Alternative 1	Biodiversity	No preference	None.	No
	Avi-fauna	No Preference	GIS examination of Land Cover (CSIR) shows this site to fall within “Thicket & Bushland (etc)”. On the outskirts of Vryburg, close to R34 tar road. Is located immediately adjacent to the Woodhouse Substation. **Either Alternative is acceptable** from an avifaunal perspective.	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
			Main concerns relate to electrocution in substation yard.	
	Surface Water	No preference	The two Bophirima Substation alternatives are located in very close proximity to one another. Neither is located close to any surface water feature, thus there is **no preference** between these two alternatives.	No
	Geotechnical	Not preferred	More costly foundation solution required. **Not preferred**.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the substation positions, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	No preference	None	No
	Visual	No preference	The two Bophirima Substations are located in very close proximity to each other, and thus there will be very little difference in terms of the respective visual impact associated with each alternative. There is this **no preference** from a visual perspective.	No
	Social	No preference	The social study has no preferred alternative for either the Bophirima site or the Kalplats site as the respective alternatives of these two substation sites are located in close proximity to each other, resulting in no change in the severity of impacts between alternatives.	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
Bophirima Substation Alternative 2	Biodiversity	No preference	None.	No
	Avi-fauna	No Preference	GIS examination of Land Cover (CSIR) shows this site to fall within "Thicket & Bushland (etc)". On the outskirts of Vryburg, close to R34 tar road. Is located immediately adjacent to the Woodhouse Substation. **Either Alternative is acceptable** from an avifaunal perspective. Main concerns relate to electrocution in substation yard.	No
	Surface Water	No preference	The two Bophirima Substation alternatives are located in very close proximity to one another. Neither is located close to any surface water feature, thus there is **no preference** between these two alternatives.	No
	Geotechnical	Preferred	Removal of vegetation and topsoil, which can however be re-used on the project. **Preferred**.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the substation positions, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	No preference	None	No
	Visual	No preference	The two Bophirima Substations are located in very close proximity to each other, and thus there will be very little difference in terms of the respective visual impact associated with each alternative. There is this **no preference** from a visual perspective.	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
	Social	No preference	The social study has no preferred alternative for either the Bophirima site or the Kalplats site as the respective alternatives of these two substation sites are located in close proximity to each other, resulting in no change in the severity of impacts between alternatives.	No

Table 70: Kalplats Substation Alternatives Assessment

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
Kalplats Substation Alternative 1	Biodiversity	No preference	None.	No
	Avi-fauna	No Preference	GIS examination of Land Cover (CSIR) shows this site to fall within "Cultivated: temporary-commercial dryland". It is situated in agricultural land on the farm Gemsbokpan, to the west of the Môrester farmstead, on the northern side of a district road. **Either Alternative is acceptable from an avifaunal perspective.** Main concerns relate to electrocution in substation yard.	No
	Surface Water	No preference	A similar situation exists with respect to the Kalplats Substation alternatives where neither proposed locations is in close proximity to any surface water feature. Again, there is **no preference** from a surface water perspective as either alternative can be selected.	No
	Geotechnical	Preferred	Removal of vegetation, topsoil and subsoil together with the importation of engineered fill from a commercial source. **Preferred**.	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the substation positions, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	No preference	None	No
	Visual	Preferred	Of concern from a visual perspective is the relative proximity to the Morestêr Farmstead which has been identified to be a sensitive receptor. As Alternative 1 is located at a slightly further distance away, **Alternative 1 is slightly preferred** from a visual perspective, although there is little material difference between the two alternatives due to their close proximity.	No
	Social	No preference	The social study has no preferred alternative for either the Bophirima site or the Kalplats site as the respective alternatives of these two substation sites are located in close proximity to each other, resulting in no change in the severity of impacts between alternatives.	No
Kalplats Substation Alternative 2	Biodiversity	No preference	None.	No
	Avi-fauna	No Preference	500m south of district Road, also just west of Môrester farmstead. Although GIS mapping shows the Land Cover (CSIR) of this site to be "Unimproved grassland", the site visit and Google earth examination found it to be extremely similar to Alternative 1. **Either Alternative is acceptable from an avifaunal perspective.** Major concerns relate to electrocution in substation yard.	No

Alternative	Specialist	Preferred/Not preferred/ No Preference	Specialist Comments	Fatal Flaws (Yes/No)
	Surface Water	No preference	A similar situation exists with respect to the Kalplats Substation alternatives where neither proposed locations is in close proximity to any surface water feature. Again, there is **no preference** from a surface water perspective as either alternative can be selected.	No
	Geotechnical	Not preferred	More costly foundation solution. **Not preferred**.	No
	Geohydrology	No preference	In view of the low significance rating of all impacts identified, **no preference** is given to any of the substation positions, and as such no concerns from a groundwater perspective have been identified.	No
	Heritage	No preference	None	No
	Visual	Not preferred	Of concern from a visual perspective is the relative proximity to the Morestêr Farmstead which has been identified to be a sensitive receptor. Alternative 2 is located slightly closer to the farmstead (200m versus 650m – Alternative 1) and is therefore **not preferred**.	No
	Social	No preference	The social study has no preferred alternative for either the Bophirima site or the Kalplats site as the respective alternatives of these two substation sites are located in close proximity to each other, resulting in no change in the severity of impacts between alternatives.	No

As is demonstrated above, no fatal flaws are present along any of the routes that have been identified. However, preference between the alternative corridor routes from different specialists have been proposed. In terms of the Bophirima Substation to Kalplats Substation Alternative 1, preference from a biodiversity perspective was proposed. However, the Bophirima Substation to Kalplats Alternative 2 was preferred from a number of specialists including avi-fauna, surface water, and visual perspectives due to several reasons (Table 67). All other specialist had no preference for this route. **Due to overriding factors, Bophirima Substation to Kalplats Substation Alternative 2 is the preferred corridor route for this section of the proposed development.**

With regards to the Kalplats Substation to Edwards Dam Substation alternative, preferences were proposed from a heritage and visual specialist opinion in favour of Kalplats Substation to Edwards Dam Substation Alternative 1. However, Kalplats Substation to Edwards Dam Substation Alternative 3 was preferred from a biophysical perspective on account of avi-fauna, surface water and biodiversity specialist perspectives due to a number of reasons (see Table 68). All other specialists had no preference on the proposed corridors for this section of the proposed development. Therefore, **due to overriding biophysical factors, Kalplats Substation to Edwards Dam Substation Alternative 3 is the preferred corridor route for this section of the proposed development.**

Finally, most specialists had no preference with respect to the location of the proposed substations at Kalplats and Bophirima. For the Bophirima Substation alternatives, **preference was proposed from a geotechnical perspective (**Table **69) in terms of Bophirima Substation Alternative 2 and as such, is the preferred substation location at Bophirima**. For the Kalplats Substation alternative locations, again most specialists had no preference. However, **visual and geotechnical specialist recommendations (Table 70) preferred Kalplats Substation Alternative 1 and as such has been selected as the preferred substation location at Kalplats**.

The “no-go” alternative assumes that the proposed activity does not go-ahead, implying a continuation of the current situation or the status quo. The “no-go” or “no-action” alternative is regarded as a type of alternative that provides the means to compare the impacts of project alternatives with the scenario of a project not going ahead. In evaluating the “no-go” alternative it is important to take into account the implications of foregoing the benefits of the proposed project.

In the case of this project, the no-go alternative would result in no distribution lines and substations being constructed. The lack of lines and substation would mean no power for the proposed developments and would hinder further development in the study area. Although the preference rating for the no-go alternative is high, it must be interpreted in terms of the current status quo in the study area. The impacts identified such as visual impacts would not occur if the project did not go ahead, however the study area is heavily transformed as a result of agriculture

and intense overgrazing which must be taken into consideration. The socio economic benefit of the proposed project is thus the determining factor in eliminating the no go factor.

16 EVALUATION AND RECOMMENDATIONS

16.1 Summary of findings

Table 71 indicates the major findings of the EIA and states the major recommendations that have been made by the specialists.

Table 71: Summary and Recommendations

Environmental Parameter	Summary of major findings	Recommendations
Biodiversity (flora and fauna)	▪ Several sensitivities relating to both the faunal and floral environment have been identified within the corridors. ▪ The proposed project could result in detrimental effects on these environments as discussed. However, power lines do not result in large scale clearing and suitable mitigation measures can be implemented to reduce the identified impacts.	▪ A biodiversity walk-down is to be conducted to ensure that tower locations are strategically positioned and access to these locations is appropriately planned. ▪ It is essential that biodiversity specialists are on the project team during construction to ensure that the issues identified in this report are prioritised.
Avi-fauna	▪ The large study area was found to be moderately sensitive for avifauna. ▪ Electrocution of birds such as African White-backed Vulture is of particular concern in the north, while collision of heavy flying birds such as Flamingos is possible throughout the site.	▪ Line marking is required to mitigate for collision impacts. ▪ An avifaunal walk through is recommended in order to identify the spans of line for marking to mitigate for bird

Environmental Parameter	Summary of major findings	Recommendations
	▪ Collisions are expected to be the largest impact of this project. ▪ Provided that the high risk sections of line are mitigated in the form of marking, the impact should be contained and an acceptable level of mitigation for this project can be reached using available devices such as bird-friendly steel lattice structures.	collisions.
Surface Water	▪ The predominant surface water features in the study area are small pans, with much of the area being characterised by endorheic drainage. A number of morphologically poorly-defined valley bottom wetland systems also occur in the study area, particularly in the northern parts. ▪ A typical feature of the vast majority of surface features in the study area is the presence of a riparian zone that is distinct from the surrounding non-wetland shrubveld vegetation in terms of its structure and species composition. These riparian zones are ecologically very important, and play an important role in terms of the morphological state of the watercourse.	▪ Alternative 3 of the Kalplats-Edwardsdam line component and Alternative 2 of the Bophirima-Kalplats alternative section are preferred, and should ideally be selected for development. ▪ Should Alternative 1 of the Kalplats-Edwardsdam line component be selected for development, it is very important that the lines completely avoid the Mosita se Laagte wetland system and that they are aligned to the east of the district road.
Geotechnical	▪ Foundation conditions considered not a suitable founding medium at Bophirima Substation Alternative 1 and will require a more costly foundation solution. ▪ Foundation conditions considered not a suitable founding medium at Kalplats Substation Alternative 2	▪ Bophirima Substation Alternative 2 is preferred from a geotechnical perspective. ▪ Kalplats Substation Alternative 1 is preferred from a geotechnical perspective.

Environmental Parameter	Summary of major findings	Recommendations
	and will require a more costly foundation solution. ▪ Impacts from a geotechnical perspective focus on removal of vegetation, topsoil and subsoils which can be acceptably mitigated.	
Geohydrology	▪ Except for a short section in the northern part of the proposed new transmission line, the area traversed by the line is underlain by geologically old hard rock terrain comprising of diamictite, dolomite, chert, quartzites, lava, and granite-gneiss. Over the northern section the area is covered by recently deposited aeolian (wind-blown) sand. ▪ With the exception of the small area around Vryburg where dolomitic rocks are present, the groundwater yield from boreholes is in general low and the different rock types are not regarded to host high yielding aquifers. ▪ .All the identified potential impacts were rated as having a Negative Low impact score (8 - 20) and therefore, these are considered to have negligible negative effects that will require little to no mitigation.	▪ Due to the low significance rating of all impacts identified, no preference is given to any of the alternative power line routes and substation positions, and therefore no concerns and/or fatal flaws from a groundwater perspective have been identified.
Heritage	▪ The following categories of heritage sites were identified as occurring in the study area: - Farming and farming related activities, such as farmsteads, stock pens, windmills, etc.	▪ As it is unlikely that the power line would have any other than a visual impact on the site, it is recommended that the site is retained in its current location.

Environmental Parameter	Summary of major findings	Recommendations
	- Local and private cemeteries. - Roadside memorials. ▪ Only one site, a small informal cemetery located on the farm Help Makaar 248, is located in what is perceived to be the corridor. ▪ Despite the occurrence of the cemetery, from a cultural heritage point of view, there are no sites, features or objects known to exist in the corridor or its alternatives that would prevent the proposed development from taking place.	▪ The site should be avoided at all times. During construction it should be clearly demarcated, e.g. by using danger tape. ▪ If retained, no permits are necessary.
Visual	▪ Due to the size of the study area, a relatively large number of sensitive visual receptors that could potentially be affected by the proposed power lines have been identified. Large parts of the study area are rural in visual character with a natural component to the landscape. The northern-most parts of the area are much more natural in character and are valued for their aesthetic quality. ▪ The result of the study shows relatively few sensitive receptor locations would be subject to a high degree of visual intrusion, with the majority of locations only subject to a low degree of visual intrusion. ▪ The potential visual impact on the lines would be reduced if preferred alternative alignments from a visual perspective for the lines were chosen.	▪ Choosing the visually preferred alignments would avoid the visually most-sensitive parts of the route and would significantly reduce the visual impact potential of the lines.

Environmental Parameter	Summary of major findings	Recommendations
Social	The findings of the SIA can be summarised as follows: Pre-Construction Phase ▪ The main issue during the pre-construction phase is that of the relocation of households and other structures. A number of households and structures have been identified that are either within or in very close proximity to the route corridors as they currently stand, which would place these households and structures at 'risk' for relocation. However, given the fact that an alignment still has to be found within the 300m wide corridor, relocation can be avoided as per Eskom's policy and that of the IFC. Construction Phase ▪ Geographical processes: A temporary loss of land will occur within the servitude and construction laydown areas, restricting the landowner access to these and leading to possible loss of crops within the 31m strip. The same would hold true for the substation sites, but in this regard the land loss is expected to be of a more permanent nature and would therefore be more applicable to the operations and maintenance phase. ▪ Demographical processes: The largest group faction of the construction team that will move into the area is estimated at around	▪ The recommendation with regards to relocation of households and other structures is that cognisance is taken of the sensitive and flagged areas marked in this report and to use this as a guideline in planning a final route alignment. ▪ The alignment of the power line within the corridor must be done in consultation with the affected landowners to minimise the impact on the property and surrounding land use. ▪ Overall the SIA did not identify any areas that can be classified as fatal flaws.

Environmental Parameter	Summary of major findings	Recommendations
	470 people during the peak of construction, which will not have a significant bearing on the size of the population of the local municipal area as a whole. However, it is expected that the presence of construction workers in areas such as Huhudi and Thakwaneng (where construction workers are likely to spend their free time) can lead to an increase in conflict situations, a rise in the HIV/AIDS rate, an increase in opportunistic crime, etc. Their presence also signals the presence of a project taking place in the area leading locals to believe that jobs might be available, which in turn might lead to the further conflict situations and the in-migration of jobseekers from elsewhere, which could intensify conflict points. The presence of unemployed jobseekers can lead to the expansion of the informal settlements at Huhudi, which would increase the housing backlog and place additional strain on the local municipality (cumulative effect). ▪ Economic Processes: Due to the skilled nature of constructing a distribution power line and a substation, it is unlikely that large numbers of local job opportunities will be created. Some informal opportunities might be created. ▪ Institutional and Legal Processes: The contractor will supply	

Environmental Parameter	Summary of major findings	Recommendations
	accommodation, normally in the form of a construction camp. Although the construction camp in itself does not pose a social impact, it can lead to a number of social ills, which in turn can then lead to social impacts. ▪ Socio-cultural processes: During the construction phase changes would mostly relate to possible conflict situations between local residents and newcomers to the area, most notably where there is a marked dissimilarity in social practices. In addition the presence of migrant workers in the form of a male-dominated construction team can fuel a 'macho-culture' with strong peer pressure, which often causes these individuals to engage in risky (sexual) behaviour. Operations and Maintenance Phase ▪ Geographical processes: During the operations and maintenance phase there will be a degree of long term loss of cultivated and grazing land, but this loss of land will mostly be centred on the distribution line towers. ▪ Economic processes: During the operations and maintenance phase some property owners might experience a negative impact on their property value. However, it is also expected that the proposed substations and the associated distribution power lines will enhance the electricity supply,	

Environmental Parameter	Summary of major findings	Recommendations
	which in turn will indirectly stimulate economic growth as the supply can meet the demand, allowing businesses and industries to expand. ▪ Socio-cultural processes: The issue of the physical presence of the line and how it affects people's sense of place can be expected to various degrees of subjectivity and different social groups.	

16.2 Conclusion

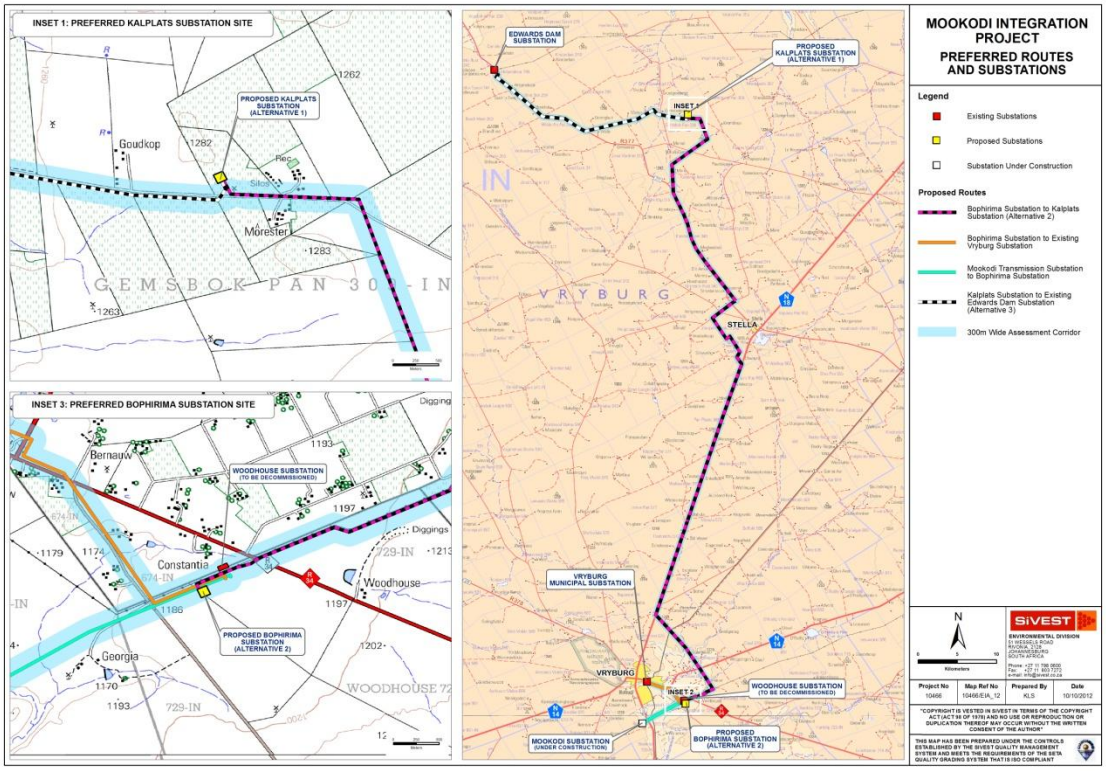
From the studies that have been conducted, it is clear that the proposed project could result in several negative environmental impacts. However, these impacts have been clearly identified and suitable mitigation measures are available to ensure these are reduced to acceptable levels.

The positive socio-economic impacts and the need and desirability for the project highlight the importance of the project. The study area has been severely transformed from a biophysical perspective and the proposed project will result in the loss of very little to no natural vegetation. Constant monitoring by Eskom of the power line servitude will most likely result in an improvement of the current conditions.

An important social aspect which needs to be incorporated into the Environmental Management Plan would be the social investment action plan. Eskom needs to highlight how they are going to engage the community during construction and how they are going to contribute to the social upliftment of the area.

Although the study area is very uniform with very few major issues and concerns, a decision has to be made on a preferable route and substation site. The Bophirima Substation to Kalplats Substation Alternative 2 is the most preferable corridor route based on biophysical factors. The Kalplats Substation to Edwards Dam Substation Alternative 3 has also been determined to be the favourable corridor route due to biophysical factors. Finally, Kalplats Substation Alternative 1 is preferred mainly due to visual and geotechnical reasons whilst Bophirima Substation Alternative 2 is preferred on account of geotechnical constraints.

It is important to note that a 300m buffer will be approved for construction should the project be approved by DEA. This will allow Eskom to manoeuvre around obstacles such as houses and graveyards that may be encountered. The final servitude will however only be 31m in width once the project is complete. This corridor has been established to avoid relocation of homesteads and further reduce the impacts that have been identified above.



Map 1: Preferred Route

These specialist studies were conducted to address the identified impacts and an impact assessment conducted to ascertain the level of impact and mitigation measure which may be required. The potential positive and negative impacts associated within these studies have been evaluated and rated accordingly. The results of the specialist studies have indicated that no fatal flaws exist as a result of the proposed substations and associated lines. It is therefore recommended that the proposed project be allowed to proceed provided that the recommended mitigation measures are implemented and provided the following conditions are adhered to:

- Social issues raised in this report are attended to;
- Landowners are constantly kept informed about the project;
- Loss of agricultural land is kept to the minimum;
- Relocation is implemented as a last resort;

- Engineering geotechnical assessment be undertaken;
- Regular maintenance of the servitude to reduce emergence of alien species and further degradation of the environment;
- An avifaunal and heritage walk down are conducted prior to the start of construction;
- Ensure that no boreholes are present within the final 31m servitude. ECO to conduct walk down;
- Sensitive wetlands and degraded drainage lines are spanned by the power lines;
- Mitigation measures for the avoidance of groundwater contamination at substation sites are strictly implemented;
- Social investment action plan to be included in the EMP prior to construction starting;
- Final EMP needs to be approved by DEA prior to construction.

It is further recommended that the comprehensive Environmental Management Plan (EMP) be implemented which includes the unique mitigation measures identified by the specialist studies. This will ensure that the substations and associated lines are constructed in an environmentally sustainable manner and according to best environmental practice. This EMP is included with this Report as an Appendix (Appendix 6).

17 REFERENCES

1. Acocks, J.P.H. (1988) Veld types of South Africa. Memoirs of the botanical survey of South Africa No. 57. Botanical Research Institute, South Africa.

2. Ansara, T. M. (2004) Determining the ecological status and possible anthropogenic impacts on the grass owl (*Tyto capensis*) populations in the East Rand Highveld, Gauteng. MSc. Dissertation, Rand Afrikaans University, Johannesburg

3. Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington D.C.

4. Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

5. Barnes, K.N. (ED.) 1998. The Important Bird Areas of Southern Africa. Birdlife South Africa, Johannesburg.

6. Barnes, K.N. (ED.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa: Johannesburg.

7. Bromilow, C. (2001) Problem plants of South Africa. Briza Publications, Pretoria.

8. Carruthers, V. (2001**)** Frogs and frogging in southern Africa. Struik Publishers, Cape Town.

9. Coetzee, K. (2005) Caring for natural rangelands**.** University of Kwazulu-Natal Press, South Africa

10. CSIR, Landcover data, CSIR Pretoria.

11. Du P. Bothma, J. (Editor) (2002**)** Game ranch management - 4th ed**.** Van Schaik Publishers, Pretoria.
12. Department of Water Affairs and Forestry. (1996). South African Water Quality Guidelines (second edition). Volume 7: Aquatic Ecosystems. DWAF, Pretoria.
13. Department of Water Affairs and Forestry. (2005) A practical field procedure for identification and delineation of wetlands and riparian areas (edition 1). DWAF, Pretoria.

14. Gerber, A., Cilliers, C.J., van Ginkel, C. and Glen, R. (2004) Easy identification of aquatic plants – a guide for the identification of water plants in and around South African impoundments. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.
15. Harrison J. A., Burger M., Minter L. R., De Villiers A.L., Baard E. H. W., Scott E., Bishop & Ellis S. (2001). Conservation assessment and management plan for southern African frogs. Final Report. IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, MN.
16. Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V and Brown, C.J. (EDS). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa: Johannesburg
17. Henderson, L. (2001) Alien weeds and invasive plants – A complete guide to declared weeds and invaders in South Africa. Plant Protection Research Institute, Agricultural Research Council Handbook No 12. Pretoria
18. Low, AB & Rebelo, AG. (Eds) 1996. Vegetation of South Africa, Lesotho and Swaziland. Dept Environment Affairs & Tourism: Pretoria.
19. Mucina, L; Rutherford, C. 2006. The Vegetation of South Africa, Lesotho and Swaziland, South African National Biodiversity Institute, Pretoria.
20. SANBI (2006) Vegetation map of South Africa, Lesotho and Swaziland. Mucina, L. and Rutherford, M.C. (Editors). Strelitzia 19, South African National Biodiversity Institute, Kirstenbosch Research Centre, Claremont, South Africa
21. Soil Classification Working Group (1991) Soil classification – a taxonomic system for South Africa. Memoirs of the Agricultural Natural Resources of South Africa No. 15, The soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.
22. Tainton, N. (Editor) (1999) Veld management in South Africa. University of Natal Press, Pietermaritzburg.
23. South African Weather Bureau www.saweather.co.za
24. Vanclay, F. 2002. Conceptualising Social Impacts. Environmental Impact Assessment Review 22 (2002: pp. 183– 211)

25. Van Rooyen, C.S. and Ledger, J.A. 1999. “Birds and utility structures: Developments in southern Africa” in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Power lines. Quercus: Madrid, Spain, pp 205-230

26. Van Rooyen, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

27. Van Rooyen, C.S. and Taylor, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina)

28. Van Wyk, B. and Malan, S. (1998) Field guide to the wild flowers of the Highveld. Struik Publishers, Cape Town.

29. Venter, F.J., Scholes, R.J., and Eckhardt, H.C., 2003, The Abiotic Template and Its Associated Vegetation Pattern, in The Kruger Experience – Ecology and Management of Savanna Heterogeneity, Island Press, Washington, USA

30. Council for Geoscience (1990). Geological Map Sheet 2724 Vryburg , Scale 1:250 000. Council for Geoscience, Pretoria.

31. Department of Water Affairs and Forestry (2000). Hydrogeological map sheet 2522 Vryburg. Dept. of Water Affairs and Forestry, Pretoria.

32. Department of Water and Environmental Affairs (2010). National Groundwater Database (NGDB). Information retrieved for the area between Delareyville and Madibogo. Dept. of Water and Environment Affairs, Pretoria.

33. Standards South Africa (2006). South African National Drinking Water Standard SANS 241:2006 Edition 6.1. Standards South Africa, Pretoria.

34. Vegter, J R (2000). Ground water development in South Africa and an introduction to the hydrogeology of groundwater regions. Water Research Commission Technical Report TT 134/00, Pretoria.

35. Van der Westhuizen, W A, De Bruiyn, H and Meintjes, P G (2006). The Ventersdorp Supergroup. *In*: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (Eds.). *The Geology of South Africa.* Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 187-208.

SiVEST Environmental Division
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Rebecca Thomas
Cell No.: + 0823029010
Email: rebeccat@sivest.co.za