AMENDMENT OF DRAFT ENVIRONMENTAL IMPACT REPORT

The Proposed Perseus-Kronos 765kV Transmission Power Line and Substations Upgrade (Part of Cape Corridor Strengthening Phase 5) Northern Cape and Free State Provinces

(NEAS Ref: DEA/EIA/0001555/2012)
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Submitted to:
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EXECUTIVE SUMMARY

Eskom Holdings SOC Limited (hereafter referred as Eskom) intends establishing a new 765kV transmission power line from the existing Perseus Substation near Dealesville, Free State to Kronos Substation near Copperton, Northern Cape. This is part of the Cape Corridor Strengthening Phase 5 Network.

At this stage, the project is not in the following 10 years of construction plan. The reason being, other processes are required to be achieved prior to the construction phase. The project has to be in compliance with the EIA process, which may take approximately up to three years, depending on the concerns to be addressed and new developments that may arise. Furthermore, there could be appeals lodged, which will require to be addressed prior to entering the land acquisition / negotiation process. Subsequently, Eskom would conduct the land acquisition / negotiation process, which can take up to approximately 5 years to complete before construction phase.

The proposed 765kV transmission power line would be associated with upgrades at the substations, which would entail the capacity upgrades and footprint expansions to accommodate the power line. The total length of the transmission power line from Perseus to Kronos Substation would be approximately 388km. Further, a servitude width of 80m would be required to accommodate the installation of towers upon which the transmission power line would be strung and for maintenance purposes. Eskom would need to negotiate for legal right of the servitude with individual landowners along the authorised corridor route.

The main purpose for this proposed power line is to improve the transmission network supply in the country by linking the Western Cape and Gauteng Provinces. This is due to the increasing energy demand from various land use activities such as farming, mining industries as well as domestic uses in the country, particularly in Johannesburg. Furthermore, the proposed power line will serve to evacuate all the local renewable energy power generated particularly in the Northern Cape to the rest of the country.

The aim of the proposed transmission power line and substation upgrades is to ensure that adequate and reliable electricity supply in the country is achieved. The advantages of the proposed transmission power line would include: avoiding current and future possible voltage collapse; contributing towards a more flexible electrical network; improvement in the overall reliability of the electrical systems, which would benefit electricity users; and to sustain economic growth across the country.

The construction of the 765kV transmission power line including associated structures is an activity identified in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), in respect of the Environmental Impact Assessment (EIA) Regulations of 2010, and may not commence without Environmental Authorisation (EA) from the National Department of Environmental Affairs (DEA).

Mokgope Consulting has been appointed by Eskom to conduct an EIA process for the proposed development. The EIA process comprises the Scoping phase and the EIR phase. The Scoping process formed part of the process of collecting, organising, analysing, interpreting and

communicating information that is relevant to the consideration of the application. The Scoping phase commenced in January 2013 and was approved by the Authorities in October 2013. In the EIR phase, the preferred alternative corridor was chosen on the basis of specialist recommendations. In addition to specialist recommendations, all comments and issues raised by interested and affected parties (I&APs) will be recorded and considered by the Environmental Assessment Practitioner (EAP) to finalise the EIR. The construction of the proposed 765kV transmission power line would take place after the DEA has granted EA and all appeals from I&APs have been dealt with successfully.

I&APs were identified, contacted and informed of the Scoping and EIR phase through electronic mailing system, and hard copies of registered letters were sent through the post. Furthermore, notices of the project and invitation to register on the I&AP Register were posted at various towns near Perseus and Kronos substations and in towns located within close proximity to the proposed alternative power line route corridors. Notices were also published in regional and local newspapers in English and Afrikaans. The draft EIR was also available at libraries in Boshof, Dealesville, Jacobsdal, Douglas, and Prieska.

Please note: Subsequent to the draft EIR, additional deviation corridors (Deviations: 1A, 1B, 1C and 1D) were introduced to the main preferred Corridor 1. The deviations were necessary to avoid the Mokala National Park future expansion areas, major game farms, irrigation center-pivots, salt pans, other ecological features and existing infrastructure.

Consequently various specialist assessments were conducted for the deviation corridors to consider sensitive areas that could be impacted along the corridors. Moreover, landowners affected by the deviation corridors would be provided with the opportunity to comment on this amended Draft EIR. All stakeholders and I&APs would be afforded up to 30 days (22 October to 20 November) to raise objections, issues and comments on the amended draft EIR and direct all their comments and issues to the EAP. This report may also be accessed on the Mokgope website (www.mokgope.co.za), and electronic copies of the EIR would be circulated to focal points within the study area as well as e-mailed to individuals upon request.

Specialist findings were assessed and summarised in this report. Potential environmental impacts associated with the proposed transmission power line are expected to occur during the construction and operational phases. Some of the identified potential impacts and recommended mitigation measures in the specialist studies include the following:

- **Vegetation and Fauna impacts** are due to the disturbance of habitats within the power line servitude and the tower footprints. Mitigation measures should take the form of preventing construction of towers in / on ecologically sensitive areas.

- **Avifauna impacts** are as a result of collisions of birds with power lines and habitat destruction during construction phase. To minimise this impact would require marking the earth wires of the proposed power line with a suitable anti-collision marking device according to Eskom Transmission guidelines, and sourcing nocturnal markers of the cables and 500m exclusion around pans.

- **Wetland impacts** are as a result of changing the sediment amount entering water resources and the disposal of human sewage during the construction phase of the

development. Recommended mitigation measures should take the form of maintaining no disturbance buffer zones (50m from the watercourses) to trap sediments with associated toxins. During construction phase, provision of adequate sanitation facilities should be located outside its associated buffer zone.

- **Agricultural impacts** are caused by the transmission power line constructed on agricultural potential land / arable cultivation land and overhead irrigation systems, where high value crops and valuable infrastructure will be affected. Mitigation measures should take the form of ensuring towers are sited away from any areas of intensive cultivation, such as areas of irrigation.

- **Visual impacts** are on quality of landscape due to the presence of a transmission power line in the operational phase and unsightly views caused by construction camps during the construction phase. Mitigations should take the form of avoiding transmission power lines to cross through ridges, rivers or any natural features that have visual value. The vegetation occurring in the area to be disturbed by construction camps must be salvaged and kept in a controlled environment such as a nursery, for future re-planting in the disturbed areas as a measure of rehabilitation.

- **Ecotourism impacts** that may be caused by this development include: visual impacts on ecotourism (including game farms and hunting lodges); impacts on existing tourism attractions; and impacts on future establishments and expansions on protected areas. Construction activities, camp and lay down areas may impact on the quality of the product which ecotourism destinations in the study area can provide to the market place. If practically possible, construction camps should be located in areas that are already disturbed.

- **Heritage site impacts** are caused by disturbance or destruction during construction phase. Mitigation measures should take the form of isolating known sites and declare them as no-go zones with sufficient associated buffer zones around them for protection. The SAHRA would have to be notified to this regard.

- **Socio-economic impacts** are as a result of disturbance on land use and hence affecting adjacent landowners. As one of the mitigation measure; during the construction phase, the workers must be requested to respect the peacefulness and quiet of the area so as not to disturb the rural nature of the area. A positive impact would be the creation of temporary unskilled employment opportunities for local communities during construction phase.

An Environmental Management Programme (EMPr) has been compiled and should be used as an environmental management guide during the construction phase of the project.

Conclusions and Recommendations:

Linear developments such as the proposed Perseus-Kronos 765kV transmission power line are rarely able to avoid crossing ecologically sensitive areas and watercourses. Nonetheless, such sensitive areas could be avoided and / or minimize impacts by applying the recommended

mitigation measures during construction and operational phases. In the scoping phase, the three main alternative corridors were considered and investigated for the proposed development. In the EIR phase, Deviations corridors 1A, 1B, 1C and 1D were introduced to further avoid the Mokala National Park future expansion areas, major game farms, irrigation center-pivots, pans, other ecological features and existing infrastructure.

It is recommended that the proposed transmission line be constructed along **Corridor 1 with Deviations 1A, 1B, 1C and 1D**. It is considered to be a suitable route for the Proposed Perseus-Kronos 765kV transmission power line and it is recommended to be granted Environmental Authorisation to satisfy the purpose and need of the proposed project:

In general, the proposed development will have a *moderate to low significance* impact provided there is effective application of the mitigation measures recommended by the specialist assessments.

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LIST OF ABBREVIATIONS AND ACRONOMYS

Alternating Current	AC
Background Information Document	BID
Basic Assessments	BA
Department of Agriculture	DOA
Department of Economic Affairs, Environment and Tourism	DEAET
Department of Energy	DOE
Department of Environmental Affairs	DEA
Department of Environmental Affairs and Tourism	DEAT
Department of Minerals and Energy	DME
Department of Water Affairs	DWA
Development Facilitation Act	DFA
Draft Scoping Report	DSR
Environmental Assessment Practitioner	EAP
Environmental Impact Assessment	EIA
Environmental Impact Report	EIR
Environmental Management Programme	EMP
Final Scoping Report	FSR
Geographic Information Systems	GIS
Government Notice Regulation Number	GNR
High Voltage Direct Current	HVAC
Interested and Affected Parties	I&APs
Integrated Energy Plan	IEP
Integrated Resource Plan	IRP
Kilo Volts	kV
National Energy Regulator of South Africa	NERSA
National Environmental Management Act of 107 1998	NEMA
National Environmental Management: Protected Areas Act 57 of 2003	NEMPAA
National Heritage Resources Act	NHRA
National Integrated Resource Planning	NIRP
Promotion of Administrative Justice Act	PAJA
Plan of Study	PoS
Public Participation Process	PPP
Transmission Development Plans	TDP
Terms of Reference	ToR
South African Heritage Resources Agency	SAHRA

TITLE

NEAS REF NO **DEA REF NO**	**DEA/EIA/0001555/2012** **14/12/16/3/3/2/438**
TITLE:	Amendment of the Draft EIR for the Proposed Perseus-Kronos 765kV Transmission Power Line and Substations Upgrade (part of Cape Corridor Strengthening Phase 5)
CLIENT	Eskom Holdings SOC Ltd
PREPARED BY	Mokgope Consulting CC 49 3rd Avenue Highlands North, Johannesburg, 2036
AUTHOR:	Judith Fasheun & Mpho Nenweli
PROJECT STATUS	Draft EIA Phase
REVIEW PERIOD	**OCTOBER / NOVEMBER 2015**

1. PROJECT BACKGROUND

1.1 INTRODUCTION

Eskom proposes to construct a 765kV transmission power line of approximately 388km connecting Perseus and Kronos Substations. The proposed Perseus-Kronos power line is a sub-project of the Cape Corridor Strengthening Phase 5 project which entails passing through the Northern Cape and Western Cape, to be in proximity to Independent Power Producers (IPPs) of solar farms and wind farms respectively.

Perseus Substation is located in Tokologo Local Municipality within the jurisdiction of Lejweleputswa District Municipality in the Free State Province. The Proposed power line would also traverse: Thembelihle and Siyancuma Local Municipalities within the jurisdiction of Pixley Ka Seme District Municipality; Letsemeng Local Municipality within the jurisdiction of Xhariep District Municipality; and Sol Plaatje Local Municipality within the jurisdiction of Frances Baard District Municipality.

Kronos Substation is located within the Siyathemba Local Municipality within the jurisdiction of the Karoo District Municipality in the Northern Cape Province.

The proposed project also entails the upgrade of the existing Kronos and Perseus Substations to accommodate the proposed power line.

1.1.1 Need and Desirability

Eskom has to supply reliable power to meet the increasing needs of electricity users. Therefore on a continuous basis, Eskom needs to maintain, construct and upgrade its infrastructure of transmission power lines and substations. According to Eskom TDP 2013–2022, some of the objectives include transmission network strengthening plans and reliability projects, which would ensure that the transmission system reliability and adequacy are sustained as load demand increases on the network.

The Greater Cape network (comprising the Eastern Cape, Northern Cape and Western Cape Provinces) supplies a combined diversified load of over 6 000 MW. The load is supplied by a network of HVAC transmission lines, referred to as the Cape Corridor, operating at 400kV and now at 765kV as part of Phase 3 and 4 of the Cape Corridor Strengthening (see Figure 1).

The load forecast indicates that the load supplied by the Cape Corridor will reach more than 8 000 MW by the year 2021. Forecasts indicate that the maximum power transfer through the Cape Corridor may result in a power transfer deficit going forward. It is for this reason that Eskom Grid Planning initiated a Strategic EIA for the requirement of an additional 765kV line into the Cape network traversing the Northern Cape Province. The line will originate from Perseus Substation in the Free State and terminate at Sterrekus Substation in the Western Cape (via Kronos, Aries, Helios, Juno and Aurora Substations). This will be referred to as Cape Corridor Strengthening Phase 5.

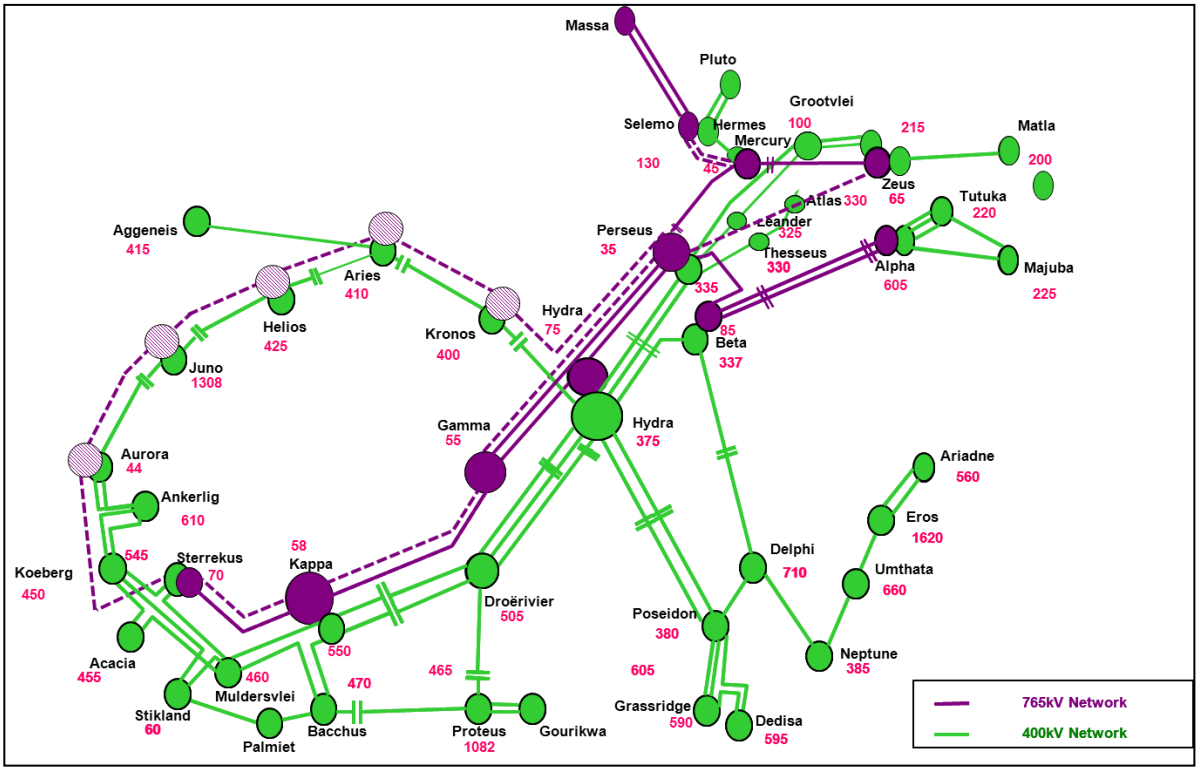


Figure 1: Cape network - 400kV and 765kV

The aim of the proposed transmission power line is to ensure that adequate and reliable electricity supply in the provinces is achieved. Some of the benefits of developing the transmission power line would include: avoiding current and future possible voltage collapse; contributing to a more flexible electrical network; improvement in the overall reliability of the electrical systems, which would benefit electricity users in the country; evacuating power generated from a number of solar renewable installations in Northern Cape and wind farms on the west coast of Western Cape; and sustaining economic growth across the country.

1.2 SCOPE OF THE PROJECT

The proposed 765kV transmission power line would be constructed from Perseus substation near Dealesville, Free State Province to Kronos substation near Copperton, Northern Cape Province, for approximately 388km in length (depending on the final route alignment). Eskom would need to register an 80m wide servitude over the final corridor alignment, which would be required to accommodate the towers within which the 765kV power line will be strung and control activities below the transmission line cables.

To facilitate final route determination, 2km wide possible corridors are identified for specialist assessment study surveys along the proposed power line, as well as to avoid any environmentally sensitive areas during servitude acquisition negotiations and construction phases of the project.

Furthermore, the transmission power line would require support structures and towers which would be spaced at a maximum of 500m intervals along the power line route, as well as vehicular access along the route for construction and maintenance purposes.

At Kronos substation, the proposed power line would also entail the upgrade of the capacity and expansion of the footprint of the substation to accommodate additional transmission capacity.

At Perseus substation, the proposed power line would only entail the upgrade of the capacity of the substation to accommodate additional transmission capacity.

1.2.1 Associated work at Substations

The upgrade of the Perseus and Kronos substations would include the following:

- Construct a 765kV power line to connect to the substations;
- Include a 765kV yard at each substation;
- Include a 765kV busbar at each substation;
- Include a 2 x 765/400kV transformers at each substation;
- Extend the 400kV yard at each substation; and
- Extend the 400kV busbars at each substation.

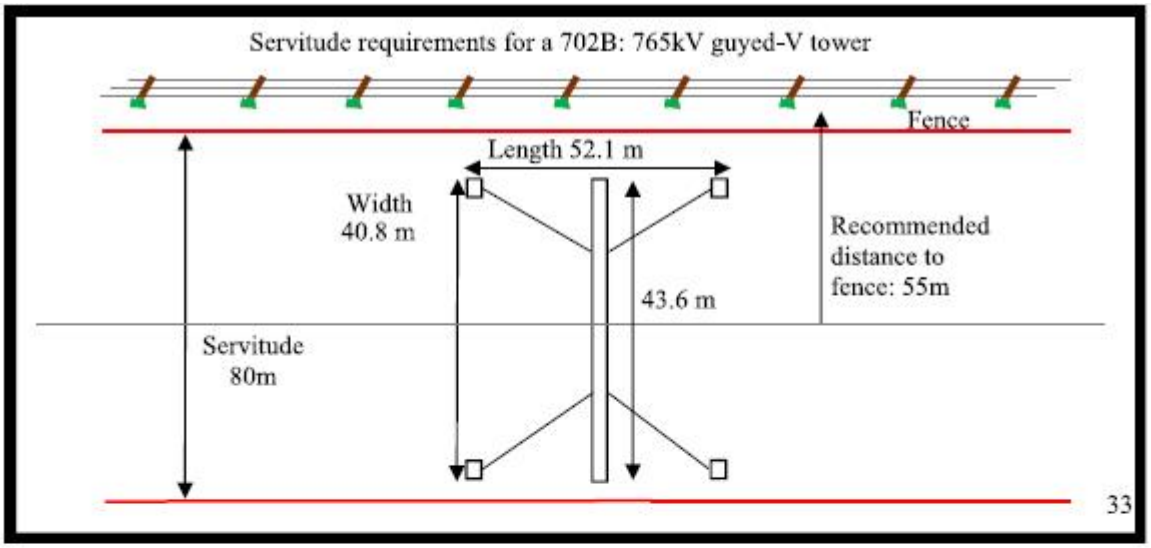
1.2.2 Tower Types

Towers for the proposed power line would be between approximately 35m and 55m in height and extend over a footprint area ranging from approximately 14.5m x 14.5m (210.25m^2) to 40.8m x 52.1m (2 125.68m^2), depending on the tower type used.

The distance between each tower would be approximately +/- 450m-500m, however this is influenced by the topography/terrain and the need for bends in the line to remain within negotiated servitudes. The actual number of towers, the type of towers and other support structures associated with the proposed power line would be confirmed and detailed following approval of the proposed development and once the final route alignment is negotiated with property owners.

In general, the type of towers to be used would consider weight, the area (e.g. topography characteristic), height, costs and erection time. In addition, transmission power line routes are planned with as few bends along the route as possible.

Examples of some of the towers that Eskom is likely to use for the proposed 765kV transmission power line and which have been widely used in similar developments are illustrated below.



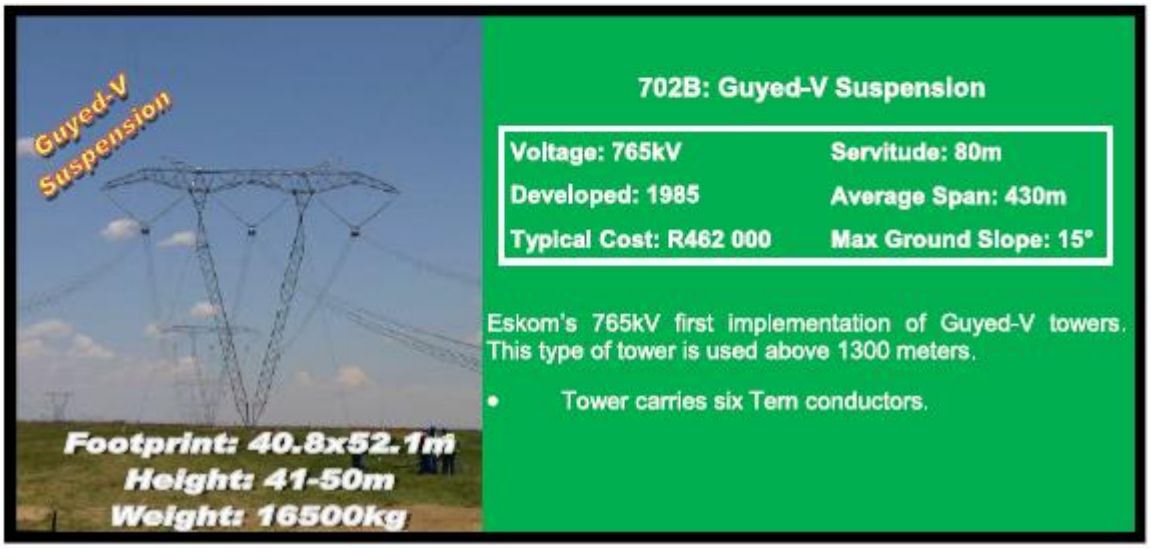
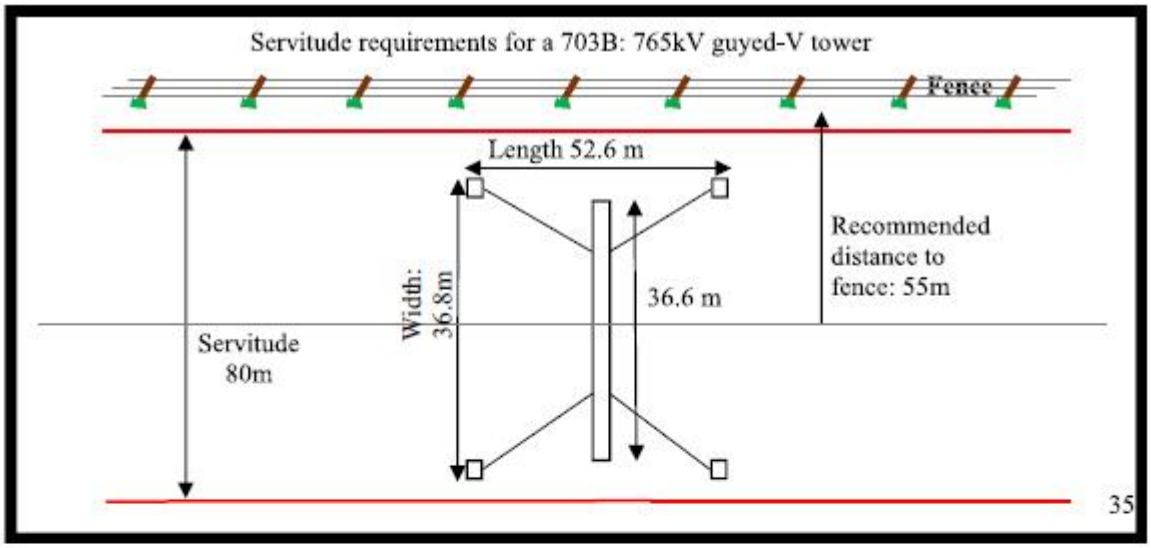


Figure 2: 702B Guyed-V Suspension Voltage: 765 kV Developed: 1985.



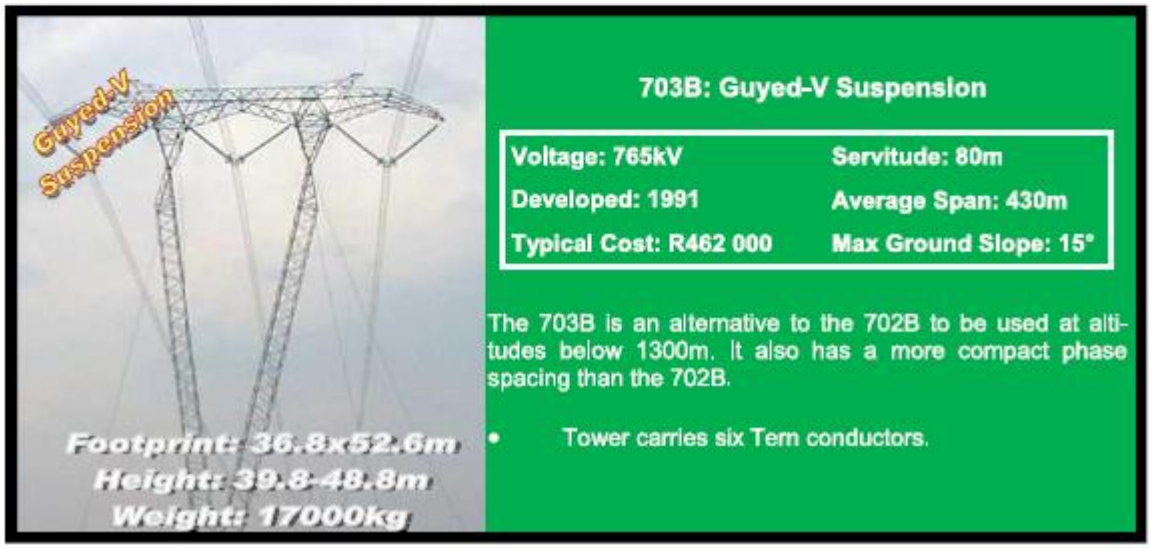


Figure 3: 703B Guyed-V Suspension Voltage: 765 kV Developed: 1991

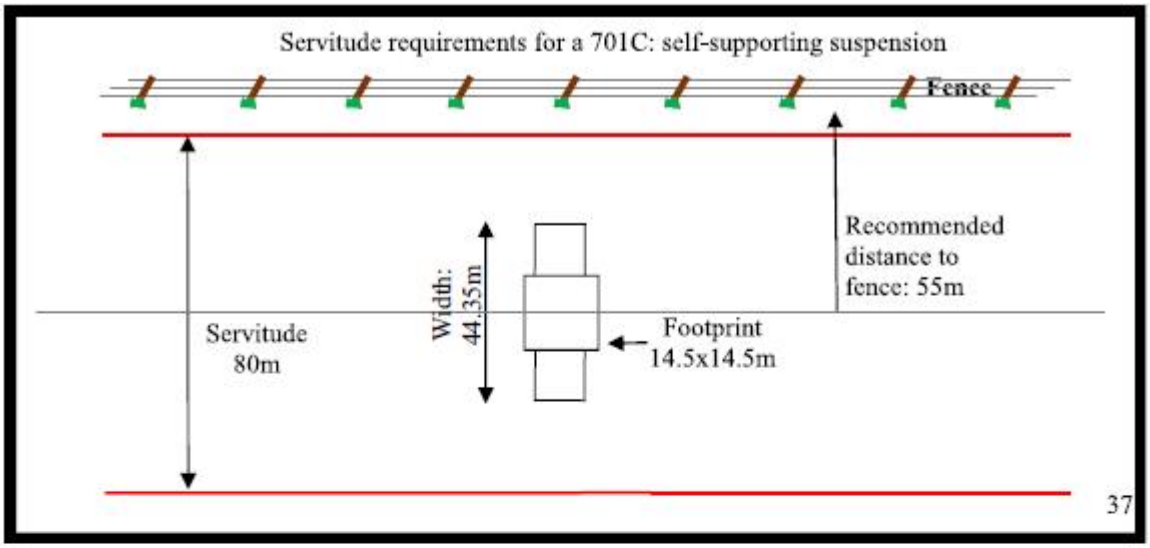
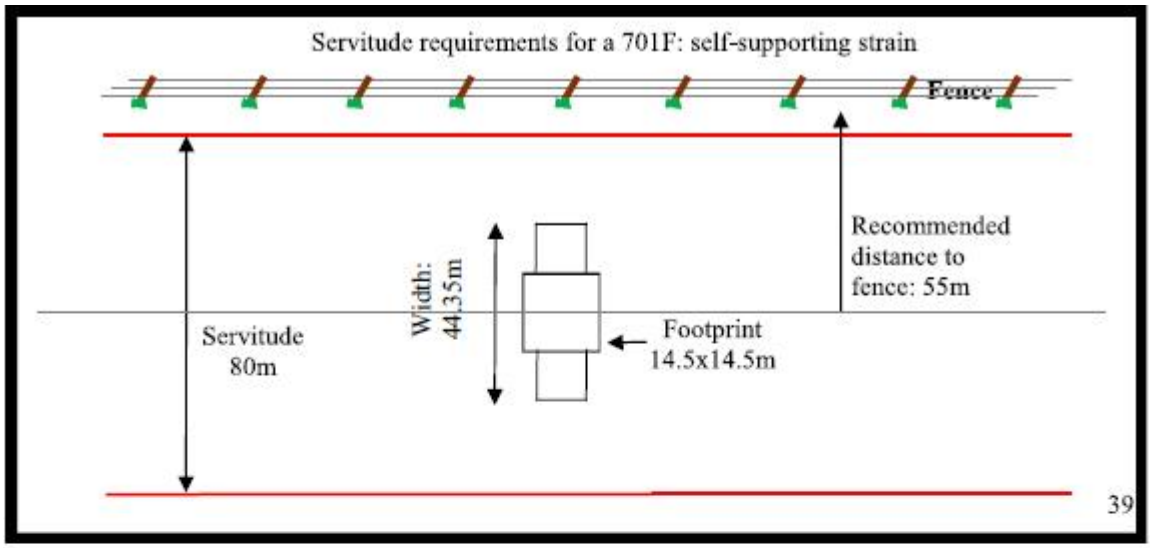


Figure 4: 701C Self - Supporting Suspension Tower Voltage: 765kV Developed: 1984



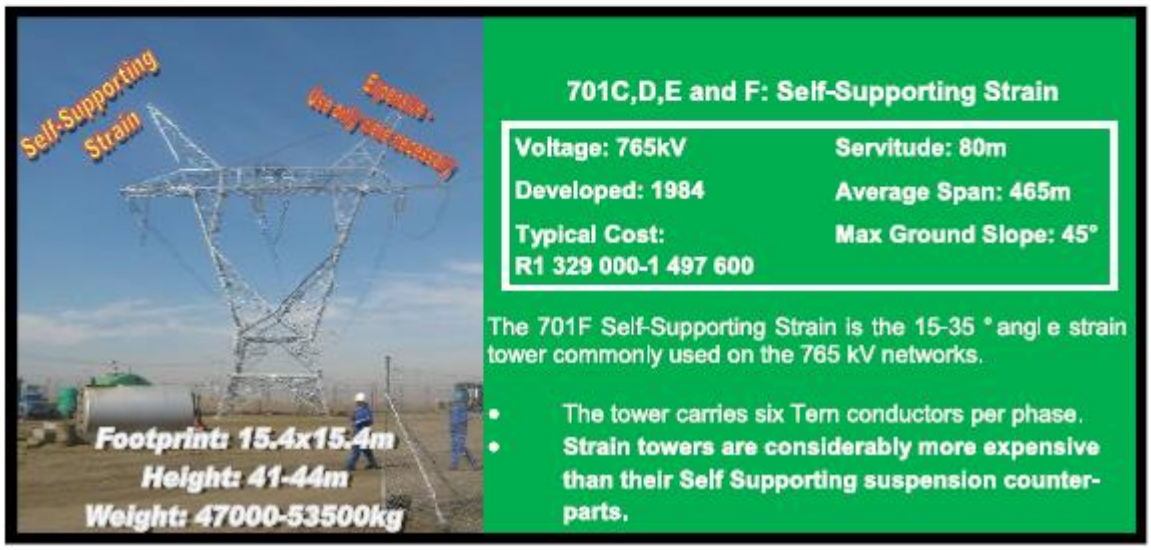


Figure 5: 701C,D,E & F Self - Supporting Suspension Strain Tower Voltage: 765kV Developed: 1984.

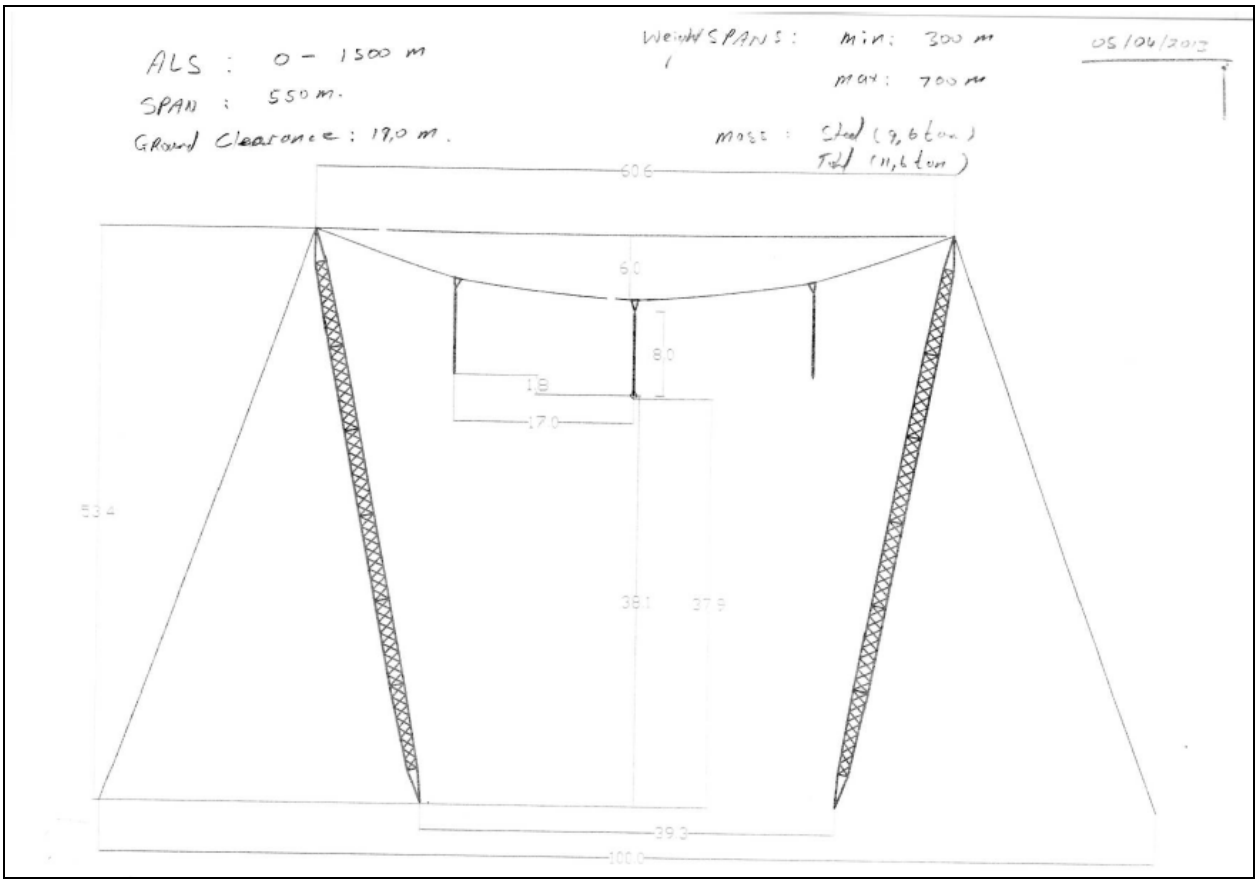


Figure 6: Crossrope Tower, Voltage: 765kV Developed: Recently

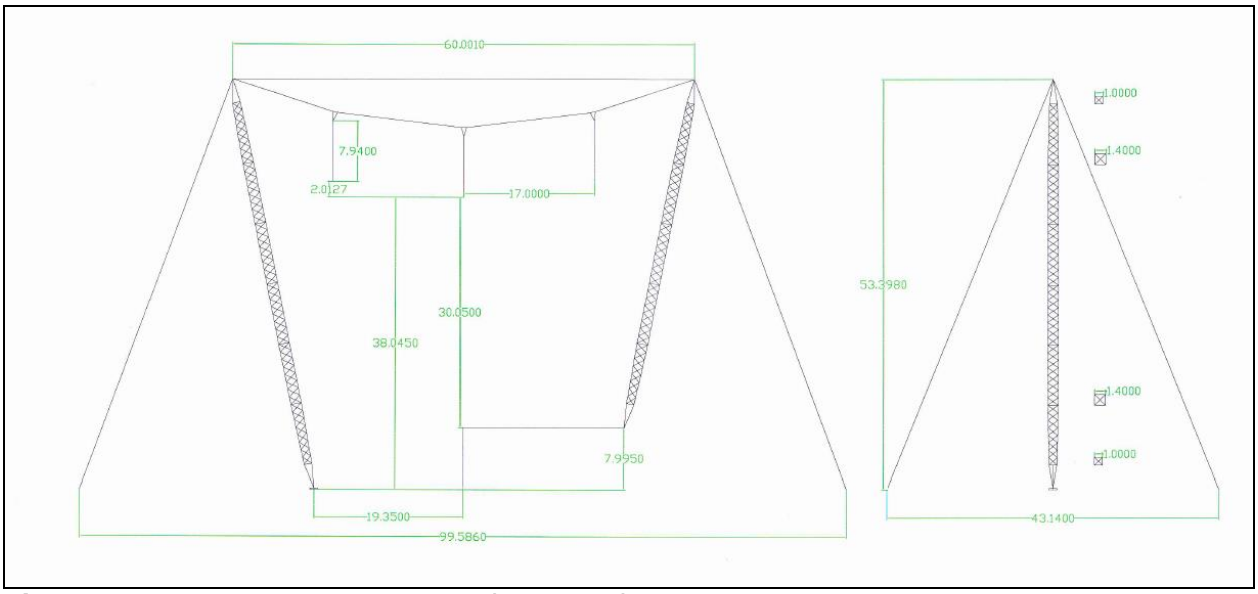


Figure 7: Crossrope Tower 705C, Voltage: 765kV

1.2.3 Servitude Requirements

Eskom will register a servitude width of 80m (40m on either side of the centre line) against the title deeds of the properties that would be traversed by the proposed transmission power line. The servitude would allow Eskom Transmission certain rights and controls that support the safe and effective construction, operation and maintenance of the power line.

For the purposes of seeking environmental authorisation, 2km wide corridors are typically investigated in detail to determine the preferred corridor to avoid any environmental sensitive features and allow for minor deviations within the corridor during the servitude acquisition negotiation process and the power line construction along the route.

1.2.4 Clearances

The minimum vertical clearance to buildings, poles and structures not forming part of the 765kV power line must be 8.5m. The conductor ground clearance between the towers must be 10.4m (Figure 8). The minimum distance of a 765kV transmission power line structure from proclaimed public roads is 11.5m from the centre line of the structure to the centre line of the road. The minimum distance between any part of a tree or shrub and any bare phase conductor of a 765kV transmission power line must be 8.5m (OHSA, 1993).

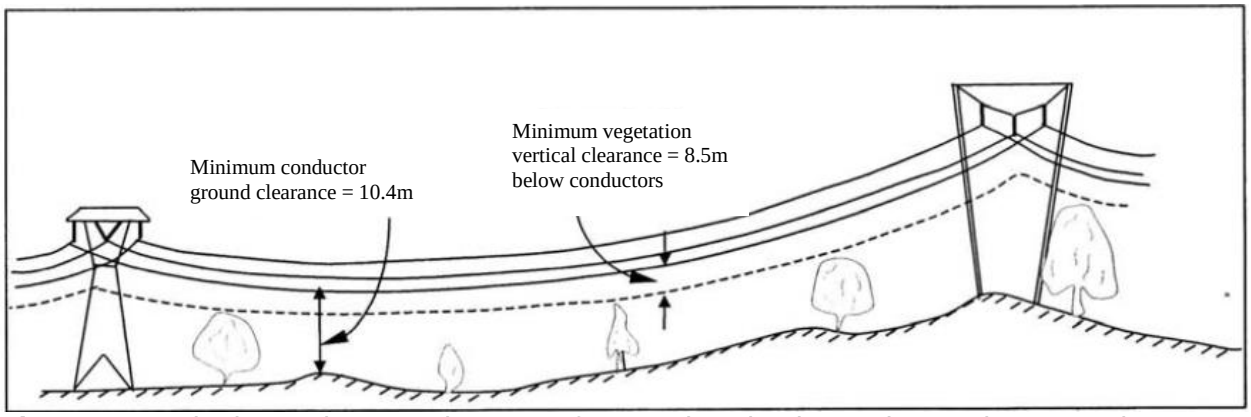


Figure 8: Servitude requirements in terms of vegetation clearing under conductors and minimum ground clearance (Source: BE, 2006)

An approximately 8m wide strip is generally required to be cleared of all trees and shrubs down the centre of transmission power line servitude for stringing purposes only. Any tree or shrub in other areas that will interfere with the operation and / or reliability of the transmission power line must be trimmed or completely cleared (CEA, 2003). More details on transmission power line vegetation management are provided in Appendix K.

Vegetation clearance for the proposed Perseus-Kronos 765kV transmission power line will be minimal due to the characteristic low-growing plant species predominant in the study area. The clearing of vegetation would be undertaken in accordance with the minimum standards to be used for vegetation clearing for the proposed new power line construction as listed in Table 1 (CEA, 2003) below.

Table 1: Minimum standards to be used for vegetation clearing for the construction of the proposed Perseus-Kronos 765kV transmission power line (CEA, 2003)

ITEM	STANDARD	FOLLOW UP
Centre line of the proposed transmission power line	Clear to a maximum (depending on tower type and voltage) of a 8m wide strip of all vegetation along the centre line. Vegetation to be cut flush with the ground. Treat stumps with herbicide.	Re-growth shall be cut within 100mm of the ground and treated with herbicide, as necessary. Monitor for invasive alien plants, and eradicate.
Inaccessible valleys (trace line)	Clear a 1m strip for access by foot only, for the pulling of a pilot wire by hand.	Vegetation not to be disturbed after initial clearing. Vegetation to be allowed to regrow. Monitor for invasive alien plants, and eradicate.
Access/service roads	Clear a maximum (depending on tower type) 6m wide strip for vehicle access within the maximum 8m width, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary. Monitor for IAP, eradicate
Proposed tower position and proposed support/stay wire position	Clear all vegetation within proposed tower position in an area not larger than a foot print of 20 x 20m (self-supporting towers) and 40 x 40m (compact cross-rope suspension towers) around the position, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil. Allow controlled agricultural practices, where feasible.	Re-growth to be cut at ground level and treated with herbicide as necessary. Monitor for invasive alien plants, and eradicate.
Indigenous vegetation within servitude area (outside of maximum 8m strip)	Area outside of the maximum 8m strip and within the servitude area, selective trimming or cutting down of those identified plants posing a threat to the integrity of the proposed transmission power line.	Selective trimming
Alien species within servitude area (outside of maximum 8m strip)	Area outside of the maximum 8m strip and within the servitude area, remove all vegetation within servitude area and treat with appropriate herbicide.	Cut and treat with appropriate herbicide.

The minimum safety clearances in terms of typical electric magnetic field levels in power line environments where the public may be exposed has been set by the International Commission on Non-Ionising Radiation Protection (ICNIRP) (see table below).

Table 2: 50Hz Electric and Magnetic Continuous Field Exposure Limits Set by ICNIRP

Exposure	Electric Field (kV/m)	Magnetic Field (µT)
Occupational – whole working day	10	500
General public – up to 24h per day	5	100

The Occupational Health & Safety indicates that a distance of 5.6 metres to any building must not be encroached. However Eskom acquires a 40 meter servitude from the centre line (80m total servitude width). A typical 765kV line has a 22 meter phase to phase spacing. Therefore from the nearest conductor to the edge of the servitude, the distance would be 34.4 meters (considering conductor blow out conditions) which comfortably complies with the 5.6 meters from the Occupational Health & Safety.

1.2.5 Access Roads

A vehicle access road is usually required to be established to allow access along the entire length of the servitude. Access is required during both the construction and operation / maintenance phases of the transmission power line life cycle. Any new access roads that are required will be established during the construction phase and are more established by vehicle passage than by grading or blading. Temporary roads of more than 8m wide may be established along the route alignment where necessary.

In order to reduce potential impacts associated with the construction of new access roads, existing roads will be used as far as possible where available and new access roads will be constructed by means of driving over the vegetation where possible to avoid permanent removal of the existing vegetation (BE, 2006). Establishment of new access routes during the construction phase would need to be negotiated with the relevant landowners once Environmental Authorisation has been obtained.

1.2.6 Storage of Transformer Oils

At Perseus and Kronos substations, storage of diesel vehicle fuel and transformer oils would be required. The diesel vehicle fuel of $10m^3$ would be stores in containers (at a time) at the substations for refueling of construction vehicles. The oil collection dams would be built to collect and store the transformer oils in cases of spillages. The oil dams would be built according to the oil volume of the largest transformer in the substation plus a 20% margin. For example: The biggest transformer in a substation may contain $180m^3$ of oil. Therefore the oil dam would be built to accommodate $1.2 \times 180m^3 = 216m^3$.

Please note: The above activities as well as other services required during the construction and operational phase would be conducted in accordance with the approved Environmental Management Programme (EMPr). Furthermore, the exact location of temporary access roads for construction purposes as well as access roads for maintenance purposes may not be finalised at this stage. After the 80m servitude acquisition within the 2km corridor, subsequently

a walk-down would be undertaken with the relevant specialists to guide on tower positions. During the walk-down stage, the required access roads would be assessed and included in the site specific EMPr.

2 PROJECT LOCALITY

2.1 DESCRIPTION OF THE PROPOSED PERSEUS-KRONOS POWER LINE

The study area of the proposed 765kV transmission power line extends between the existing Perseus and Kronos Substations near Dealesville, Free State and Copperton, Northern Cape, and includes three main alternative corridors and deviation routes to be considered, each within a 2km corridor. This is to include affected landowners within the 2km corridor. The total length of the power line would be approximately 388km between the two substations.

Perseus Substation is located in Tokologo Local Municipality within the jurisdiction of Lejweleputswa District Municipality in the Free State Province. The proposed power line would also traverse: Thembelihle and Siyancuma Local Municipalities within the jurisdiction of Pixley Ka Seme District Municipality; Letsemeng Local Municipality within the jurisdiction of Xhariep District Municipality; and Sol Plaatje Local Municipality within the jurisdiction of Frances Baard District Municipality.

Kronos Substation is located in the Siyathemba Local Municipality within the jurisdiction of Karoo District Municipality in the Northern Cape Province.

The power line traverses between Perseus Substation, which is approximately 5km north west of Dealesville and 50km south east of Boshof in the Free State Province and Kronos Substation, which is approximately 11km south of Copperton and 56km south west of Prieska.

The general topography within the study area is flat to undulating landscapes, while rocky outcrops and mountainous areas could be encountered. The proposed route corridors would cross national roads such as: N10, N12 and N8 and some regional roads such as: R386, R403, R369 and R705.

2.2 COORDINATES

The approximate coordinates are provided below:

Table 3: Approximate Coordinates between Kronos and Perseus Substations

	Corridor 1	Corridor 2	Corridor 3
Start point at Kronos	30° 1'19.48"S 22°20'18.21"E	30° 1'19.48"S 22°20'18.21"E	30° 1'19.48"S 22°20'18.21"E
Mid-point	29° 23' 52.55"S 24° 0' 23.49"E	29° 50' 9.05"S 22° 53' 3.47"E	29° 13' 53.76"S 24° 0' 30.34"E
End point at Perseus	28°38'10.25"S 25°44'53.73"E	28°38'10.25"S 25°44'53.73"E	28°38'10.25"S 25°44'53.73"E

The Aerial Photograph and Locality Map are illustrated below in Figure 9 and Figure 10 respectively.

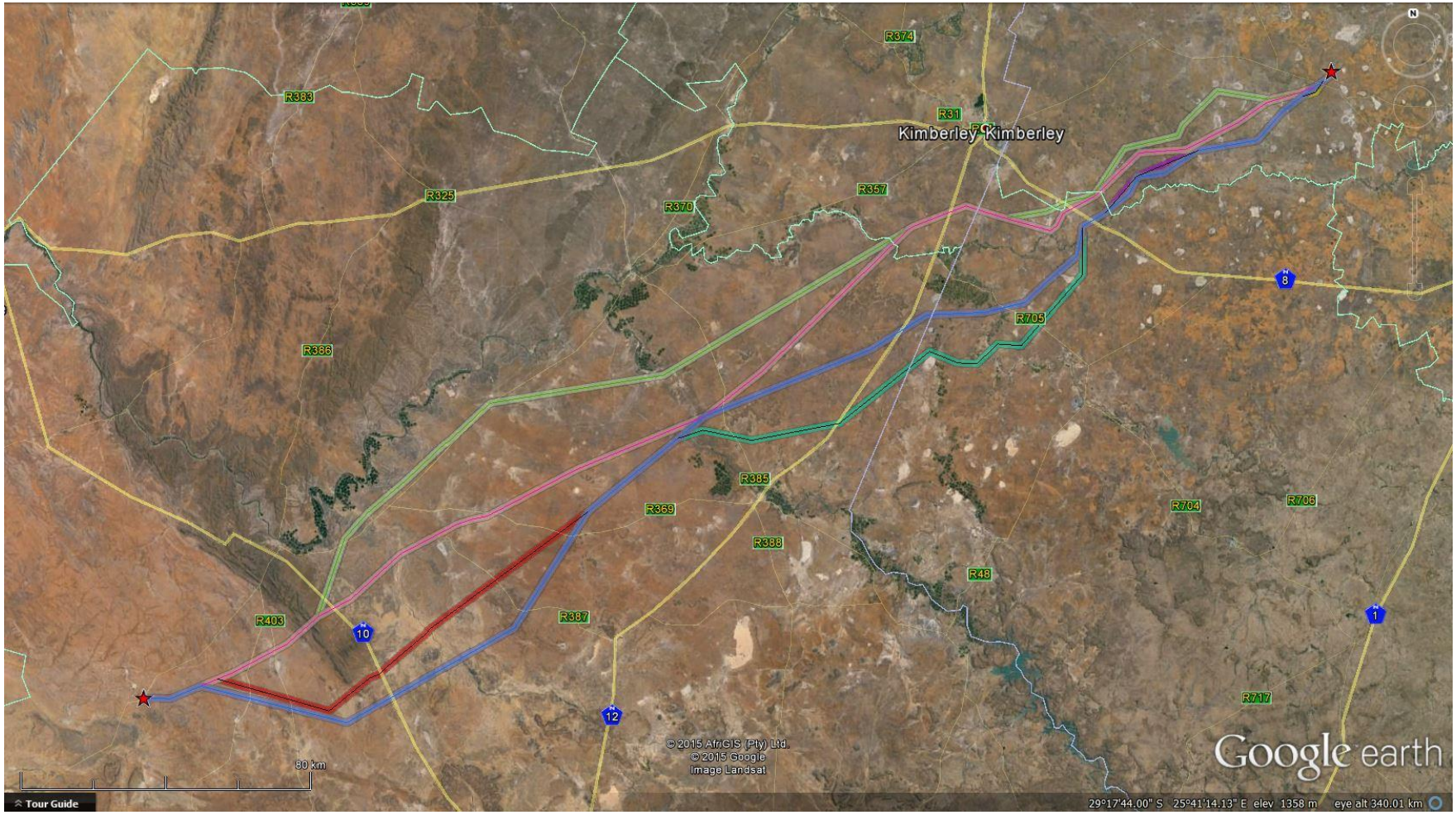


Figure 9: Aerial photo of locality area (Source: Google)

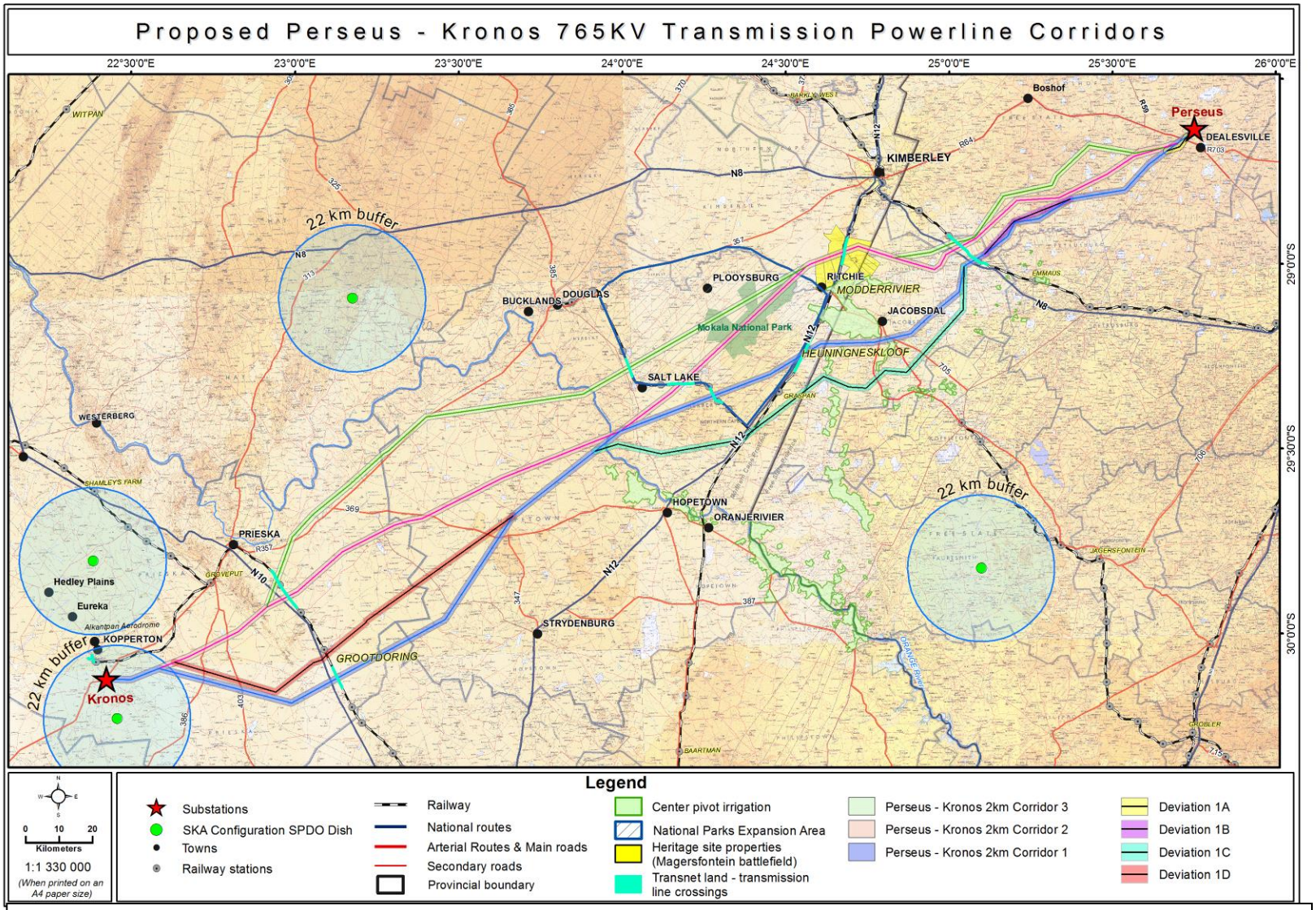


Figure 10: Locality Map of the Proposed Development (Clearer Map is provided in Appendix C)

2.3 LAND OWNERSHIP

The proposed 765kV power line is approximately 388km linear activity that would require 80m wide servitude over privately owned land to be secured. The servitude is to ensure the safe construction, and maintenance / operation of the power line. The servitude would entitle Eskom certain rights such as access to the proposed development site. The final alignment would be located within the preferred 2km corridor so that environmentally sensitive areas and areas of high biodiversity significance can be avoided and also avoid environmental sensitivities outside the study area.

Eskom has not yet acquired servitudes and therefore would require landowners consent if any of the alternative route corridors is selected as the final route alignment for the proposed power line.

The proposed development could affect many aspects of the environment along the course of the activity such as: crossing fences, boreholes, farm tracks, dwellings, mines, pipelines and watercourses. Landowners located within 2km of the linear activity could also be potentially affected. The landowners were identified and given notice of the proposed development during the Scoping and EIA process. The map depicting the proposed routes traversing the landowners' properties is provided in Appendix C.

3. IDENTIFICATION OF ALTERNATIVE SCENARIOS

In accordance with EIA Regulations No. 543 (18 June 2010), the EIA process is required to involve the identification of alternatives based on the locality and technical feasibility. The alternatives that are identified must be feasible. The options should also include the "do-nothing" alternative. The EIA study involves assessment of these alternatives in terms of their potential impacts on the surrounding biophysical and socio-economic environment. Therefore, the least environmentally intrusive and consequently most feasible option would be determined after thorough assessments of all proposed alternatives have been compared and recommended by the specialists as well as considering other stakeholders' concerns.

The alternative scenarios that were investigated for this project comprise: location alternatives; process and technical alternatives; and the do-nothing alternative. In terms of the location, 3 main alternative route corridors were considered for the proposed transmission power line. At a later stage of the EIA process, 4 deviation routes to the main Corridor 1 were developed. See reasons below:

Deviation Lines	Technical Reasons for the Deviations
1A	The initial Corridor 1 at this particular area was too congested. The new deviation avoids two major line crossings and is directed to the available bay at Perseus Substation.
1B	The deviation avoids houses, a ridge, a few irrigation center pivots, a major cell tower, an extra strain tower and is further away from the river.
1C	Initially this deviation was named Deviation 1A (prior to amendment of this report) The reasons for the deviation were to avoid the Mokala National Park and the park's future expansion areas. Eskom further added a few smaller deviations to it to avoid major game farms, irrigation center pivots and salt mines/pans.
1D	The deviation avoids a river crossing, pans, soil erosion, bad terrain and reduces the line distance.

3.1 LOCATION ALTERNATIVES

The figure below shows proposed alternative route corridors considered for the construction of the transmission power line. Alternative Corridor 1, Corridor 2 and Corridor 3 run the entire length of the development between Kronos and Perseus Substations. Additional deviations to Corridor 1 comprise: Deviations 1A, 1B, 1C and 1D. The route corridors could traverse areas of sensitive biodiversity of which specialists have identified in their studies. The key determinants in identifying the different route options would include: the receiving environment such as

centre-pivots, terrain (certain mountainous areas are not accessible and suitable for building), mining areas, environmentally sensitive areas (wetlands, dams, pristine areas, national protected areas; amongst others.); game farms, existing infrastructures (roads, railways, buildings, community dwellings / households, amongst others).

Not limited to the above-mentioned determinants, there is a variety of other considerations that must be taken into account since there may be legislative restrictions that have to be adhered to.

Another key determinant is of "economic factor". The shorter and straighter (with few bends) the route is, the less expensive it is to build the proposed power line.

3.1.1 CORRIDOR 1 with Deviations 1A, 1B, 1C and 1D (Southern line)

From Kronos substation in the Northern Cape, Corridor 1 splits from Corridor 2 and 3 and crosses the N10 road more south than Corridor 2 and 3. Corridor 1 comes into close proximity to Corridor 2 about 30km north of Hopetown. From here the corridor crosses into the Free State Province about 45km south of Kimberley town to end at Perseus substation just north of the town of Dealesville (Figure 11).

Deviation 1A: About 10km before the Perseus substation, Deviation 1A splits form Corridor 1 in a north-easterly direction and re-joins Corridor 1 about 2km before Perseus substation. The initial route was too congested and this deviation was proposed to avoid two major line crossings and is directed to the available bay at Perseus Substation.

Deviation 1B: After Corridor 1 from Kronos crosses the Orange River, Deviation 1B splits from Corridor 1 for about 31km before it re-joins Corridor 1. The deviation avoids houses, a ridge, a few irrigation center-pivots, a major cell tower, an extra strain tower and is further away from the river.

Deviation 1C: This route deviates from Corridor 1, about 26km north-west of Hopetown. This route is the most southern route and crosses the N12 road about 28 km south of where Corridor 1 crosses the N12. Deviation 1C connects with Corridor 1 again just south of the N8 road between Kimberley and Petrusburg. The reasons for the deviation were to avoid the Mokala National Park future expansion areas. Eskom further added a few smaller deviations to it to avoid major game farms, irrigation center pivots and salt mines/pans.

Deviation 1D: About 20km north-east of the Kronos substation, Deviation 1D splits from Corridor 1 and aligns for about 5km with Corridor 2, where after is splits in a north-westerly direction to join Corridor 1 approximately 120km further. This deviation will avoid a river crossing, pans, soil erosion, bad terrain and reduces the line distance.

3.1.2 CORRIDOR 2 (Centre line)

Corridors 2 and 3 follow the same alignment from Kronos substation until approximately 22km south west of the town of Prieska, at the N10 road. Here the two corridors split and join again about 10km west of the town of Ritchie, where the corridors also traverse Magersfontein properties (Figure 11). Corridor 2 joins Corridor 3 as it passes about 25km south of Kimberley and into the Free State Province to Perseus substation (Figure 11).

3.1.3 CORRIDOR 3 (Northern line)

Corridor 3 follows the same alignment as Corridor 2 from Kronos substation until approximately 22km south west of the town of Prieska. At the N10 road, Corridor 3 splits northwards. After about 185km, Corridor 3 joins Corridor 2 about 10km west of the town of Ritchie, where the two corridors also traverse Magersfontein properties (Figure 11). Corridor 3 joins Corridor 2 as it passes about 25km south of Kimberley and into the Free State Province until it reaches Perseus substation, near Dealesville town (Figure 11).

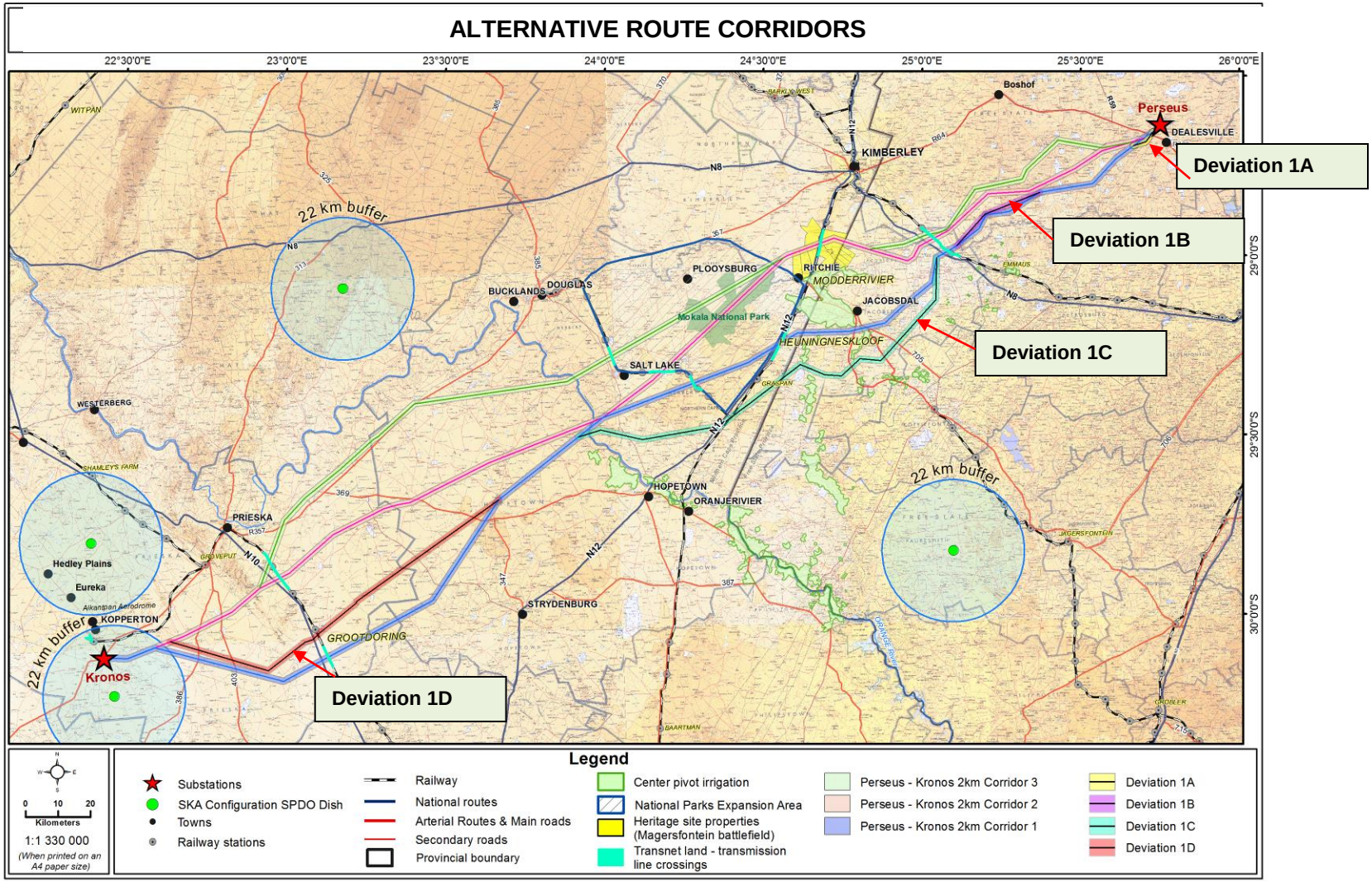


Figure 11: Proposed Alternative Corridors

3.2 PROCESS AND TECHNICAL ALTERNATIVES

There are two technical alternatives relevant for a 765kV power line other than the "Do-Nothing" Alternative.

3.2.1 765kV Alternating Current (AC)

In AC voltage, the flow of electric charge periodically reverses direction, whereas in HVDC the flow of electric charge is in one direction. The line length for an AC system is only viable for a line length of approximately 450km. Therefore, for this power line, which would be about 388km in length, an AC system could be used and Eskom would need to install transformers in different substations along the route. Furthermore other locally generated renewable energy would be able to be collected along the route.

3.2.2 High Voltage Direct Current (HVDC)

HVDC system uses direct current for the bulk transmission of electricity, compared to the more common AC system. For long distance transmission of more than 1000km, HVDC would be more appropriate provided transformation would not be required along the line route. The HVDC converter stations are expensive and only viable if the line length is very long (>1000km). Therefore considering the length of the entire proposed power line from Western Cape to Gauteng, an HVDC system would be less costly than an AC system.

3.2.3 Advantages of HVDC over AC

- The most common reason for choosing HVDC over AC transmission is that HVDC is more economic than AC for transmitting large amounts of power point-to-point over long distances.
- Even though HVDC conversion equipment at the terminal stations is costly, overall savings in capital cost may arise because of significantly reduced transmission line costs over long distance routes.
- HVDC needs fewer conductors than an AC line, as there is no need to support three phases.
- Also, larger conductors can be used since HVDC does not suffer from the skin effect[1]. These factors can lead to large reductions in transmission line cost for a long distance HVDC scheme.
- Depending on voltage level and construction details, HVDC transmission losses are quoted as about 3.5% per 1,000 km, which is less than typical losses in an AC transmission system.
- HVDC transmission may also be selected because of other technical benefits that it provides for the power system. HVDC schemes can transfer power between separate

[1] Skin effect is the tendency of an AC to become distributed within a conductor such that the current density is largest near the surface of the conductor, and decreases with greater depths in the conductor.

AC networks. HVDC power flow between separate AC systems can be automatically controlled to provide support for either network during transient conditions, but without the risk that a major power system collapse in one network will lead to a collapse in the second.

3.2.4 Disadvantages of HVDC

- The disadvantages of HVDC are in conversion, switching, control, availability and maintenance.
- HVDC is less reliable and has lower availability than AC systems, mainly due to the extra conversion equipment.
- The required converter stations are expensive and have limited overload capacity. At smaller transmission distances, the losses in the converter stations may be bigger than in an AC transmission line for the same distance.
- Operating a HVDC scheme requires many spare parts to be kept, often exclusively for one system, as HVDC systems are less standardized than AC systems and technology changes faster.
- In contrast to AC systems, realizing multiterminal systems is complex (especially with line commutated converters), as is expanding existing schemes to multiterminal systems. Controlling power flow in a multiterminal DC system requires good communication between all the terminals; power flow must be actively regulated by the converter control system instead of the inherent impedance and phase angle properties of the transmission line.
- The increasing size of the conductor to reduce power loss in transmission is expensive and will have a significant visual contrast.

The following table outlines the comparisons between a 765kV AC and HVDC:

Table 4: HVDC vs AC

	AC	**HVDC**
Current:	AC	DC
Maximum line length:	+- 450km	> 1000km
Towers & Conductor:	3 phase bigger foot print	1 phase smaller foot print
Transformation:	Possible at different substations	Not possible, loose the advantage of the network
Substations:	Feeder bay every 450km	Only two converter stations needed

Please note: Even though both options (765kV HVDC and 765kV AC) are regarded viable alternatives for point-to-point long distance transmission of more than 1000km, the 765kV AC alternative is preferred for this project due to the following reasons:

- The distance between the substations / point-to-point is approximately 880km (Perseus to Juno substations), which is less than the optimal 1000km distance for DC;

- The transformers are to be installed at the following substations: (Perseus and Kronos), (Kronos and Aries), (Aries and Helios), and (Helios and Juno) to enable the collection of other renewable energy along the proposed entire line route (*i.e.* from Juno to Perseus substations);
- The cost of DC conversion equipment is much higher as compared to an AC system at the terminal stations or substations;
- However, should a need arise for Eskom after the Environmental Authorisation has been granted to convert from AC to HVDC, The EAP is of the opinion that there will be no need for any further assessments provided the HVDC line is erected within the corridors assessed in this report because HVDC has lesser environmental impact (*i.e.* less tower footprint, servitude width and conductors).

3.3 DO NOTHING ALTERNATIVE

The “do nothing” alternative is the option of not undertaking the proposed development, which implies that the 765kV overhead line would not be constructed. Retention of the status quo would mean that it would not be possible to meet the growing future electricity demands in the area and other surrounding towns and large power consumers such as mines fed by the substations, nor would it be possible to effectively evacuate increasing renewable power generated in the Northern & Western Cape to the rest of the country.

This option is not economically feasible because electricity users such as mining companies, farmers, and domestic users would be unable to avoid interruptions. Consequently, without the proposed new power line there is an increasing possibility that outages could occur, resulting in economic losses that could run into millions of rands, particularly for the various industries in the area.

The “do nothing” alternative would also have the inability to meet future demand which would cap economic development at current levels leading to failure to meet provincial and national growth targets.

The do nothing scenario puts the national grid at risk, particularly between Perseus and Sterrekus, due to the high number of transmission lines in the power corridor/spine. Flash overs & fires would result in significant outages whereas this Northern Alignment allows for continuous power supply via alternative substations.

4. LEGAL REQUIREMENTS

South Africa's policy and legislation for environmental management, including biodiversity conservation, has undergone profound changes in the past decade. The proposed project was considered in accordance with the legislation described below.

Of importance are also all provincial and municipal by-laws and regulations that are not listed here but which would be complied with during all phases of the proposed development. Some of the acts may have changed or are in the process of change. However, once the construction phase commences, legislation and all amendments that are in force at that time will apply.

4.1 LEGISLATION RELATED TO PROPOSED PROJECT

Constitution of South Africa (Act 108 of 1996)

The Constitution (Act No. 108 of 1996) provides the legal basis for allocating powers to different spheres of Government and contains a number of rights specifically relevant to the national energy policy. The Constitution states that Government must establish a national energy policy to ensure that national energy resources are adequately tapped and delivered to cater for the needs of the nation. Energy should be made available and affordable to all citizens, irrespective of geographic location. The production and distribution of energy should be sustainable and lead to an improvement in the standard of living of citizens (DME, 2003b:6).

Section 24 of the Bill of Rights provides that:

"Everyone has the right:
a) to an environment that is not harmful to their health or well-being; and
b) to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that:
    i. prevent pollution and ecological degradation;
    ii. promote conservation; and
    iii. secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development."

National Environmental Management Act (No 107 of 1998, as amended)

NEMA (Act No. 107 of 1998) emphasizes the involvement of sustainable development, which requires the integration of social, economic and environmental aspects in the planning, implementation and evaluation of decisions to ensure that development serves present and future generations.

To maintain the practice of sustainable development, NEMA EIA Regulations identify listed activities that need to apply to the EIA process by involving: social aspects, which comprise the public participation process; the economic factors through identifying the need and desirability of

the proposed activities and the benefits on the communities and/or country at large; and by identifying and assessing alternative activities that would pose the least negative impacts on the environment and biodiversity in the study areas.

In terms of NEMA (Act No. 107 of 1998) this proposed development is identified in Government Notice No. R543 of 18 June 2010 as part of listed activities that must apply to the EIA process. Other listed activities associated with the proposed development are outlined in Table 5 of this report. As identified listed activities in GN R544, 545, and 546, the proposed development will require the submission of a Scoping Report and an Environmental Impact Assessment Report to the relevant authorities as part of the environmental authorization process.

Energy Policy

The White Paper on Energy Policy (DME, 1998) sets out Government Policy with regard to the supply and consumption of energy for the next decade. The policy strengthens existing energy systems in certain areas, calls for the development of underdeveloped systems and demonstrates a resolve to change in a number of areas. The policy addresses most elements of the energy sector.

Furthermore, the White Paper on Energy Policy identified the need to undertake an Integrated Energy Planning (IEP) process in order to achieve a balance between the energy demand and resource availability, whilst taking into account the health, safety and environmental parameters. In addition, the policy identified the need for the adoption of a National Integrated Resource Planning (NIRP) approach to provide a long-term cost-effective resource plan for meeting electricity demand, which is consistent with reliable electricity supply and environmental, social and economic policies.

Electricity Regulation Act of 2006

The proposed development is aligned to the following objectives (DME, 2006b:6):

- achieve the efficient, effective, sustainable and orderly development and operation of electricity supply infrastructure in South Africa;
- ensure that the interests and needs of present and future electricity customers and end users are safeguarded and met, having regard to the governance, efficiency, effectiveness and long-term sustainability of the electricity supply industry within the broader context of economic energy regulation in South Africa;
- facilitate investment in the electricity supply industry;
- promote the use of diverse energy sources and energy efficiency; and
- facilitate a fair balance between the interests of customers and end users, licensees, investors in the electricity supply industry and the public.

In addition, the Electricity Regulation Act (Act No 4 of 2006) in terms of section 46 (2, c) determined that projects involving new generation capacity that is needed to ensure the continued uninterrupted electricity supply would require authorisations or exemptions in terms of

NEMA (No 107 of 1998) or as may be required by any other law for the purpose of authorisation for proposed Eskom developments (DME, 2006).

Integrated Energy Plan (IEP) – 2003

The Department of Minerals and Energy (DME) commissioned the IEP to provide a framework in which specific energy policies, development decisions and energy supply trade-offs could be made on a project-by-project basis. The framework was intended to create a balance in providing low cost electricity for social and economic development, ensuring a security of supply and minimizing the associated environmental impacts. The IEP projected that in the years to come the additional demand in electricity would necessitate an increase in electricity generation capacity in South Africa. Therefore, contemporary concerns relate to electricity transmission capacity to accommodate growth in demand (DME, 2003a).

Integrated Resource Plan (IRP) – 2009

The Department of Energy, under the New Generation Capacity regulations has authorised the System Operations and Planning Division in Eskom to produce the IRP for electricity in consultation with the Department and the National Energy Regulator of South Africa (NERSA) (DOE, 2009). The objective of the IRP is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure for South Africa over the next 25 years. In summary, the IRP is intended to:

- Improve the long term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development
- Ascertain South Africa's capacity investment needs for the medium term business planning environment;
- Consider environmental and other externality impacts and the effect of renewable energy technologies.
- Provide the framework for Ministerial determination of new generation capacity (inclusive of the required feasibility studies) as envisaged in the New Generation Capacity regulations.

The National Heritage Resources Act (No. 25 of 1999)

The proposed development comprises certain activities (*e.g*. changing the nature of a site exceeding 5 000 m^2) that require authorisation in terms of Section 38 (1) of the Act. Section 38 (8) of the Act states that if heritage considerations are taken into account as part of an application process undertaken in terms of the ECA, there is no need to undertake a separate application in terms of the National Heritage Resources Act (NHRA).

The requirements of the National Heritage Resources Act can thus be addressed as an element of the EIA process, specifically by the inclusion of a Heritage Impact Assessment (South Africa, 1999). In addition, for instance, NEMA section 24 (4) (b) (iii) appears to reinforce the provisions of NHRA by requiring that procedures for assessing impacts including heritage impacts for most

of NHRA sections 38 (1) activities be addressed in an application for Environmental Authorisation.

Minerals and Petroleum Resources Development Act (No. 28 of 2002)

In terms of the Act, the sourcing of material for road construction purposes (*i.e*. the use of borrow pits) is regarded as mining and accordingly is subject to the requirements of the Act. In terms of the proposed project, Section 106 (3) provides exemption from the Act. "Only where the organ of state has obtained formal exemption from the Minister, the organ of state has to:

- make formal application for exemption;
- notice of the exemption has to be gazetted by the Minister; and
- the organ of state has to compile an EMP per borrow pit and submit these to DMR for approval" (DME, 2002).

In this case, an EMP would be appropriate for approval.

Expropriation Act (No. 63 of 1975)

The Expropriation Act is used to acquire land from unwilling sellers (South Africa, 1975). If necessary, Eskom would need to acquire additional land for this development. This would have to take place during the pre-construction and post-authorisation phase of the development.

National Environmental Management: Biodiversity Act (No. 10 of 2004)

Provisions of this Act which are relevant to this study include the guiding principles relating to threatened and protected ecosystems and species, species and organisms posing a threat to biodiversity, permits relating to listed threatened and protected species, alien species or invasive species. Cognisance is also taken of the list of critically endangered, vulnerable and protected species as listed in the Government Notice No. R151 of 23 February 2007.

National Environmental Management: Waste Act (No. 59 of 2008)

In terms of section 16 (1) of the Act, duty of care is applicable to (DEAT, 2008b):

- Avoid the generation of waste and where such generation cannot be avoided, to minimize the toxicity and amounts of waste that are generated;
- Reduce, re-use, recycle and recover waste;
- Where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;
- Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour or visual impacts;
- Prevent any employee or any person under the proponent's supervision from contravening this Act; and
- Prevent the waste from being used for an unauthorised purpose.

Conservation of Agricultural Resources Act (No 43 of 1983)

In terms of GN 1048 of 1984 and GN 2485 of 1999, the Act provides management principles relating to weeds and invaders and also categories of weeds and invaders (DOA, 1983).

National Water Act (No 36 of 1998)

The National Water Act states that duty of care to remedy the effects of pollution to water resources needs to be taken into consideration in all circumstances (section 19). The Act also stipulates procedures to be followed in the event of an emergency incident which may impact on a water resource (Section 20) as well as governing water use licences (Section 21) if required for construction purposes (DWAF, 1998).

National Forests Act, (No 84 of 1998

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that "no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister".

Promotion of Administrative Justice Act (PAJA) (No 3 of 2000)

The Promotion of Administrative Justice Act aims to give effect to the right to administrative action that is lawful, reasonable and procedurally fair, and to the right to written reasons for administrative action as contemplated in Section 33 of the constitution of the Republic of South Africa 1996 and provides for matters incidental thereto (PAJA, 2000). In particular, the proposed development was considered in accordance with this Act in terms of the following (PAJA, 2000:4):

An administrator undertaking procedurally fair administrative action must give adequate notice of the nature and purpose of the proposed administrative action:

- a reasonable opportunity to make representations;
- a clear statement of the administrative action;
- adequate notice of any right of review or internal appeal, where applicable; and
- adequate notice of the right to request reasons if they were not provided

In cases where an administrative action affects the rights of the public, an administrator, must decide whether to hold a public inquiry and therefore conduct the public inquiry or appoint a suitably qualified person to do so and determine the procedure for the public inquiry, which must:

- include a public hearing and comply with the procedures to be followed in connection with public inquiries;
- conduct the inquiry in accordance with that procedure; and

- compile a written report on the inquiry and give reasons for any administrative action taken or recommended

If an administrator decides to follow a notice and comment procedure, the administrator must:

- take appropriate steps to communicate the administrative action to those likely to be materially and adversely affected by it and call for comments from them;
- consider any comments received; and
- comply with the procedures to be followed in connection with notice; and
- comment procedures

Any person whose rights have been materially and adversely affected by administrative action and who has not been given reasons for the action may, within 90 days after the date on which that person became aware of the action, request that the administrator concerned furnish written reasons for the action. The administrator to whom the request is made must, within 90 days after receiving the request, give that person adequate reason in writing for the administrative action.

National Environmental Management: Protected Areas Act (No 57 of 2003) (NEMPAA)

NEMPAA provides for protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also supports the establishment of a national register of all national, provincial and local protected areas, for the management of those areas in accordance with national norms and standards, for intergovernmental cooperation and public consultation in matters concerning protected areas, for continued existence, governance and functions of South African National Parks and for matters in relation to protected areas.

The proposed development would traverse environmentally sensitive areas (identified by biodiversity specialists during field work). Nonetheless, mitigation measures will be adhered to with regards to avoid and/or minimise detrimental impacts on the environmental sensitive areas.

4.2 LISTED ACTIVITIES

EIA Regulations 2010 promulgated in terms of NEMA under Government Notice (GN) No. R544, 545 and 546 outline the activities for which Environmental Authorisation must be applied following either Basic Assessments or EIA process.

Developments which trigger activities within GN R544 and R546 require a Basic Assessment and those that trigger GN R545 activities require a full EIA. Due to the length and capacity of the proposed transmission line and substations upgrades, a full EIA is being conducted for the proposed power line and associated works.

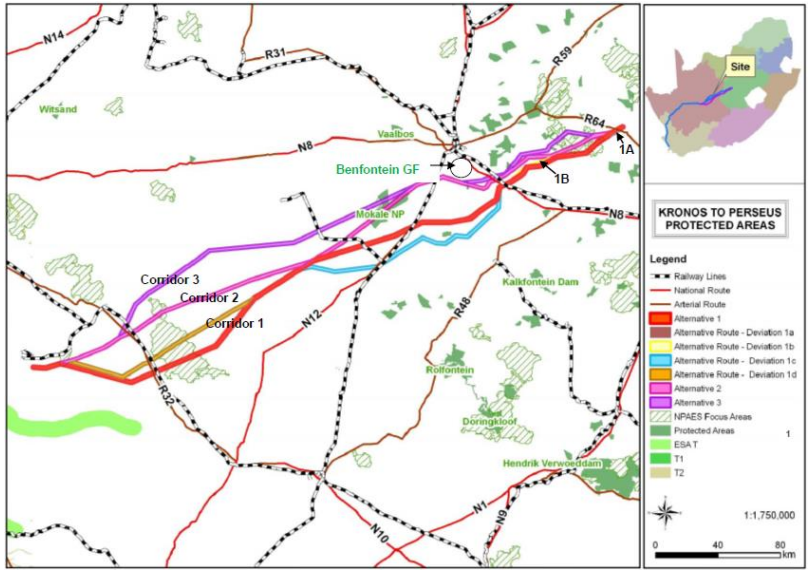
The following listed activities are relevant to this project:

Table 5: Activities listed within Government Notice No. R544, R545 and R546 applicable to this project (as per numbering in the Government Notice)

Activity Number	Description of each listed activity as per the project description	Reasons For Listed Activities Triggered
GN R544		
11(xi)	*The construction of:* *(xi) Infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.*	The footprint working area for each of the tower structures to be constructed would range from approximately 210.25m^2 to 2 125.68m^2. These area footprints exceed the threshold of 50m^2. Some of the tower structures will be constructed within a watercourse and within 32m of a watercourse. The watercourses will be impacted during the construction phase of the project and rehabilitation will be undertaken prior to the operational phase.
13	*The construction of facilities or infrastructure for the storage, or for the storage and handling of dangerous goods, where such storage occurs in containers with a combined capacity of 80m^3 but not exceeding 500m^3*	Oil collection dams will be built to collect and store transformer oils in cases of spillages at the substations. The biggest transformer in a substation could contain up to 180m^3 of oil. The oil dams will be built to accommodate a capacity of 216m^3 of transformer oil. Therefore the capacity of the oil dams would exceed the threshold of 80m^3 but less than 500m^3.
22(ii)	*The construction of a road outside an urban area:* *(ii) Where no reserve exists, where the road is wider than 8m*	Construction heavy vehicles will require access along the final route alignment from Perseus to Kronos substation to transport towers and other associated structures. Temporary access roads will be constructed during construction phase of the project and the roads will be rehabilitated prior to operational phase of the project. The access roads wider than 8m where no reserve exists will be determined along the chosen route alignment prior to construction

Activity Number	Description of each listed activity as per the project description	Reasons For Listed Activities Triggered
		phase of the project.
38	*The expansion of facilities for the transmission and distribution of electricity where the expanded capacity will exceed 275 kV and the development footprint will increase.*	Both Perseus and Kronos substations will entail an upgrade of the capacity to accommodate the 765kV transmission capacity. Only Kronos substation development footprint will increase.
GN R545		
8	*The construction of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more, outside an urban area or industrial complex.*	The proposed project involves the construction of a 765kV transmission power line from the Perseus substation near Dealesville in the Free State Province to Kronos substation near Copperton in the Northern Cape Province. The length of the power line would be approximately 388km, however, depending on the final route alignment.
GN R546		
12 (a)	*The clearance of an area of 300m^2 or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.* *(a)Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA…*	Each working area for tower construction will range from approximately 210.25m^2 to 2 125.68m^2. These working area footprints will require vegetation clearance where 75% or more of the vegetation cover constitutes indigenous vegetation. The tower working footprints of approximately 2 125.68m^2 exceeds the threshold clearance area (*the clearance of an area of 300m^2 or more of vegetation…)* The study area falls within the: • Grassland Biome, which is dominated by grasses and plants with perennial underground storage organs; • Nama-Karoo Biome, which is dominated by a grassy, dwarf shrubland; and • Savanna Biome (mainly around Jacobsdal area), which is characterised by a grassy ground layer and a distinct upper layer of woody plants. The biomes are made up of various vegetation types. The proposed

Activity Number	Description of each listed activity as per the project description	Reasons For Listed Activities Triggered
		power line would impact on at least twelve vegetation types. Of these, only one type (Vaal-Vet Sandy Grassland) is considered to be endangered. The Vaal-Vet Sandy Grassland that is present around the Perseus substation is classified as an endangered ecosystem.
16 (iv) (a) ii (aa) (bb) (hh)	*The construction of:* *(xi) Infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.* ***(a) In Free State and Northern Cape Provinces:*** *ii. Outside urban areas, in:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas; and* *(hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve.*	The footprint working area for each of the tower structures to be constructed would range from approximately 210.25m^2 to 2 125.68m^2, which exceeds the threshold of 10m^2. Some of the tower structures will be constructed within a watercourse and within 32m of a watercourse. The proposed power line routes will cross numerous perennial and non-perennial rivers and drainage lines including the Orange River, Modderrivier, Riet River and tributaries of the rivers. The watercourses that will be affected will be determined along the chosen route alignment prior to construction phase of the project. The watercourses will be impacted on during the construction phase of the project and rehabilitation will be undertaken prior to the operational phase. <u>Geographical areas:</u> As indicated in Figure (a) below, the proposed alternative routes would traverse protected areas as well as NPAES focus areas. In particular, Corridors 2 and 3 would traverse Mokala National Park and are in close proximity to Benfontein Game Farm. The route alternatives would all traverse through a portion of the Freestate Highveld Grassland focus area for expansion in close proximity to the Perseus substation. Corridors 2, 1 and Deviation 1D would traverse the Gariep Focus Area.

Activity Number	Description of each listed activity as per the project description	Reasons For Listed Activities Triggered
		 Figure a: Protected Areas, private nature reserves, and NPAES focus areas along the proposed corridor alternatives

5. APPOINTMENT OF ENVIRONMENTAL CONSULTANTS

Mokgope Consulting CC has been appointed by Eskom to undertake an Environmental Impact Assessment (EIA) for a linear activity of the proposed Perseus-Kronos 765kV Transmission Power line and Substations Upgrade. The proposed power line development is identified as an activity that may have significant detrimental effects on the environment, as defined by the EIA Regulations of 2010.

The process which is to be followed is in compliance with the National Environmental Management Act (NEMA), (Act No 107 of 1998), as amended, and the EIA Regulations as published in Government Notice No. R543 of 2010, considering Government Notice No. R544, R545 and R546 of 2010, of application for Environmental Authorisation in terms of a Scoping and full EIA process. The application has been submitted for authorisation to the National Department of Environmental Affairs and is registered under the NEAS Reference: DEA/EIA/0001555/2012; and DEA Reference: 14/12/16/3/3/2/438.

5.1. THE ENVIRONMENTAL ASSESSMENT PRACTITIONERS (EAP)

(a) Name of EAP: Mpho Nenweli

Description: Master of Environment and Society; and MBA:
Graduated from Vista University with a BA (Geography and English) and a BA Hons (Geographical Sciences). Mpho also completed a Masters (Environment and Society) from the University of Pretoria, and a Masters in Business Administration (MBA) from the Management College of Southern Africa (MANCOSA). Mpho began his career as a Supplemental Instructor at Vista University in 1998. In 2001 he joined KNA Consulting Engineers as an Environmentalist responsible for compiling EIA applications. In 2003 he was employed by the Western Cape Provincial Department of Environmental Affairs and Development Planning as an Environmental Officer, handling EIA reviews for *inter alia*, dams, roads, petrol stations, cellular masts, wine cellars, shopping centres, residential areas, amongst others, and was promoted to the position of Senior Environmental Officer in 2003. He became Assistant Director in the National Department of Social Development in 2004. In 2005, he became Deputy Director: Local Integrated Development Planning in the National Department of Social Development. He later became Deputy Director: International Population Affairs where he was involved in *inter alia*, facilitating and managing the development, implementation, monitoring and evaluation of South African international strategy on population and development. He is the founding Member of Mokgope Consulting.

(b) Name of EAP: Judith Fasheun

Description: Master of Environment and Development:
Graduated from the School of Environmental Sciences, University of KwaZulu-Natal (UKZN). Judith majored in Geography and Environmental Management, studied a B.Sc honours degree in the latter, and completed a Master's degree through the Centre of Environment, Agriculture

and Development (CEAD) at UKZN. In terms of environmental consulting, Judith has 5 years relevant experience, and has been involved in undertaking a number of EIAs associated with Eskom power line projects. Judith is a member of the International Association for Impact Assessment (IAIA) and a member of the South African Council of Natural Scientific Professions (SACNASP) registered as Certificated Natural Scientist (Environmental Science), Registration number 300019/14.

The Environmental Assessment Practitioner has signed as independent consultants in front of a commissioner of oaths. The declaration of independence from the EAP is provided in Appendix A. The EAPs' Curriculum Vitae (CV) are provided in Appendix B.

5.2 EAP COMPANY BACKGROUND

Mokgope Consulting is an independent black-owned company with its headquarters in Highlands North, Johannesburg. The company renders services in Environmental Impact Assessments, Town and Regional Planning, Development Facilitation, Project Management and Consultancy. The company has undertaken projects with various clients that range from private individuals to private companies.

Mokgope Consulting is a company with 75% shareholding owned by black women and 100% black owned. Mokgope Consulting is categorised as a Level 3 Broad Based Black Economic Empowerment Company. The members of the company have extensive experience in Town Planning and Environmental Management Systems. The staff and its strategic partners are ready to perform work of good quality to promote sustainable development in South Africa.

5.3 STRATEGIC PARTNERS

Mokgope Consulting operates largely within a well-managed network of strategic partnerships to create synergies that further enhance its project management solutions, specialist knowledge and expertise. The following is the structure of our networks:

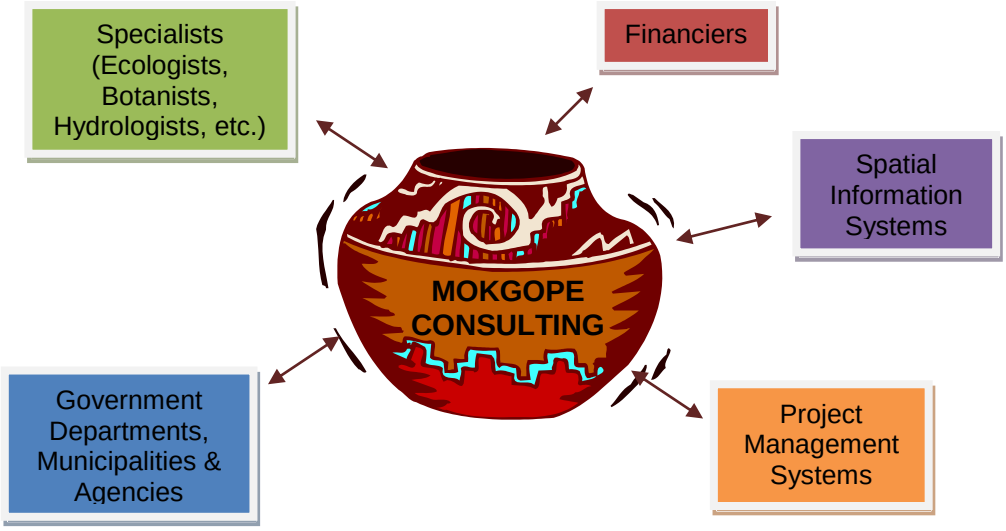


Figure 12: Network of strategic partners

This network has provided alternatives that give the company a strong competitive edge on the efficient and effective delivery of projects. With these strategic partners, Mokgope Consulting is able to offer an integrated solution for all environmental, technical and social projects.

5.4 PROJECT TEAM

Mokgope Consulting has employees that are highly conversant with South African legislation and guidelines and procedures that provide insight on how to conduct EIAs, Basic Assessments (BA) and other environmental permits. The team is experienced in conducting the following environmental management services:

- Basic Assessments;
- Full scoping and EIA process;
- Developing Environmental Management Programmes (EMPr); and
- Monitoring of compliance to Records of Decision (ROD), now known as Environmental Authorisations (EA) and EMPr.

We have skills that enable us to handle ecologically and socially sensitive projects. We also have well developed and seamless processes that enable us to deliver good quality projects on time.

Table 6 includes professionals that were involved in the running and execution of the EIA for the proposed Perseus-Kronos 765kV transmission power line project. Table 7 includes the specialists that were involved in the environmental assessment as well.

Table 6: Core EIA Project Team for Perseus-Kronos project

TEAM MEMBER MOKGOPE CONSULTING	FUNCTION
Mpho Nenweli	Project Director: Responsible for managing the project, reviewing of specialist reports, Scoping, EIA and EMP reports. Also involved in the appointment of the project team and their management thereof.
Judith Fasheun	EIA Process: Responsible for compiling the Scoping and EIA Reports. Public Participation Process: Responsible for the identification of I&APs. Also involved in stakeholder engagement and the public participation meetings.
Victoria Somo	Project Administration and Coordination; and facilitating in the Public Participation Process.
Bruce Sebolai	Afrikaans Translator for Public Participation: Coordination of key stakeholder groups (farmers unions), Community liaison and appraisal of local municipalities.

Table 7: Team of specialists appointed

FIELD	*NAME*	*EXPERIENCE*	*FUNCTION*
Vegetation	Antoinette Eyssell (Dimela Eco Consulting)	BSc (Agric, 1996), BSc (Hons, 1999) Msc Environment, 2010. Pr Sci Nat (400019/11) Ecological Science. Antoinette works privately as mainly as vegetation assessor with more than 7 years' experience.	To conduct studies on the impact of the proposed transmission line and substations on local vegetation and ecosystems.
Fauna	James Harvey	BSc (Zoology, Hydrology), BSc (Hons) (Hydrology), MEnvDev (Environmental Management). James works privately as an ecological researcher and consultant and has seven years consulting experience.	To conduct studies on the impact of the proposed transmission line and substations on local animals and their habitats. Emphasis will be placed on endangered species that may occur within the study area.
Avifauna	Jon Smallie (Wildskies Ecological Services)	BSC Hons – Wildlife Science, MSC Env Management. 13 years of experience conducting avifaunal specialist studies for electrical infrastructure. SACNASP accredited	To conduct studies on the impact of the proposed development on birds.

FIELD	NAME	EXPERIENCE	FUNCTION
Wetland	Antoinette Bootsma (Limosella Consulting)	BSc Hons (Botany, 2005), Currently registered for MSc, (Ecology). Short courses: (wetland delineation, legislation and rehabilitation, 2007); & (wetland soils, Terrasoil Science, 2009). Member: (SACNASP 400222-09). Wetland scientist - 5 years experience.	To conduct wetlands assessment on the impact of the proposed transmission line and substations on existing wetlands in the area
Agriculture	Garry Paterson (ARC Institute for Soil, Climate and Water)	Masters (Soil science), University of Pretoria in 1998. He is currently working as a senior soil scientist as the ARC- Institute for soil, climate and water. His specialty includes soil classification and mapping, soil surveys and environmental assessments. He has done a number of agricultural potential assessments for Eskom with excellent reporting skills and knowledge of soils.	To conduct an agriculture impact assessment on the impact of the proposed development on the existing area.
Visual	Gerhard Griesel (Axis Landscape Architecture)	BSc Hons (Landscape Architecture, 2002). ML(Prof), 2003. (Cand. SACLAP – 20161). Years of experience: 2004 - current.	Undertaking the aesthetic impacts of the proposed transmission line and substations.
Ecotourism	Dereck Milburn (Integrated Ecotourism Solutions)	Dereck has been actively involved in the Ecotourism Industry for the last 10 years. He is an accredited assessor with the Tourism Grading Council and is an accredited Consultant with the Tourism Enterprise Partnership. He specializes in ecotourism planning and management on all levels and holds a N.Dip in Ecotourism Management along with industry qualifications required to be an effective Ecotourism Consultant.	To identify the economic and tourism impacts associated with the project, whether positive or negative
Heritage	J. A. van Schalkwyk	Masters (Anthropology, 1985). D. Litt. et Phil (Anthropology,	To conduct a heritage impact assessment on the proposed

FIELD	NAME	EXPERIENCE	FUNCTION
		1996). Member: Association for Southern African Professional Archaeologists, Anthropology Southern Africa and African Studies Association.	transmission line and substations.
Socio-economic	Golden Chalunda (African Development Economic Consultants)	MA (Economics), B.Soc.Sc (Economics & Computer Science). Economic Consultant specialising in Sector Analyses, Urban Economics, Trade & Investment and Economic Development. Golden Chalunda will carry out all background research, and analyse and forecast the socio-economic impacts of the proposed Eskom project on business, settlements, tourism, agriculture, agriculture industry and other land uses.	To conduct a socio-economic impact assessment on the social environment affected by the proposed development

For more information on the specialists please refer to their CV and or company profiles provided in Appendix B.

6. OVERVIEW OF THE RECEIVING ENVIRONMENT

This section discusses the key characteristics of the biophysical and biodiversity aspects of the potentially affected area. For this project, the study area is defined as the development footprint and its immediate surroundings as well as to a larger scale; the local municipal areas, the broader district and region.

The information pertaining to the receiving environment has been compiled with information from desktop studies, which represent basic literature survey and a review of available spatial data. Nonetheless, information gathered during the field survey is available in Appendix M, to inform the description of the various specialist assessments within the proposed power line corridors.

6.1 BIOPHYSICAL ENVIRONMENT

6.1.1 Climate and Topography

The Free State Province receives summer rainfall and average summer temperatures of 23ºC and average winter temperatures of 8ºC. Maximum temperatures can increase to well above 30°C in summer, while frost in winter is common. The Northern Cape Province is considered semi-arid and the western portion of this province receives rainfall in winter, whereas the eastern portion usually receives summer rainfall. Rainfall increases to the east of the province and average approximately 400mm per annum. Within the eastern area studied, much of the proposed routes are situated in areas that receive late summer or early autumn rainfall. Temperatures can reach 40°C in summer, while frost and temperatures below 0°C are recorded in winter (Mucina & Rutherford, 2006).

The Provinces within the study area comprise mainly of flat to undulating landscapes while rocky outcrops and mountainous areas are encountered in some areas. The western extent of the proposed power line routes covers a flat to gently undulating plain, with some hilly and "broken" veld, mostly situated to the west and south of the escarpment. Pans can characteristically be observed within depressions and riparian areas along the lowest points in the landscape.

6.1.2 Geology and Soils

The power line corridors are for its greatest extent underlain by shale, tillite and other sedimentary rock (Figure 13). Shale is the result of the deposition of layers of clay, while the tillite consists of consolidated masses of unweathered blocks (large, angular, detached rock bodies). In the south-western extent of the corridors, schist and quartzite occur. Schist is metamorphic rock derived from clays and muds which have passed through a series of metamorphic processes involving the production of shales, slate and phyllites as intermediate

steps. Quartzite is a hard, non-foliated metamorphic rock which was originally sandstone converted into quartzite through heating and pressure.

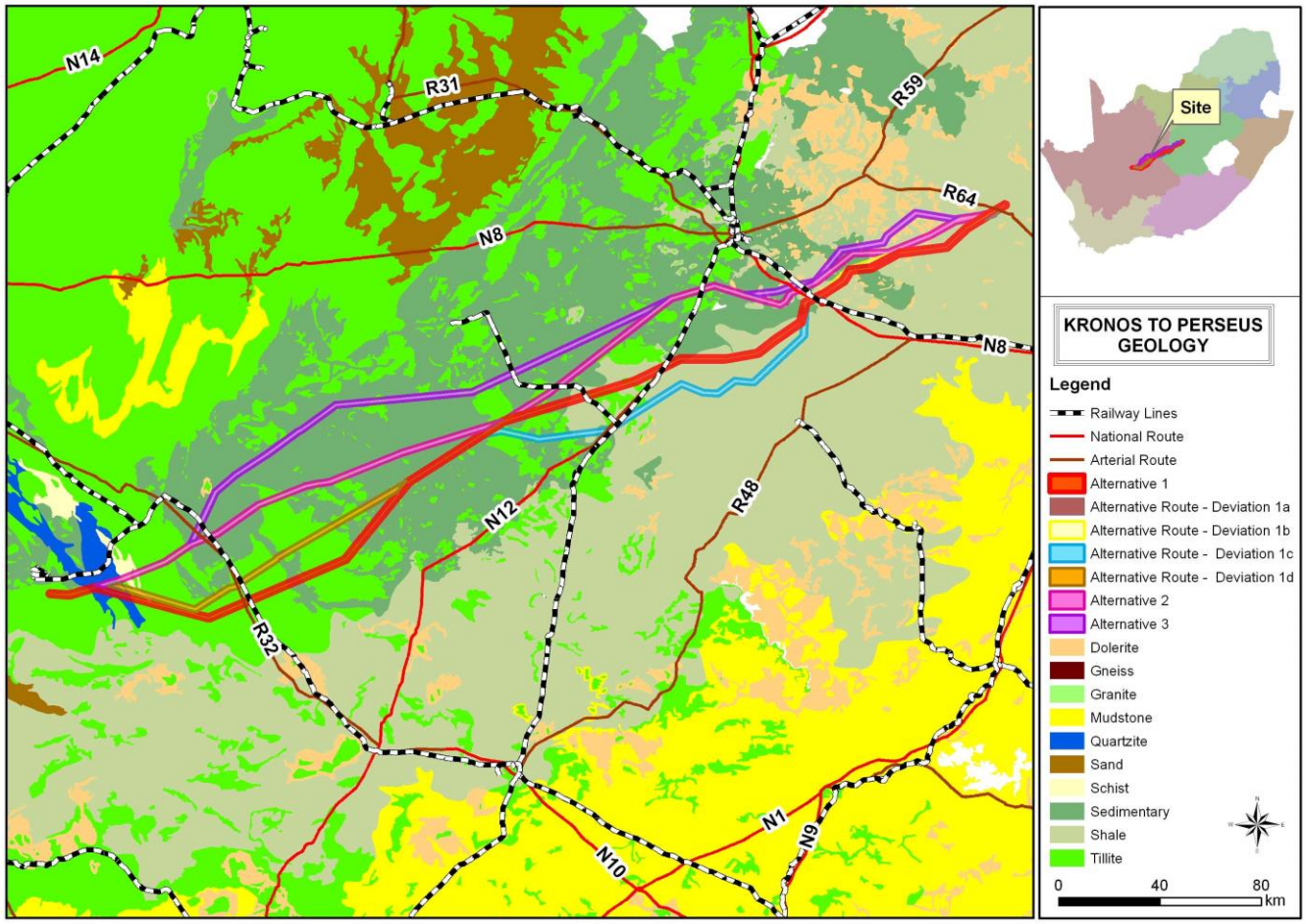


Figure 13: Geology underlying the proposed power line routes

The soil class along the most of the power line corridors is S2 (Figure 14), which is shallow, free draining and highly erodible. S13, Lithosols (shallow soils on hard or weathering rock) and S16 also occur within the corridors. S16 comprises ultrametamorphic koppies (locally called black hills) with shallow soil forms including Mispah and Glenrosa (Mucina & Rutherford, 2006). In addition, S17 is present around the Kronos substation and along Corridor 1 (southern corridor) occurs and comprise undifferentiated structure-less soils. S7 occurs, especially in proximity to the Perseus substation and comprise soils with Soils with a pedocutanic horizon (a horizon with strong blocky structure and clearly expressed cutans).

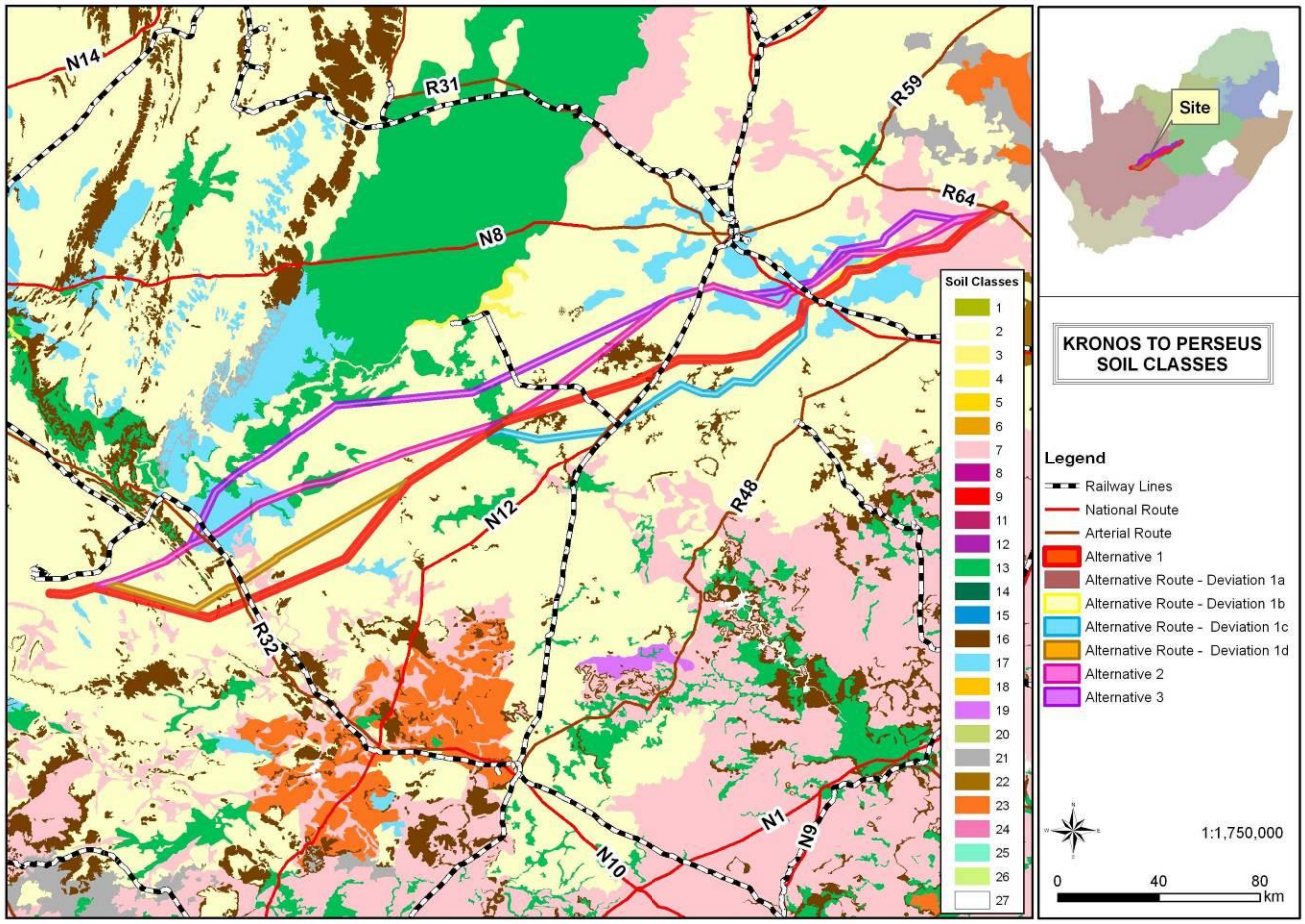


Figure 14: Soil classes underlying the proposed power line route alternatives

6.1.3 Watercourses

Surface water spatial layers such as the National Freshwater Ecosystems Priority Areas (NFEPA) Wetland Types for South Africa (SANBI, 2010) reflected the presence of several pans/wetlands and perennial and non-perennial rivers within the proposed power line corridors (Figure 15). The pans are typically endorheic (inward draining) salt pans occurring within the Grassland and Nama Karoo biomes (Mucina & Rutherford, 2006). The salt pans are characterised by depressions in the landscape containing temporary to permanent (less often) water. The pans could be dry for years between temporary flooding (Davies & Day 1986). This is mainly due to a high evaporation rate and a low precipitation rate in these parts of the country. The pan bottoms are usually formed by shales of the Ecca group which gives rise to vertic clays. Erosion in some places can be considerable. The highest concentration of pans in South Africa is found in the Northern Cape, Western and North-Central Free State. A high occurrence of these pans is noted in the north eastern extent of the corridors (Figure 15).

Perennial and non-perennial rivers are intersected by the proposed corridors and extensive systems of intermittent river channels are evident (Figure 15). Main rivers include the Orange River, Modderrivier, Riet River and tributaries of the Vaal River and Brak River

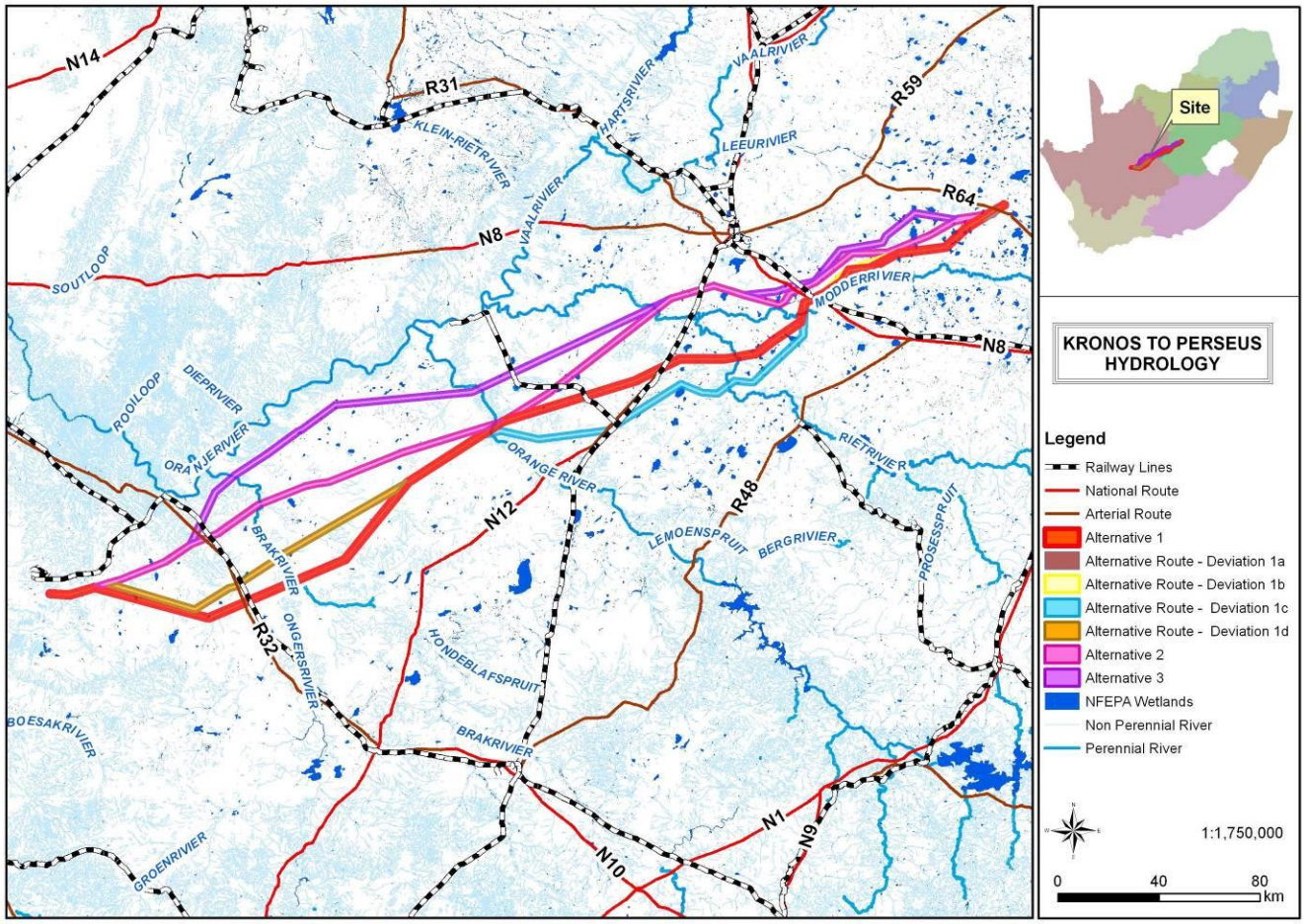


Figure 15: Water courses and water bodies along the proposed route alignments

Quaternary catchment

The power line corridors stretch over eighteen (18) Quaternary Catchments (Table 8). As per Macfarlane *et al*, (2009) one of the most important aspects of climate affecting a wetland's vulnerability to altered water inputs is the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) (i.e. the average rainfall compared to the water lost due to the evapotranspiration that would potentially take place if sufficient water was available). As per Table 8, the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) in the catchments are relatively low (<1) and signifies that wetlands within this quaternary catchment are more dependent on water from their upstream catchment than on direct precipitation (Macfarlane, *et al*, 2009). Consequently, the wetlands are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

Table 8: Characteristics of the Quaternary Catchments relevant to the assessment of wetland health (Adapted from Schultze [1997])

Catchment	Mean Annual Precipitation MAP (mm)	Potential Evaporation PET (mm)	MAP: PET
C51K	337.9	2572.8	0.13
C51L	325.2	2670.6	0.12
C51M	308.0	2679.1	0.11
C52H	438.9	2452.8	0.18
C52K	393.9	2517.5	0.16
C52L	364.0	2601.5	0.14
D33H	280.5	2679.6	0.10
D33J	232.9	2686.6	0.09
D33K	277.8	2726.6	0.10
D54D	168.0	2731.9	0.06
D62D	288.6	2463.8	0.12
D62G	234.9	2656.1	0.09
D62H	198.4	2694.8	0.07
D62J	222.2	2717.9	0.08
D71A	268.9	2721.9	0.10
D71C	242.3	2736.5	0.09
D71D	239.6	2738.8	0.09
C51K	337.9	2572.8	0.13

6.2 BIODIVERSITY ENVIRONMENT

6.2.1. Vegetation

Biomes

The study area falls within the Grassland Biome, the Nama-Karoo Biome as well as the Savanna Biome of South Africa. The Grassland Biome is dominated by grasslands wherein high summer rainfall, combined with dry winters, frost and veld fires are unfavourable to the growth of indigenous trees. The Grassland Biome therefore comprises mainly of grasses and plants with perennial underground storage organs, for example bulbs and tubers. The majority of plant species in grasslands are non-grassy herbs (forbs) of which the growth of various species are stimulated by fires. Furthermore, the majority of Rare and Threatened plant species in the

summer rainfall regions of South Africa are restricted to high-rainfall grasslands, making the Grassland Biome in most urgent need of conservation.

The Savanna Biome is the largest Biome in southern Africa, occupying over one-third of the surface area of South Africa (Mucina & Rutherford, 2006). Rainfall varies from 235 to 1 000 mm per year and frost may occur. The vegetation is characterised by a grassy ground layer and a distinct upper layer of woody plants. Where this upper layer is near the ground the vegetation may be referred to as Shrubveld, where it is dense, as Woodland, and the intermediate stages are locally known as Bushveld (Mucina & Rutherford, 2006). Most of the savanna vegetation types are used for grazing and due to the Kruger and Kalahari Gemsbok National Parks as well as numerous game farms within the Biome, conservation of the vegetation is considered good. However, half of the Savanna vegetation types are considered to be inadequately conserved (Mucina and Rutherford, 2006).

The Nama-Karoo Biome is characterized by summer rainfall that varies between 100 and 520mm per year. The majority of this Biome is covered by a lime-rich, weakly developed soil over rock and although less than 5% of rain reaches the rivers, the high erodibility of soils poses a major problem where overgrazing occurs (Mucina and Rutherford, 2006). The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and grazing rapidly increases the relative abundance of shrubs. This Biome is subjected to alien invasive species such as *Opuntia aurantiaca* (Prickly Pear) and *Prosopis glandulosa* (Honey-Mesquite). Most of the land is used for grazing and under conditions of overgrazing, many indigenous species may proliferate, including *Rhigozum trichotomum* (Threethorn), *Chrysocoma ciliata* (Bitterbos) and *Acacia karroo* (Sweet Thorn). There are very few rare or threatened plant species in the Nama Karoo Biome. Biomes can be divided into smaller units known as vegetation types wherein the vegetation, soil and landscapes are similar.

Vegetation Types

Each biome is made up of various vegetation types, based largely on soil, topography and climate variations within the biomes. The proposed power line corridors could impact on ten (10) vegetation types as geographically presented in Figure 16 and listed in Table 9 (Mucina & Rutherford, 2006). One of these vegetation types, Vaal-Vet Sandy Grassland, is considered to be endangered due to a high degree of transformation within this grassland by cultivation and grazing. In addition, the Upper Gariep Alluvial Vegetation is currently vulnerable to further degradation and transformation. The remainder of the vegetation types along the propose power line routes are not considered to be in danger as the remaining extent of natural vegetation (> 90%) is more than the conservation target (between 21% and 24%) for these vegetation units. Although much of the vegetation occurring along the proposed power line routes are classified as Least Threatened, very little or none of these vegetation types are formally protected e.g. in. reserves or other protected areas (Table 9).

Table 9: Vegetation types that occur within the study area

Biome	Bioregion (vegetation organisation level between that of vegetation type and biome)	Vegetation Type	Conservation Status
Grassland	Dry Highveld Grassland	1. Vaal-Vet Sandy Grassland	Endangered
		2. Western Free State Clay Grassland	Least Threatened, but not protected
Savanna	Eastern Kalahari Bushveld	1. Vaalbos Rocky Shrubland	Least Threatened
		2. Kimberley Thornveld	Least Threatened
Nama-Karoo	Upper Karoo	3. Northern Upper Karoo	Least Threatened bur hardly protected
		4. Upper Karoo Hardeveld	Least Threatened but poorly protected
		5. Eastern Upper Karoo	Least Threatened but hardly protected
	Bushmanland Bioregion	6. Bushmanland Arid Grassland	Least Threatened but poorly protected
		7. Bushmanland Basin Shrubland	Least Threatened
		8. Lower Gariep Broken Veld	Least Threatened, poorly protected
Azonal*	Inland Saline Vegetation	9. Highveld Salt Pans	Least Threatened
	Alluvial	10. Upper Gariep Alluvial Vegetation	Vulnerable, associated with riparian vegetation

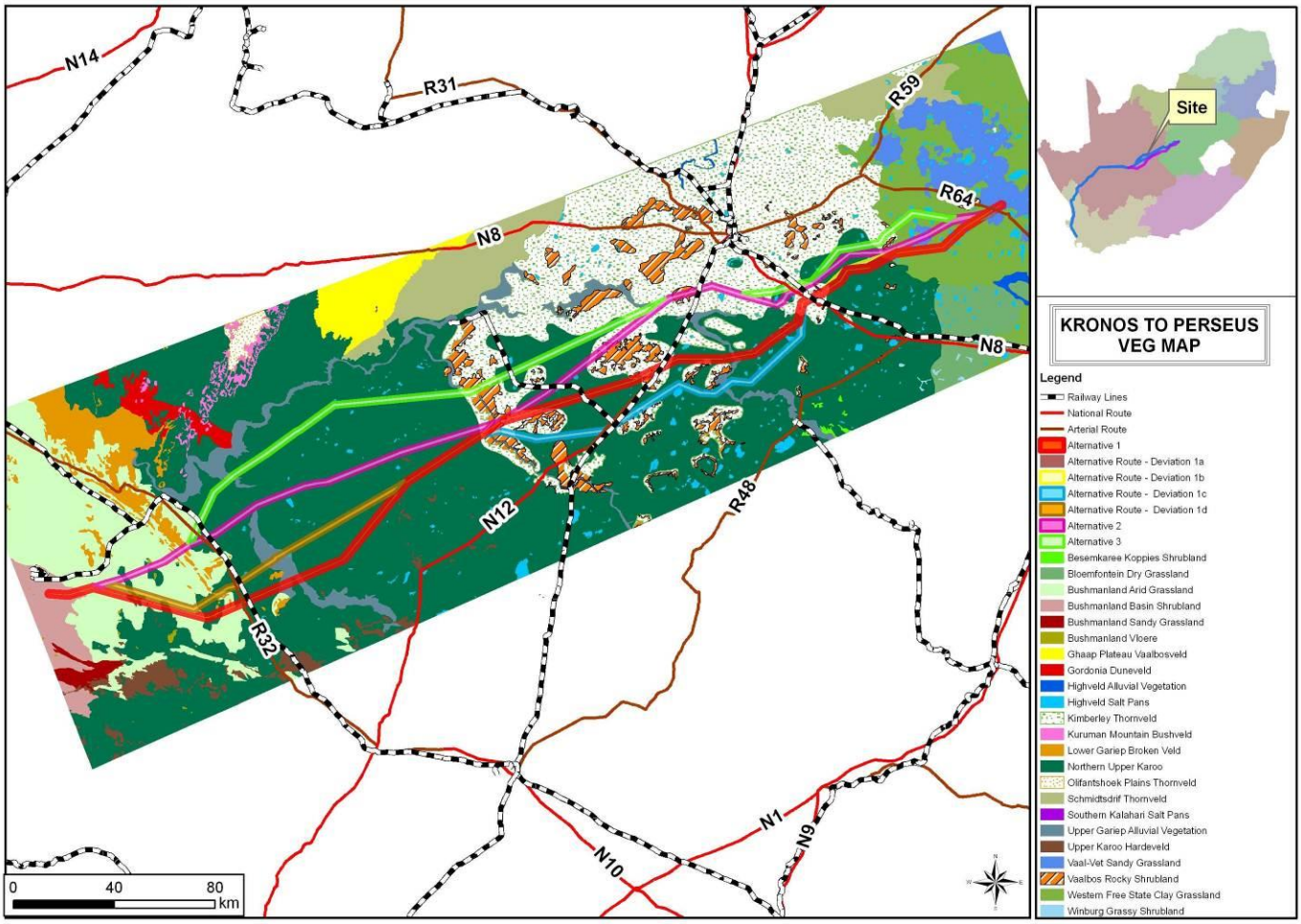


Figure 16: Vegetation types occurring along the proposed Perseus-Kronos route alignments

Listed Ecosystems

The South African Biodiversity Act (Act 10 of 2004) provides for the listing of threatened or protected ecosystems. These ecosystems are grouped into Critically Endangered-, Endangered-, Vulnerable- and Protected Ecosystems (Section 52(1) (a) of the National Environmental Management: Biodiversity Act (Government Gazette 34809, Government Notice 1002, 9 December 2011)). Development a listed ecosystem could have environmental authorization implications in terms of the National Environmental Management Act, 1998 (Act No 107 of 1998) [NEMA] and Environmental Impact Assessment (EIA) regulations. This means any development that involves loss of natural habitat in a listed critically endangered or endangered ecosystem is likely to require at least a basic assessment in terms of the EIA regulations. Wherever listed ecosystems occur, these areas should be included as sensitive areas and be incorporated into Environmental Management Frameworks (EMF's). Therefore, impacts should be avoided, minimised, mitigated and / or offset considered were appropriate.

The Vaal-Vet Sandy Grassland that is present around the Perseus substation is classified as an Endangered ecosystem.

Protected Areas

Protected areas (PAs) in South Africa should be regarded as sensitive to developments. South Africa's legislated PAs are grouped as the following types:

- Type 1: includes National Parks, Provincial Nature Reserves, Local Authority Nature Reserves and Department of Forests and Fisheries' Forest Nature Reserves Forest Nature Reserves.
- Type 2: includes Mountain Catchment Areas, Wildlife Management Areas, private nature reserves, National Heritage Sites, Department of Forestry and Fisheries (DAFF) Forest Areas, South African Defence Force (SANDF) property, bird sanctuaries, and botanical gardens.
- Type 3: includes game farms, private game reserves and conservancies.

Protected Areas Expansion Strategy

South Africa's PA network currently falls far short of sustaining biodiversity and ecological processes and therefore the National Protected Area Expansion Strategy (NPAES) is being implemented (DEA, 2009). The NPAES was commissioned by the Department of Environmental Affairs (DEA), co-ordinated by the South African National Biodiversity Institute (SANBI), and drafted in close collaboration with the South African National Parks (SANParks), other national conservation agencies and the Provincial conservation agencies. A project team comprising SANBI, SANParks and DEA provided oversight to specialist consultants contracted to draft the strategy. The goal of the NPAES is to achieve cost effective protected area expansion for ecological sustainability and increased resilience to climate change. The NPAES sets targets for PA expansion, provides maps of the most important areas for PA expansion, and makes recommendations on mechanisms for PA expansion. The NPAES uses two factors, importance

and urgency, to identify priority areas for PA expansion in the terrestrial environment. Although not currently protected, these areas should be considered as being of high development constraint for infrastructure proposed to be located within or in close proximity to these areas.

The proposed power line corridors will all traverse through a portion of the Free State Highveld Grassland focus area for expansion (in close proximity to the Perseus substation). In addition, Corridors 1, Deviation 1D and Corridor 2 will pass through a Gariep focus area, while Corridor 3 will pass just north of this Gariep focus area (Figure 17).Therefore, it is advisable that any electrical infrastructure in this area be planned in consultation with the South African National Biodiversity Institute (SANBI) as well as the Department of Environmental Affairs (DEA).

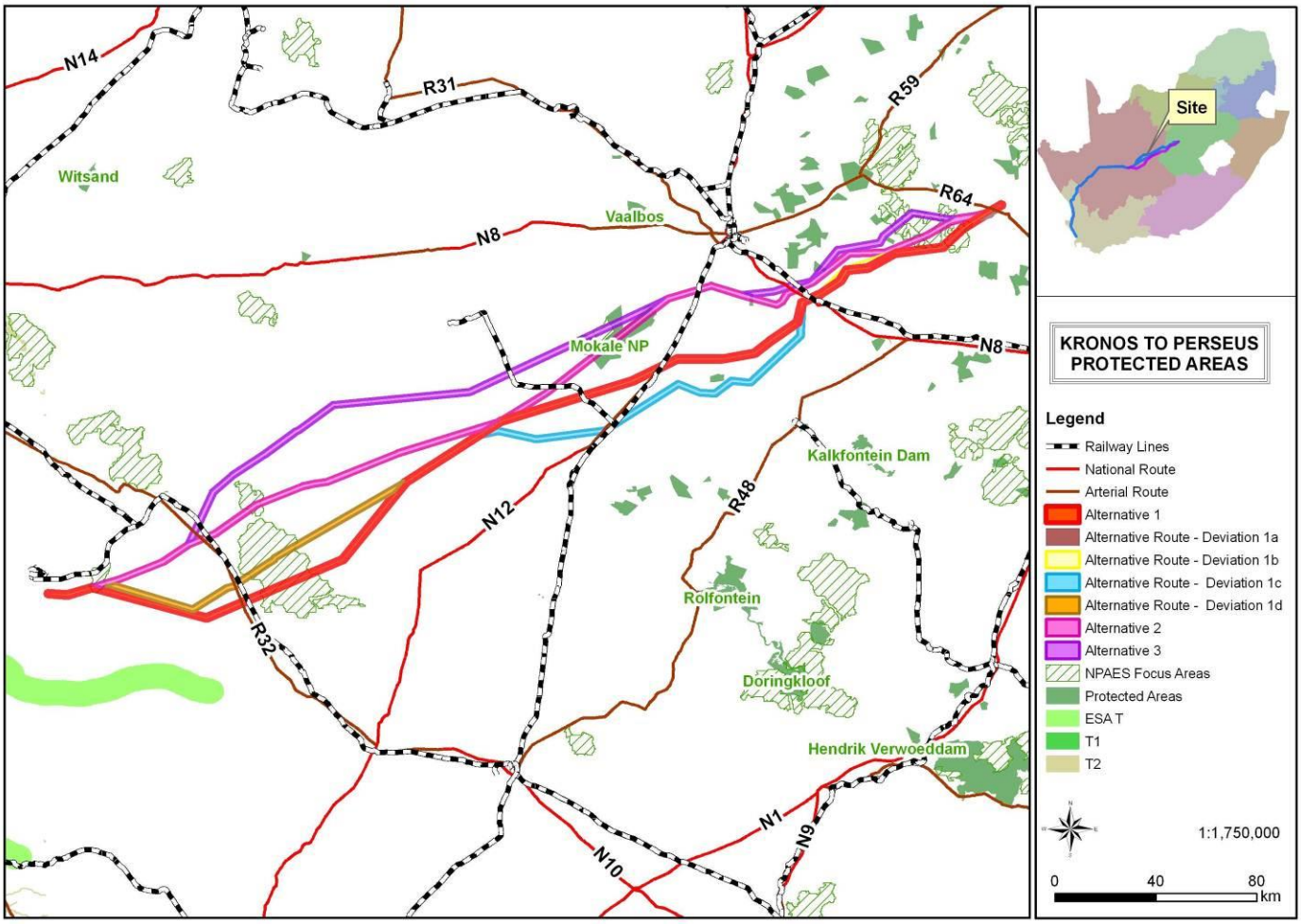


Figure 17: Protected areas, NPAES focus areas, CBA's and ESA's along the proposed Perseus-Kronos proposed power line corridors

6.2.2 Fauna

The broader study area is likely to support a reasonable diversity of terrestrial vertebrate fauna. This includes a small number of mammals of conservation importance (Friedmann & Daly 2004). The fauna and vegetation studies that were conducted identified the species present in greater detail, assessed the effect of the proposed development on ecological communities (especially sensitive species) and provided recommendations, including mitigation measures, where necessary (Fauna Report, Appendix M).

6.2.3 Avifauna

The possible impacts of the proposed power line on avifauna include the following: collision of birds (predominantly large terrestrial species) with the overhead cables; destruction or alteration of bird habitat during construction and maintenance; disturbance of birds (particularly those breeding) during construction and maintenance of the power line; nesting of birds on the tower structures; and electrical faulting caused by birds perching, nesting or roosting on towers.

Collision of birds with overhead cables, in particular earth wires

Large terrestrial bird species likely to be found in this area include Ludwig's Bustard *Neotis ludwigii*, Secretary bird *Sagittarius serpentarius*, Kori Bustard *Ardeotis kori*, Blue Crane *Antrhopoides paradiseus*, Northern Black Korhaan *Afrotis afraoides*, and Karoo Korhaan *Eupodotis vigorsii*. Of these species, conservation concern is greatest for the bustards and cranes, which are both classified as 'Vulnerable' by Barnes (2000), and the Secretary bird (Near-threatened, Barnes 2000). These species are well known to be susceptible to collisions with power lines and the existing power lines in the broader area are known to cause significant numbers of bird collisions of these species.

Habitat destruction

This route will traverse an arid area, with low vegetation and open landscapes. There is an important protected area – Mokala National Park situated in the study area. Several Important Bird Areas are also situated close to the alignment such as SA037 Platberg Karoo Conservancy, SA033 Benfontein, and SA031 Dronfield farm (BirdLife South Africa 2012). Two large rivers, the Vaal and Riet, are in the study area and may need to be crossed by the line. The type of open landscape that is dominant in this study area is prime habitat for large terrestrial birds and raptors. Fortunately this habitat type is likely to be fairly uniform in the broader landscape and so the impact of the proposed power line through habitat destruction is anticipated to be low provided the above mentioned sensitive areas are avoided.

Disturbance of birds

Whether disturbance of birds occurs or not will need to be confirmed during a walk down of the approved corridor, but it could be a concern for large eagles breeding on the existing transmission lines (or natural substrate) in the area.

Electrical faulting caused by birds

For this interaction to occur requires either large birds such as eagles and vultures or large numbers of smaller birds regularly perching or roosting on the towers. The likelihood of this will be assessed in more detail during the EIA phase but at this stage it is considered unlikely to be a significant impact. The likelihood of electrical faulting caused by birds is low on a 765kV power line due to the large clearances between hardware, but is also dependent on the exact tower structure used.

Nesting of birds on tower structures

Of the large raptors, White-backed Vulture *Gyps africanus* could occur on site as it has a strong population in the Kimberley area. White-backed Vulture has been recorded nesting on transmission towers previously. Verreaux's Eagle *Aquila verreauxii* and Martial Eagle *Polemaetus bellicosus* are also likely to occur here and have proven elsewhere that they readily use power lines to perch and nest on. Of the medium sized raptors, Black-chested Snake-Eagle *Circaetus pectoralis*, Southern Pale Chanting Goshawk *Melierax canorus*, Steppe Buzzard *Buteo vulpinus*, Jackal Buzzard *Buteo rufofuscus*, Booted Eagle *Aquila pennatus*, and Lanner Falcon *Falco biarmicus* are also likely to be recorded in the area. Certain of these species could nest on the power line. Nesting of birds on the proposed power line could be viewed as a positive interaction since the power line provides nesting substrate in an area otherwise devoid of substrate (few trees). However it is likely that there are also negative consequences of birds breeding on power lines, such as increased exposure to collision with cables, and possible exposure to electromagnetic fields created by the electricity. There is also the consequence of nest management (trimming, relocation, removal) by Eskom staff being necessary if the birds choose to nest in the wrong areas on the towers.

7. SCOPING AND EIA PROCESS

7.1. SCOPING PROCESS

The following objectives were met during the Scoping process:

- To identify and evaluate potential environmental impacts that could emanate from activities at different stages of the implementation of the proposed development. These could either be positive and or negative impacts. This was done through a desktop review of existing data.
- To provide the competent authorising body with sufficient information to identify the issues that require assessment as well as the nature and extent of specialist studies required during the EIA process.
- To clarify scope and nature of activities and reasonable and feasible alternatives to be considered during the EIA process.
- To ensure considerable evaluation of all alternatives including the “do nothing option”.
- To identify key environmental, socio-economic and biophysical issues associated with the proposed development.
- To conduct an open participatory and transparent process and facilitate the inclusion of Interested and Affected Parties and stakeholders’ concerns of the proposed project in the decision making process.

Figure 18 below provides a summary illustration of the Initiation and Scoping Phase.

The EIA process followed the framework outlined in Figure 19 as far as the finalization of the Environmental Impact Report.

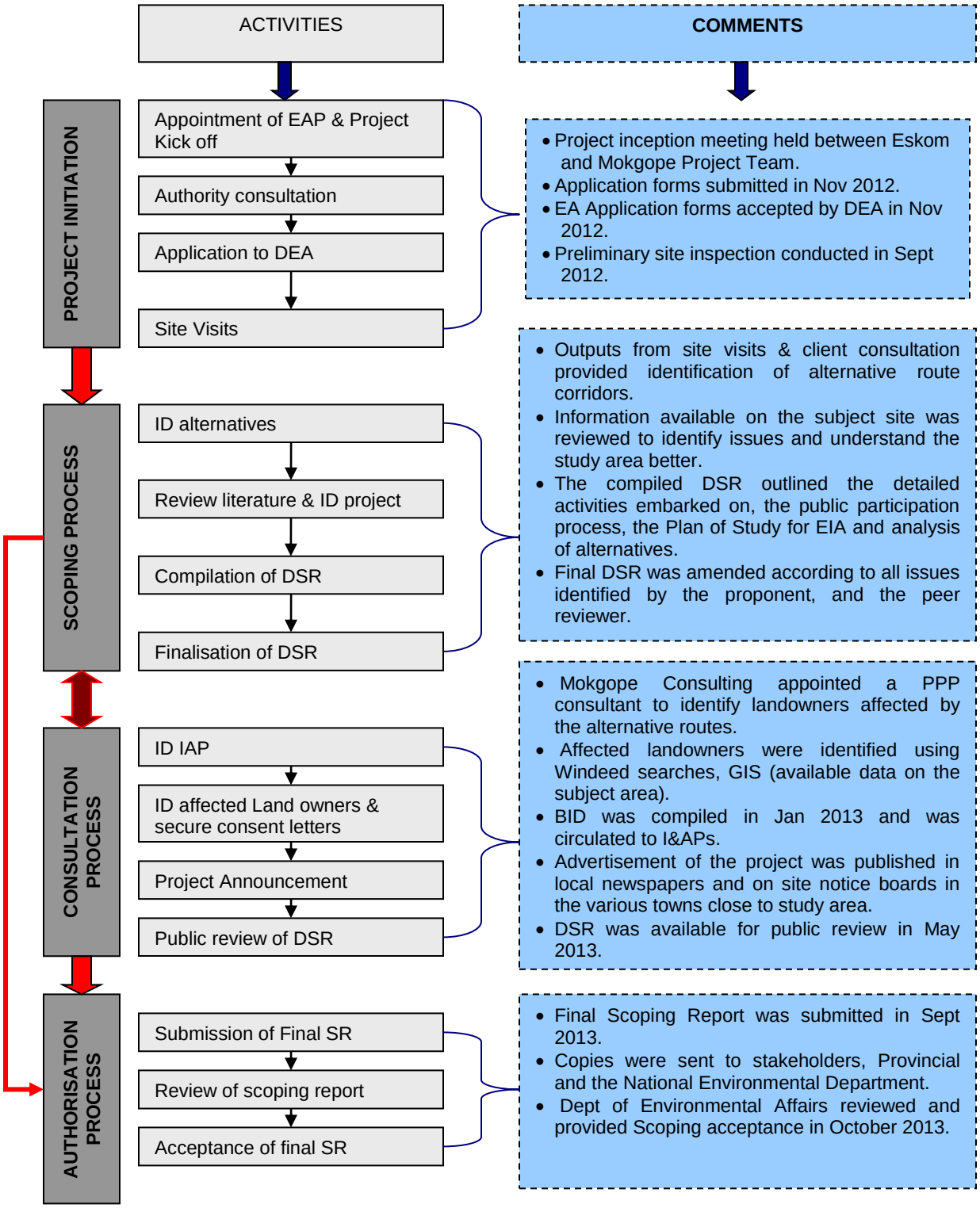


Figure 18: Initiation and Scoping Stage flow chart

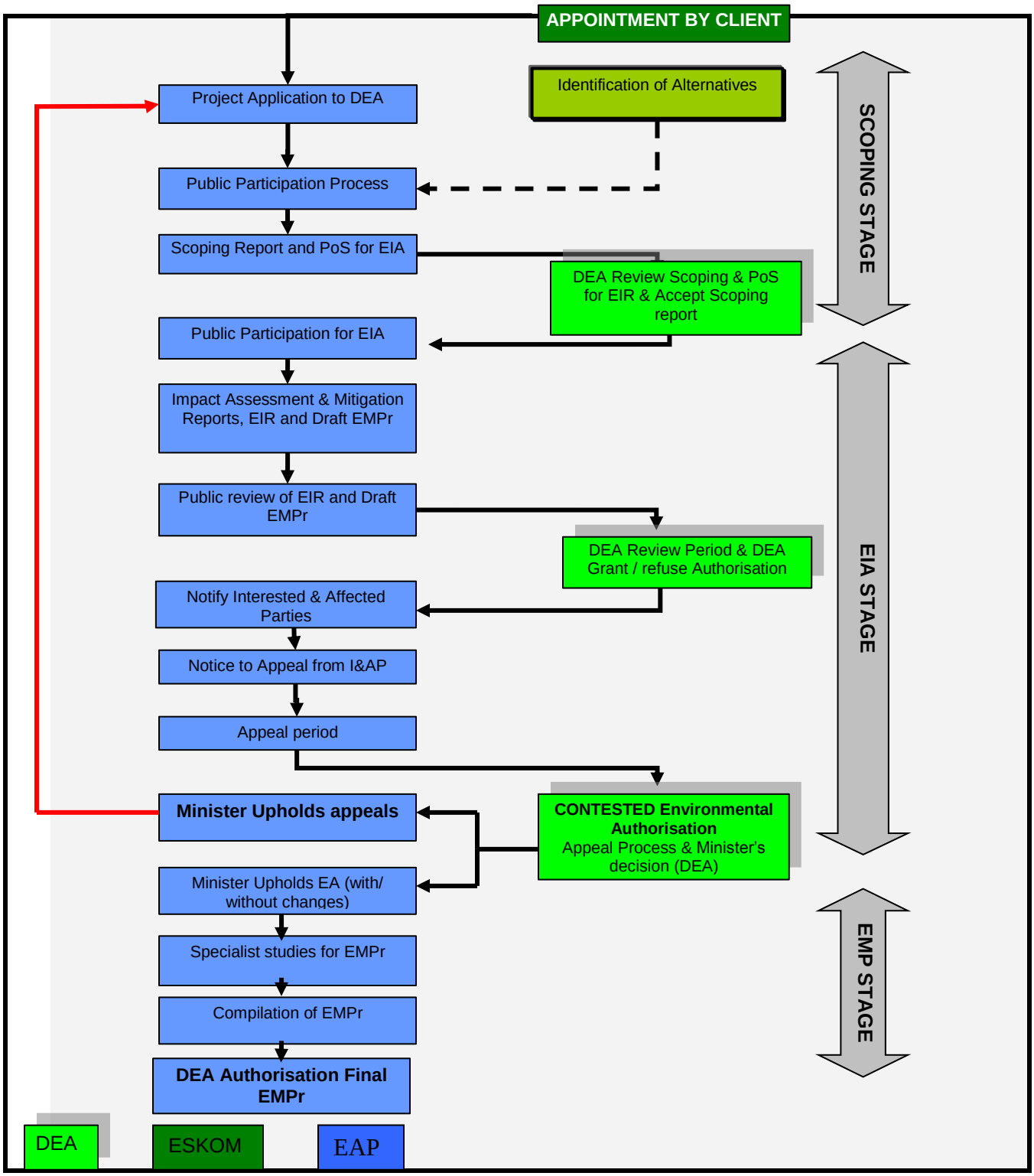


Figure 19: Outline of the EIA process flow

7.2 TECHNICAL PROCESS

For the Scoping phase, the following technical process has been followed:

7.2.1 Pre-consultation meeting with client

On notification and receipt of the appointment letter from Eskom, a project inception meeting was held on 11 September 2012 between Eskom and Mokgope Consulting. During the kick-off meeting the following was discussed:

- Project Scope and requirements (confirmation of scope of work);
- Project Schedule;
- Identification of key stakeholders and role players; and
- Preliminary analysis options for power line route corridors and substations upgrade.

7.2.2. Application for Authorisation in terms of GN No 543 of 2010

Application for authorization following an EIA was submitted to DEA in November 2012. DEA acknowledged receipt and acceptance of the application by providing the project reference numbers. NEAS Ref: DEA/EIA/0001555/2012 and DEA Ref: 14/12/16/3/3/2/438.

Northern Cape Department of Environment and Nature Conservation and Development, and Free State Department of Economic Development, Tourism and Environmental Affairs are regarded as the key commenting authorities on this project and they have been included on the list of Key stakeholders.

To secure approval for Scoping report from the authorities, Mokgope Consulting embarked on the following activities:

- Compilation of the Draft Scoping Report (DSR);
- Circulation of the DSR to I&APs for comments;
- Finalisation of the Final Scoping Report (FSR) incorporating comments from I&APs and stakeholders; and
- Submission of the DSR and FSR.

7.2.3 Landowner Consent

Eskom Holdings currently does not own any properties where the proposed transmission power line would be constructed. Therefore, land owners consent and registration of servitudes will be required for the final alignment within the approved corridor.

7.2.4 Site Inspection

Mokgope Consulting and Eskom undertook a preliminary flyover site inspection between the 18 and 20 September 2012. Site inspection photographs are provided in Appendix E.

The site inspection was conducted with the intention to:

- Gather information about the study area;
- Identify properties which may be crossed by the proposed transmission line. This would require negotiations with the landowners for the construction of the transmission line;
- Identify alternatives for the power line construction and substations upgrade;
- Provide a visual understanding of the study area. This would also offer an opportunity to conduct a precursory assessment of impacts of the proposed development on the biophysical and social environment; and
- Provide an opportunity to advertise the proposed transmission power line.

7.2.5 Identification of issues

To compile the Final Scoping Report, issues identified from I&APs, local municipalities, field visits and consultations with Eskom were considered. This information made it possible to identify additional specialist studies required. The studies were used in the assessment of potential impacts from the proposed development as well as identifying sensitive areas. The following specialist studies were conducted during the EIA phase:

Table 10: Specialist Studies and requirements

Specialist Studies	Requirements
Flora and Fauna	• Provide status of habitat and identification of all ecologically sensitive areas. • Identify endangered species and their locations. • Identify conservation worthy areas and how the proposed development can avoid them. • Identify potential impacts of the fauna and flora, if any, on the proposed infrastructure per alternative route corridor to be assessed and substations to be upgraded. • Identify potential impacts and mitigation measures of the proposed infrastructure on the fauna and flora per alternative route corridor to be assessed and the substations to be upgraded. • Provide recommendations for clearing of plants and acceptable heights. • Recommendation of the best alternative route corridor and technology to be used.
Avifauna	• Provide status of bird habitats in the area and any endangered species including their migration patterns. • Identify areas where bird interactions may play a major role. • Classify potential bird impacts, if any, on the proposed infrastructure and

Specialist Studies	Requirements
	infrastructures impact on the bird species in the area. • Recommendations regarding how to mitigate any potential impacts on both birds and the proposed infrastructure. • Recommendation of the best alternative route corridor and technology to be used.
Wetland Assessment	• Identify wetlands and river crossings. • Mapping of information digitally on all alternatives being assessed. • Analyses of both negative and positive impacts on the proposed infrastructure, if any, and on the natural environment by the proposed development. • Recommendations for mitigation measures for each potential impact identified. • Recommendation of the best alternative route and technology.
Agricultural Assessment	• Identify agricultural activities taking place in the area and the significance to the local economy and livelihoods. • Identify stakeholders in this sector to be engaged on the proposed development, • Analyses of both negative and positive impacts on the agriculture by the proposed development. • Recommendations for mitigation measures for each potential impact identified. • Identify potential impacts of the proposed power line on the agricultural sector in the area. • Recommendation of the best alternative route corridor and technology.
Heritage Impact Assessment	• Identification & location of archaeologically, historically important areas, heritage declared sites, paleontology sites. • Mapping of all areas to be affected and the identification of mitigation measures. • Recommendation of the best alternate route.
Visual Impact Assessment	• Identification and location of visual impact that may affect no-go areas. • Development of mitigation measures. • Recommendation of the best alternative routes and technology.
Socio-economic Impact Assessment	• Social and economic impact assessment of the proposed development. • Identify service crossings, electrified railways, roads, airfields, and local settlements with people who will be affected by the proposed development. • Provide a brief background of the area (i.e. language, population composition amongst others). • Identify socio-economic factors of locally affected communities and how they will be impacted by the proposed development. • Identification of various land uses *e.g.* agricultural areas, mining, game lodges, nature reserves, zonings and future land use to be considered during corridor selection. • Identification of proposed townships lodged with local municipalities within

Specialist Studies	Requirements
	the study area, if any. • Identify potential impacts of the proposed development on those settlements and land-uses or economy. • Identify areas of tourism potential in the study area that may be affected by the proposed development. • Recommendation of the best alternative route corridor and technology.
Ecotourism Assessment	• Identify pristine and relatively undisturbed natural areas. • Provide insight into the impact of human beings on the environment, and to foster a greater appreciation of our natural habitats. • Outline principles that minimize the negative aspects of conventional tourism on the environment and enhance the cultural integrity of local people.
Geographical Information Systems	• All maps to be produced in a format which will enable the process of corridor and route selection and assessment of issues for inclusion in the Scoping report and EIR. The maps will include information like land use, access routes, conservation areas and locality. The locality maps must be printed on A3 size to ensure clear illustrations.

The studies would also identify the potential positive impacts of the proposed development such as skills transfer to local communities and employment opportunities particularly during the construction phase.

7.2.6 Collection of Information

Mokgope Consulting gathered information on the potential impacts of the project from various stakeholders, registered Interested and Affected Parties (I&APs), local authorities and Eskom. Basic information was gathered from existing literature on the study area with inputs from various specialists. Information gathered was used to compile the Draft Scoping Report (DSR) which was circulated back to the stakeholders for review before being submitted to DEA for final review and acceptance.

7.2 7. Review of DSR

The DSR was prepared on the basis of information and issues identified during the Scoping Phase of EIA process. The DSR was amended based on public review and comments obtained from the I&APs (including the commenting authority and the Provincial Environmental Departments). Findings of the assessments of the specialist studies were compiled during the EIR phase.

7.3 PUBLIC AND STAKEHOLDER PARTICIPATION DURING SCOPING

7.3.1 Background Information Document

A Background Information Document (BID) was drafted, ratified and approved by the client before it was circulated to all identified I&APs. The BID encouraged all individuals to contact Mokgope Consulting should they wish to be registered on the I&AP database and/or make a comment regarding the proposed project. The BID is provided in Appendix D.

7.3.2 Registration as Interested and Affected Parties

All I&APs were notified of the project through: site notice posters; telephonic conversations; fax; post; and or e-mailed, as well as advertising in regional and local newspapers. The following methodology was utilised to identify all major stakeholders and interested and affected parties:

- GIS data available;
- Deeds searches;
- Researching relevant local, provincial and / or national stakeholders; and
- Random identifications (such as farmers' associations) during site visits and public meetings.

7.3.3 Identification of I&APs

Criteria used to identify I&APs affected is as follows:

- Landowners within the 2km corridors of the proposed transmission line construction and substations upgrade;
- Landowners and occupiers of land in close proximity to the proposed alternative route alignments and substations;
- Industries and other projects in the vicinity of the proposed development; and
- Government Departments in the Northern Cape and Free State Provinces.

Names and contact details of the affected landowners were recorded on the I&AP Register. The first contact with these I&APs was in the form of a written notice accompanied by a BID. Notices were sent to all identified I&APs. The registers of identified I&APs has been provided in Appendix F.

Please note that the I&APs Register was updated continuously at each stage of the EIA process.

7.3.4 Newspaper Adverts

Adverts were published in the following newspapers in English and Afrikaans:

- The Weekly;
- Oewernuus; and
- Volksblad.

These advertisements were calling for registration of I&APs on the project register and announcing the public meetings that were held end of May 2013. The proof of advertisements is provided in Appendix H.

All respondents were registered and confirmation of registration was sent to them in their preferred medium of communication. For all I&APs who responded to the advert, a written acknowledgement letter accompanied by a BID was sent to them as confirmation of registration on the project database.

7.3.5 Site Notices

Site notices were posted early May 2013 at various focal points in the towns that are in close proximity to the proposed development. The site notice photographs are provided in Appendix G.

7.3.6 Involvement of Key Stakeholders

The affected local authorities and organisations were contacted to introduce the project and identify relevant people to engage with during the project execution process. Names of representatives from these authorities and organisations were included in the I&APs database and received project correspondence. Written notification of the project together with a BID was sent to the relevant stakeholders. Identified key stakeholders are registered in the I&APs Register provided in Appendix F.

7.3.7 Public Meetings

Public meetings were held in the areas that were convenient for affected parties and landowners to travel to. During the public participation meetings, presentations were conducted in English and translated in Afrikaans. The notification of the public meetings was advertised in local and regional newspapers.

The purpose of the meetings comprised the following:

- To introduce the project to the local I&APs;
- To identify issues pertinent to the project;
- Invite people to register as I&APs;

- To link Eskom, the consultant and local communities; and
- To provide I&APs with an opportunity to participate in the identification of feasible alternatives route corridors.

The minutes and attendance registers of the public meetings are provided in Appendix I.

7.3.8 Public review of Draft Scoping Report

All stakeholders were given the opportunity to review and comment on the Draft Scoping Report (DSR) in accordance with Environmental Regulation 56. The report was placed at Prieska Library, Douglas Library, Jacobsdal Library and Boshof Library. Written notices were sent to stakeholders to inform them of the availability of the report. In addition, advertisements in English and Afrikaans were published in the relevant newspapers. Copies of the Scoping Report were made available on www.mokgope.co.za.

All key stakeholders and I&APs were afforded 40 days to comment on the DSR. All I&APs were given an opportunity to forward their written comments, objections, inputs and queries within that period. This was done in order to assess and provide stakeholders and I&APs an opportunity to comment on the alternative route corridors to be recommended during the EIR Phase. All comments received from stakeholders and I&APs were acknowledged and contained in the “Comments and Response Report”, which is provided in Appendix J. Stakeholders and I&APs were required to make all their comments to Mokgope Consulting.

The DSR was amended to include all issues and concerns raised by the public during the commenting period (May to June 2013). Some of the constraints identified during the public meetings were overlaid in the locality map. The amended Scoping Report was published as a Final Scoping Report and submitted to DEA for final review in September 2013. The Scoping Report was approved in October 2013 and formed the basis for further studies to be conducted during the EIA phase.

8. ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

This section gives a brief outline of the process followed when conducting the EIA process for the proposed 765kV transmission line and substations upgrade in the Northern Cape and Free State Provinces. During this phase, specialist studies were undertaken to assess all potential impacts that are significant. This process was also informed by the findings from the Scoping Phase.

Please note: After the draft EIR and EIR public participation phase, new deviation lines were proposed for technical feasibilities to avoid: Mokala National Park future expansion areas, major game farms, irrigation centre-pivots, salt mines/pans, other ecological features and existing infrastructure. This report was thus amended to include the deviation corridor studies in Chapter 9.

8.1 PURPOSE OF THE ENVIRONMENTAL IMPACT REPORT

The EIA phase provides stakeholders and I&APs the opportunity to ascertain that their issues and concerns raised during the Scoping phase have been adequately considered, and to capture further public comments. In addition, the specialist studies that were identified in the Scoping phase have been undertaken in the EIA phase. The specialist studies assessed impacts on both the social and the biophysical environment and identified ways that could mitigate the anticipated impacts.

The purpose of this EIR is therefore, to:

- Outline the manner in which the biophysical and socio-economic aspects of the environment may be affected by the proposed activity;
- Appraise the I&APs and stakeholders of the information collated during the investigation of impacts by the project specialists and team members;
- Outline methods used for analysing and interpreting the information;
- Provide an assessment of any positive and negative implications of the proposed activity and identified alternatives;
- Recommend the least impacting alternative route corridor to DEA for final authorisation regarding the proposed project;
- Provide mitigation measures for all identified impacts on the feasible option; and
- Provide the I&APs with an opportunity to comment on the information provided in the report prior to final submission to the DEA.

8.2 PUBLIC PARTICIPATION

All stakeholders and registered I&APs were given the opportunity to review the draft EIR in accordance with the Environmental Regulation R543. The report was placed in public places that included amongst others the libraries in Prieska, Douglas, Jacobsdal, Dealesville and Boshof, as well as municipal offices. Advertising in English and Afrikaans on the availability of the report at public places was prepared to inform stakeholders and registered I&APs. In

addition, stakeholders and registered I&APs were informed of the availability of the report through letters and / or telephonically where necessary.

40 days commenting period (30 June to 8 August 2014) was afforded to all stakeholders and I&APs, who were given an opportunity to forward their written comments, objections, inputs and queries within that period. The purpose was to assess and provide I&APs an opportunity to comment on the specialist studies, alternatives routes investigated, recommendations and conclusions.

All issues identified during this public review period were documented and compiled into a Comments and Response Report (CRR). The Environmental Assessment Practitioner responsible for the public participation process communicated with the stakeholders and I&APs throughout the duration of the project.

Please note: The draft amended EIR would be available for public reviewing / commenting from 22 October to 20 November 2015.

8.2.1 Public Meetings

Public meetings were held during the EIA phase in July 2014. Similar to the Scoping phase meetings, the EIA public participation meetings were conducted in English and Afrikaans. Public participation meeting venues and dates were scheduled to suit the I&APs. These meetings provided the I&APs with an opportunity to critique, analyse and engage with the consultants on the outcome of the studies and proposed recommendations. Minutes of the meetings were compiled and circulated to all interested and affected people.

The public participation meetings were advertised in the local and regional newspapers in English and Afrikaans to ensure that local stakeholders and I&APs were informed beforehand. Other forms of public notification was through site notices, which were posted at public areas in Prieska, Douglas, Mokala National Park, Jacobsdal, Dealesville and Boshof, and through electronic notification to registered I&APs.

8.3 AUTHORITY REVIEW OF THE ENVIRONMENTAL IMPACT REPORT

After comments from the public on the amended draft EIR have been received and incorporated into the report, the final EIR will be submitted to the authorities for consideration. In addition, prior to submission to the authorities, I&APs as well as stakeholders would be afforded at least 21 days to comment on the final report.

8.4 EIA TIMEFRAMES

The following work programme has been followed during the EIA process.

Please note: the timeframes are either stated in terms of Mokgope Consulting's planning or the applicable legislative requirements and outcomes of the various public participation stages. This

would mean that the future tentative dates in this report could change and should only be considered as a guideline.

Table 11: Proposed Project Schedule

ACTIVITY	TIME FRAME	STATUS
Submit Application form to DEA	November 2012	**Complete**
Preliminary Site Visit – Site notice posting	March/April 2013	**Complete**
PPP for Scoping process	January-May 2013	**Complete**
Circulation of Draft Scoping Report	May/June 2013	**Complete**
SUBMISSION OF SCOPING REPORT TO DEA	September 2013	**Complete**
Approval of Scoping Report	October 2013	**Complete**
Circulation of draft EIR	June/July 2014	**Complete**
PPP for EIR phase	July 2014	**Complete**
Circulation of Amended draft EIR	Oct 2015	**In Progress**
SUBMISSION OF FINAL EIR TO DEA	December 2015	Pending
Anticipated Environmental Authorisation	February 2016	Pending
APPEAL PERIOD	March/April 2016	Pending
SITE WALK-DOWN & EMPR	Aug – Oct 2017	Pending

8.5 TERMS OF REFERENCE FOR SPECIALIST STUDIES

The specialist studies were conducted focusing on a 2km corridor from the Kronos to Perseus Substations along the alternative route corridors. All specialists were required to provide their independent professional assessment and opinion on the impacts and mitigation measures to be applied. The Terms of Reference (ToR) for each specialist is summarised below. Specialists were requested to use the evaluation criteria or similar, provided under Section 8.6.

Please note: In July 2015, specialists were requested to conduct desktop assessments of the new deviations corridors. Therefore the specialists' reports were amended to include the deviations.

ToR: Fauna

A faunal assessment was done with the following aims:

- Review existing information;
- Conduct a site visit to visually assess the state of the site and determine potential impacts, with special emphasis on threatened and/or endangered species;
- Identify mitigation measures for any potential direct, indirect and cumulative impacts and feasible alternatives for the proposed development;
- Provide a ranking assessment of the suitability of the proposed alternatives; and
- Compile a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Vegetation

A flora impact assessment was conducted with the following aims:

- Review existing literature and identification of red data species;
- Conduct a site visit to visually assess the site and identify potential impacts;
- Identification of potential direct, indirect and cumulative impacts, alternatives and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives; and
- Compile a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Avifauna

The Avifauna study was done with the following aims:

- Review of existing literature;
- Conduct site visit to visually assess the site and identify potential impacts;
- Identification of potential direct, indirect and cumulative impacts, alternatives and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives; and
- Compile a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Social Impacts

A socio-economic impact assessment was conducted with the following aims:

- Review existing literature on the study area;
- To provide assessment of the study area and identify potential impacts (social and economic) and develop mitigation measures;
- Identification of alternative activities , their impacts and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives; and

- Compiling a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Agriculture

An agriculture impact assessment was conducted with the following aims:

- Review existing literature on the study area;
- Conduct a site visit to visually assess the site and identify potential impacts (social and economic) and develop mitigation measures;
- Identification of alternative activities , their impacts and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives; and
- Compiling a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Heritage and Archaeological

A historical and archaeological impact assessment was conducted with the following aims:

- Review existing literature on the study area;
- Conduct a site visit to visually assess the site and identify potential impacts and develop mitigation measures;
- Identification of alternatives , their impacts and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives;
- Obtaining comments from the heritage agency in the Northern Cape and Free State on the compiled specialist report; and
- Compiling a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Visual

The Visual study was done with the following aims:

- Conduct site visit to visually assess the site and identify potential impacts on the aesthetics of the receiving environment;
- Identification of potential direct, indirect and cumulative impacts, alternatives and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives; and
- Compile a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Wetland

A wetland impact assessment was conducted with the following aims:

- Review existing literature;
- Conduct a site visit to visually assess the site for any affected wetlands;
- Identification of potential direct, indirect and cumulative impacts, alternatives and mitigation measures;
- Provide a ranking assessment of the suitability of the proposed alternatives; and
- Compile a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: Ecotourism

- Identification Tourism Status Quo;
- Identification of potential impacts;
- Significance Rating of Impacts;
- Identification of mitigation measures; and
- Compile a report indicating all findings, fatal flaws, recommendations and maps indicating sensitive and/or no-go areas.

ToR: GIS

The GIS specialist was to continue to compile / amend maps required by the project team during the assessment process. This would include providing all relevant and up to date metadata sets.

8.6 METHODOLOGY FOR THE ASSESSMENT OF POTENTIAL IMPACTS

All impacts identified during Scoping and EIA stages of the study have been classified in terms of their significance. The broad significance categories are as follows:

- The **Nature** of the impact: This will describe the cause and the effect, what will be affected and how it will be affected.

- **Mitigation level:** The degree to which the impact can be mitigated.

- The **Extent** of the impact: This will be categorised as local, regional or national.

- The **Magnitude** of the impact: This will be quantified as:
    - Low: Will cause a low impact on the environment;
    - Moderate: Will result in the process continuing but in a controllable manner;
    - High: Will alter processes to the extent that they temporarily cease; and
    - Very High: Will result in complete destruction and permanent cessation of processes.

- The **Probability:** which shall describe the likelihood of impact occurring and will be rated as follows:
    - Extremely remote: Which indicates that the impact will probably not happen;
    - Can Occur: there is a possibility of occurrence;
    - Unusual but Possible: Distinct possibility of occurrence;
    - Almost Certain: Most likely to occur; and
    - Certain/ Inevitable: Impact will occur despite any preventative measures put in place.

- **The duration (Exposure)**: wherein it will be indicated whether:

    - The impact will be immediate;
    - The impact will be of a short tem (between 0-5 years);
    - The impact will be of medium term (between 5-15 years);
    - The impact will be long term (15 and more years); and
    - The impact will be permanent.

- **Reversibility/ Replaceability:** The degree to which the impact can be **reversible or the lost resource can be replaced.**

To determine the significance ranking, the following ranking (or similar) will be applied to each impact identified:

The Significance of the impact is calculated as follows:

Significance= **Consequence** (Magnitude+ Duration+ Extent + Reversibility) **X Probability**

Table 12: Significance ranking (Savahanna Environmental, 2008)

RANKING	MAGNITUDE	REVERSIBILITY	EXTENT	DURATION	PROBABILITY
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable
4	High		National	Long term (impact ceases after operational life of asset)	Almost certain
3	Moderate	Reversibility with human intervention	Provincial	Medium term	Can occur
2	Low		Local	Short term	Unusual but possible
1	Minor	Completely reversible	Site bound	Immediate	Extremely remote
0	None		None		None

RANKING	100-65	64-36	35-16	15-5	4-1
SIGNIFICANCE	Very High	High	Moderate	Low	Minor

9. ENVIRONMENTAL IMPACT ASSESSMENTS AND MITIGATION MEASURES

The information provided in this section summarises findings of specialist reports. Please note that in July 2015 amendments to the specialist reports were produced to include new deviations to Corridor 1. The deviations were proposed to avoid ecologically sensitive areas and existing infrastructures where possible. The detailed amended reports of the various specialist assessments are provided in **Appendix M.**

9.1 VEGETATION ASSESSMENT

9.1.1 Key Findings

Vegetation Groupings Observed Along the Corridors

Due to the arid nature of much of the surveyed area, the vegetation was found to be mainly used for grazing and large scale vegetation clearing for cultivation was recorded mainly along the perennial rivers and around the town of Dealesville. Therefore the natural species composition was observed to still be largely intact and as expected based on the literature review. Although the vegetation could be subdivided into numerous smaller vegetation communities, this would have involved numerous sampling points within the proposed corridors and for a project of this extent, this would be costly and deemed unfeasible.

Based on the field survey and the literature reviewed, the vegetation that could be impacted on by the proposed power line corridors were classified into 6 broad vegetation groupings. For the most part, the vegetation within the vegetation groupings was homogenous. A summary of the broad vegetation groupings and their sensitivity to the proposed power line development is as follows:

Table 13: Broad vegetation groupings and sensitivity observed along the proposed power line

Broad vegetation grouping	Summary	Sensitivity
Mixed Karoo	The majority of the power line route corridor alternatives are proposed to be situated within this vegetation group, supporting a mixture of karoo bossies, grasses, small shrubs and limited trees. Around the Kronos substation, the salt content in the soils are high and the vegetation comprised of low growing shrubs, including the salt tolerant *Salsola* species. From Copperton to just south of the town of Prieska, more dry grassland, mixed with karoo-bossies was encountered. Here the grass layer dominated with *Stipagrostis* species. Where the grass and herbaceous layer has been subjected to intense grazing, the *Acacia melifera* tree as well as the shrub *Rhigozum trichotomum* encroached to form medium to dense stands. East of the N10 road, the vegetation becomes again dominated by dwarf karoo shrubs and some grasses. This vegetation included a tree layer and included the nationally protected tree *Boscia albitrunca* (Witgat / Sheppard's tree).	Medium

Broad vegetation grouping	Summary	Sensitivity
	Plants of conservation concern confirmed to occur in the Nama-Karoo vegetation group include *Hoodia gordonii* as well as provincially protected plant species.	
Thornveld	In the northern extent of the power line routes (and in specific Corridor 2 and Corridor 3), Thornveld vegetation was observed. The Thornveld was characterised as open woodland with tall growing microphyllous and thorny trees and a well-developed shrub and grass layer. Trees observed included the nationally protected *Acacia erioloba* (Camel Thorn) and *Boscia albitrunca* (Witgat / Sheppard's tree). As with the Mixed-Karoo, the Thornveld overlapped with grassland in ecotones comprising of grassland with sparse tree cover. Other than the protected trees, some plant of conservation concern is expected to occur within this vegetation unit.	Medium
Grassland	*Dry Grassland* The grassland is situated in the most northern extent of the power line route corridors. Perseus substation and surroundings are situated in the endangered Vaal-Vet Sandy Grassland, although the area studied were found to be largely transformed. The grassland was species poor grassland but contained a high number of Highveld Salt Pans. Furthermore, the natural grasslands does provide suitable habitat for plants of conservation concern.	Medium
	Moist Grassland Other than riparian areas and pans within the grassland, aerial imagery indicated that some areas along the proposed power line routes could support higher soil moisture during parts of the year.	High
Vegetation on rocky outcrops, ridges, inselbergs	The area studied included three vegetation types typically occurring on ridges and rocky outcrops in the area. The Vaalbos Rocky Shrubland occurs on ridges contained within the Thornveld (mainly in the northern extent of the power line corridors), while the Upper Karoo Hardeveld and Lower Gariep Broken Veld are contained within the Mixed-Karoo vegetation (southern extent of the corridors). On the dolerite koppies around the towns of Kimberley and Hopetown, as well as south-west of the town of Dealesville, the vegetation on hills and koppies contained more shrubs than the surrounding Thornveld on the plains or grassland. Towards the southern extent of the power line corridors, the inselbergs and outcrops were situated within the Mixed- Karoo vegetation and were characterised by dwarf karoo shrubs and grasses, as well as taller shrubs such as *Rhigozum obovatum,* and *Kleinia longiflora*. These inselbergs comprised mainly of the Lower Gariep Broken Veld vegetation type, with limited Upper Karoo Hardeveld present along the corridors in the Prieska-area. The vegetation on ridges, inselbergs, rocky outcrops and koppies are known to comprise higher species diversity and therefore their protection contributes to conservation of biodiversity.	High

Broad vegetation grouping	Summary	Sensitivity
Riparian vegetation	Much of the riparian areas observed at the time of the field survey were being utilised for agricultural purposes such as cultivation and grazing. In addition, the alien invasive weed *Prosopsis glandulosa* invaded large portions of riparian habitat. However, riparian areas are protected by legislation and impacts on riparian areas as well as a regulated buffer zone should be avoided. Although the vegetation along the non-perennial rivers and drainage lines were not always significantly different to the surrounding terrestrial vegetation, the vegetation that occurred there are invaluable when sporadic high rainfall events does occur. The vegetation stabilises the soil and keep it from washing away, causing degradation of the non-perennial rivers and sedimentation further downstream. The Upper Gariep Alluvial vegetation is found around the perennial river areas and is situated on alluvial deposits. There is a possibility that the protected bulb *Crinum bulbispermum* (Orange River Lily) occur along the perennial riparian areas.	High
Vegetation of salt pans	The vegetation in the salt pans plays an important role in the health and functioning thereof. In addition, the Near Threatened Grass *Sporobolus oxyphyllus* is known to occur at saltpans in the Dealesville area (Perseus substation vicinity). Furthermore, pans (being a type of wetland) are protected by national legislation and therefore should be regarded as sensitive to developments. The highest concentration of pans along the route is in proximity to Perseus substation and situated within the Free State Highveld Grassland focus area for protected area expansion. If the proposed power line infrastructure can span the pan areas, it is assumed that the impact of the development on pans would be low or negligible. However, note that activities within 500m of a wetland (Regulation 1199 of the National Water Act, 1998 (Act 36 of 1998) are subjected to a Water Use License.	High

The vegetation groupings are geographically represented in Figure 20.

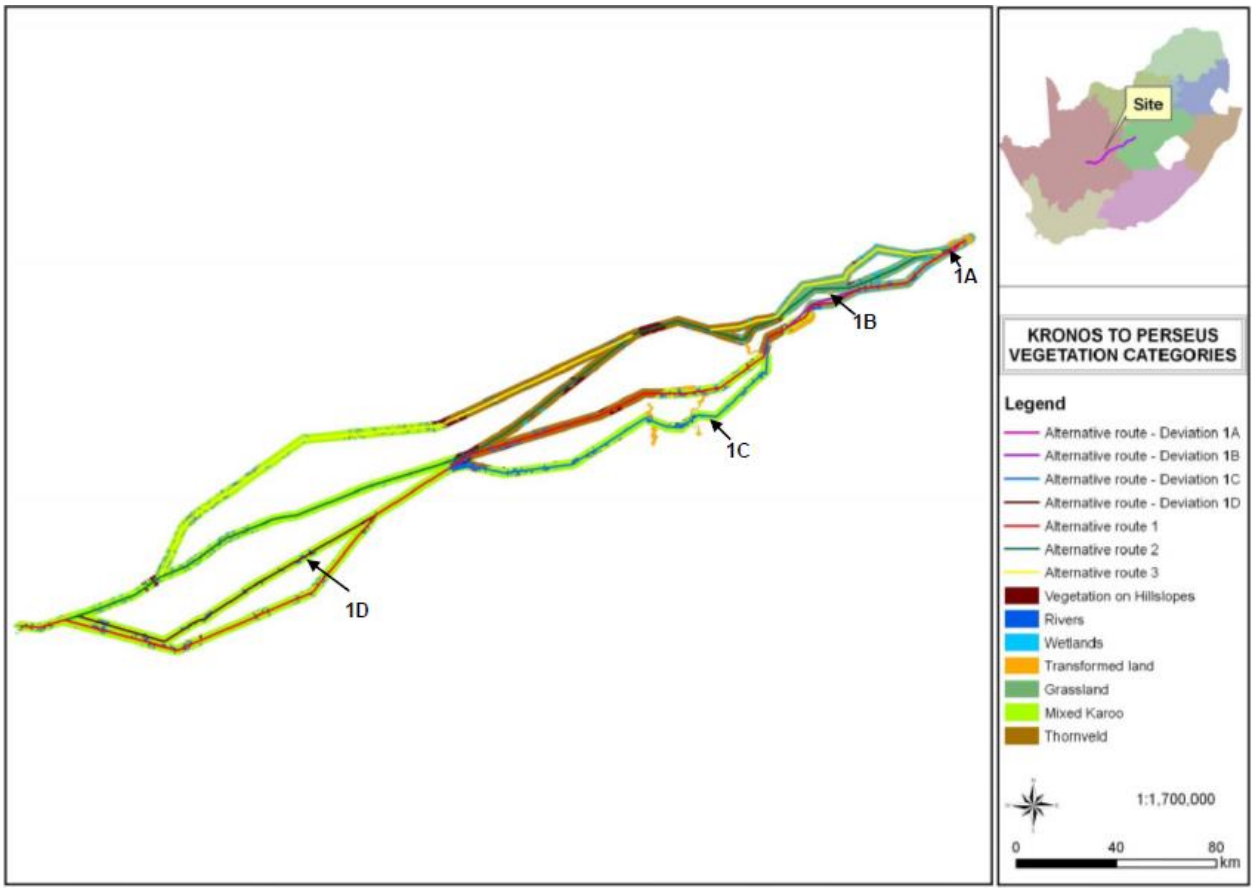


Figure 20: Broad Vegetation Groupings observed along the proposed Perseus-Kronos Corridors and Deviations to Corridor 1 (Eyssell, 2013)

Protected Plants

Provincially, a number of plants are protected by the Northern Cape Nature Conservation Act No.9 of 2009 and by the by the Free State Nature Conservation Ordinance No 8 of 1969. The removal or pruning of these plants will require a permit from the Northern Cape Department of Environment and Nature Conservation or the Free State Department of Tourism, Environment and Economic Affairs.

Table 14 lists provincially protected species that were confirmed to occur or could likely occur along the power line corridors. The species identified at the time of the field survey are printed in **bold.** However, it is thought that during favourable conditions, more protected plant species may be identified to occur along the power line route alternatives. Table 14 indicates that the most protected plant species is expected to occur on the rocky outcrops and ridges and within the Mixed-Karoo and Thornveld vegetation.

Table 14: List of protected plants that could potentially occur and suitable habitat

Species	Mixed Karoo	Thornveld	Grassland	Hills	Riparian	Pans	Province
Acacia erioloba*		x					**NC**
All species of *Aloe including:*							FS
• *Aloe broomii*	x			x			NC
• *Aloe chlorantha*				x			NC
• *Aloe claviflora*	x						NC
• *Aloe dichotoma*	x						
• *Aloe grandidentata*		x					NC
• *Aloe hereroensis*				x			NC
Anacampseros species	x			x			NC
Ammocharis coranica	x	x					NC
Androcymbium albomarginatum				x			NC
Avonia ustulata and all other species	x						NC
Boscia albitrunca*	x	x		x			**NC**
Boscia foetida		x					**NC**
Crassula barbata subsp *broomii*				x			NC
Commiphora species		x		x			
Crinum bulbispermum					x		NC/FS
***Delosperma* species**	x			x			**NC**
Gnaphalium simii						x	NC
Gymnosporia szylowiczii	x						NC
Haemanthus species		x					NC
Harpagophytum procumbens	x	x		x			NC
***Harveya* species**	x						NC
Hoodia gordonii		x					NC
Lachenalia auriolae				x			NC
Lithops aucampiae		x	x				NC/FS
Lithops hookeri	x						NC
***Ledebouria* species**	x		x				**NC/FS**
Manulea deserticola	x						NC
Mestoklema tuberosum	x						NC
Moraea species	x	x					NC
Nymandia capensis				x			NC
Ornithogalum paucifolium species?				x			NC
Ruschia intricata	x						NC
Stapelia grandiflora		x		x			NC
Stapelia olivacea				x			NC
Sutherlandia fructescens	x						NC
Tritonia laxifolia	x						NC
Watsonia species			x				FS

Species	Mixed Karoo	Thornveld	Grassland	Hills	Riparian	Pans	Province
Potential species per broad vegetation community	**19**	**12**	**3**	**15**	**31**	**1**	

*****Trees also protected nationally

Nationally Protected Trees

A number of South Africa's indigenous trees are nationally protected under the National Forests Act, 1998 (Act No 84 of 1998). The removal or pruning of these protected trees will require a permit from the Department of Agriculture Forestry and Fisheries. Two species are likely to occur namely:

1. Boscia albitrunca (Witgat / Sheppard's tree)	Occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. The tree was noted to sporadically occur in the Nama-Karoo vegetation and within the Thornveld vegetation
2. Acacia erioloba (Camel Thorn).	Usually occurs in deep sandy soils or along watercourses in arid areas.

Alien Invasive Plants

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants be controlled and eradicated by means of an eradication and monitoring programme.

Below is a brief explanation of the three categories of problem plants in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The alien plant species identified on the study site is listed in Appendix C in the Vegetation Report, Appendix M.

The main invasive species identified in the study area were:

- *Prosopsis glandulosa* (Honey Mesquite) within drainage lines and riparian areas. This tree is currently a Category 2 but proposed Category 1b in the NEMBA list.

Category 1 and 2 species should be removed and re-infestation monitored as part of an alien invasive monitoring plan for the approved route alternative.

Vegetation Sensitivity

The vegetation sensitivity assessment aimed to identify whether the broad vegetation groupings within the area studied is of conservation concern and thus sensitive to linear infrastructure development.

To determine the sensitivity of the vegetation observed along the proposed power line corridors, weighting scores as listed in Table 15 below were applied (also see the vegetation sensitivity rating in Appendix B, in the Vegetation Report, Appendix M.). The vegetation with the lowest score represents the vegetation that has the least / limited sensitivity to the development of a power line.

Table 15: Weighting Scores

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

The sensitivity analysis results of the above assessment were classified as per Table 16 below.

Table 16: Scoring of vegetation that occurred within the study area (Eyssell, 2013)

Broad vegetation community	Conservation Status of regional Vegetation	Predominant state	Legislated protection	Plants of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18	Sensitivity
Cultivated / Transformed areas	0	0	0	0	1	0	1	low
Thornveld	0	2	0	2	2	2	8	medium
Mixed-karoo	0	2	0	2	2	2	8	medium
Grassland	1*	2	2*	1	2	2	10	medium
Rocky outcrops and ridges	0	3	2˜	3	3	3	14	high
Riparian vegetation	1	1	3	2	3	3	13	high
Pan vegetation	0	2	3"	2	3	3	13	high

Although only the Vaal-Vet Sandy Grassland is classified as Endangered, grassland as a whole is a highly threatened vegetation type.

From the above Table 16, it is deduced that the vegetation associated with the hydrological features (pans, potential wetlands and riparian areas) as well as hills within the proposed power line corridors are the most sensitive to development, followed by the remainder of the natural vegetation, whether it is Thornveld, Grassland or Mixed-Karoo vegetation. The resultant vegetation sensitivities are geographically represented in Figure 21.

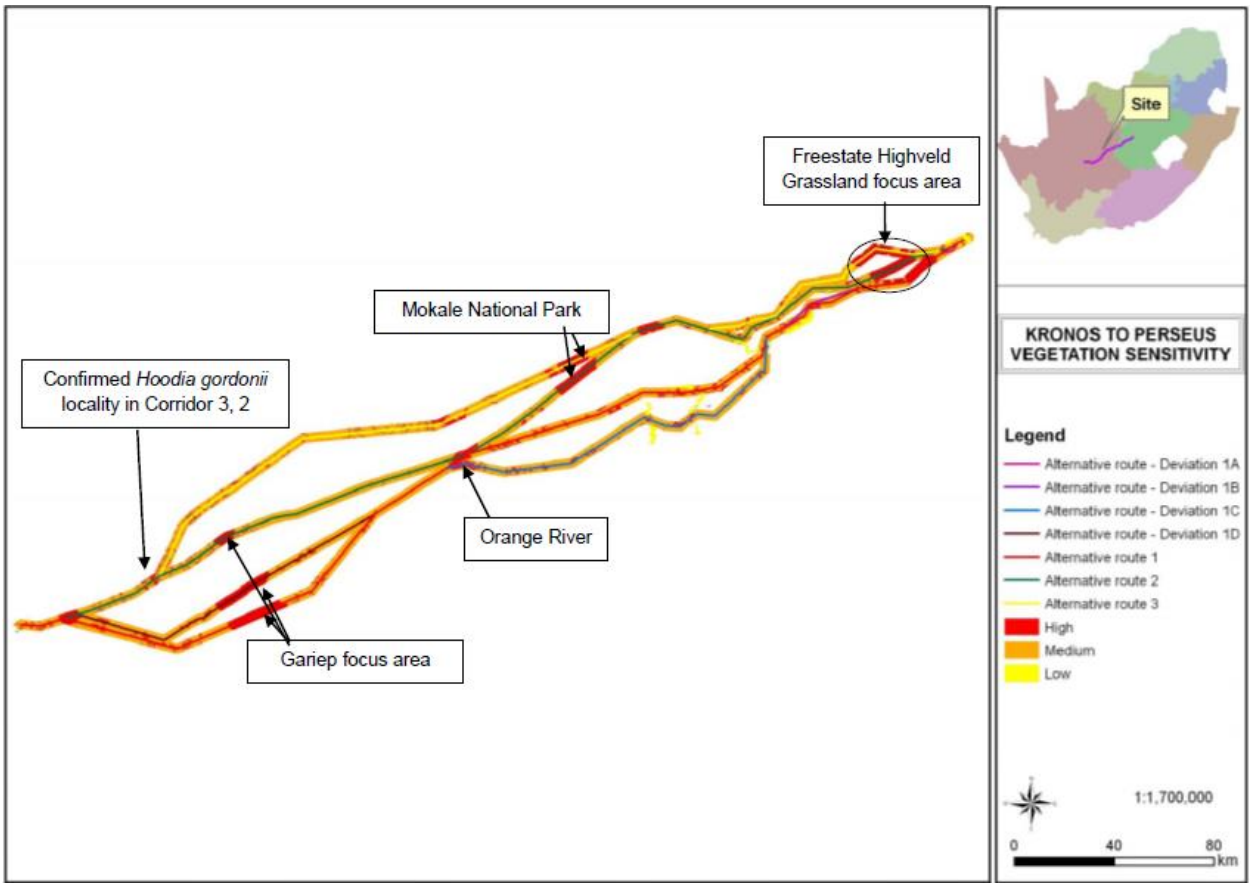


Figure 21: Vegetation Sensitivity Map (Eyssell, 2015)

Protected Areas and Protected Areas Expansion

Protected areas (PAs) in South Africa should be regarded as sensitive to developments. South Africa's legislated PAs are grouped as the following types:

- Type 1: includes National Parks, Provincial Nature Reserves, Local Authority Nature Reserves and Department of Forests and Fisheries' Forest Nature Reserves Forest Nature Reserves.
- Type 2: includes Mountain Catchment Areas, Wildlife Management Areas, private nature reserves, National Heritage Sites, Department of Forestry and Fisheries (DAFF) Forest Areas, South African Defence Force (SANDF) property, bird sanctuaries, and botanical gardens.
- Type 3: includes game farms, private game reserves and conservancies.

Corridor 2 and 3 traverse the Mokala National Park (a Type 1 PA) and a number of smaller private nature reserves. However, they pass south of the Benfontein Game Farm (Figure 22). The approximate locality of the Benfontein Game Farm (GF) (a Type 3 PA) is indicated south of Kimberley (Figure 22). The N8 road forms the north-eastern boundary of the game farm.

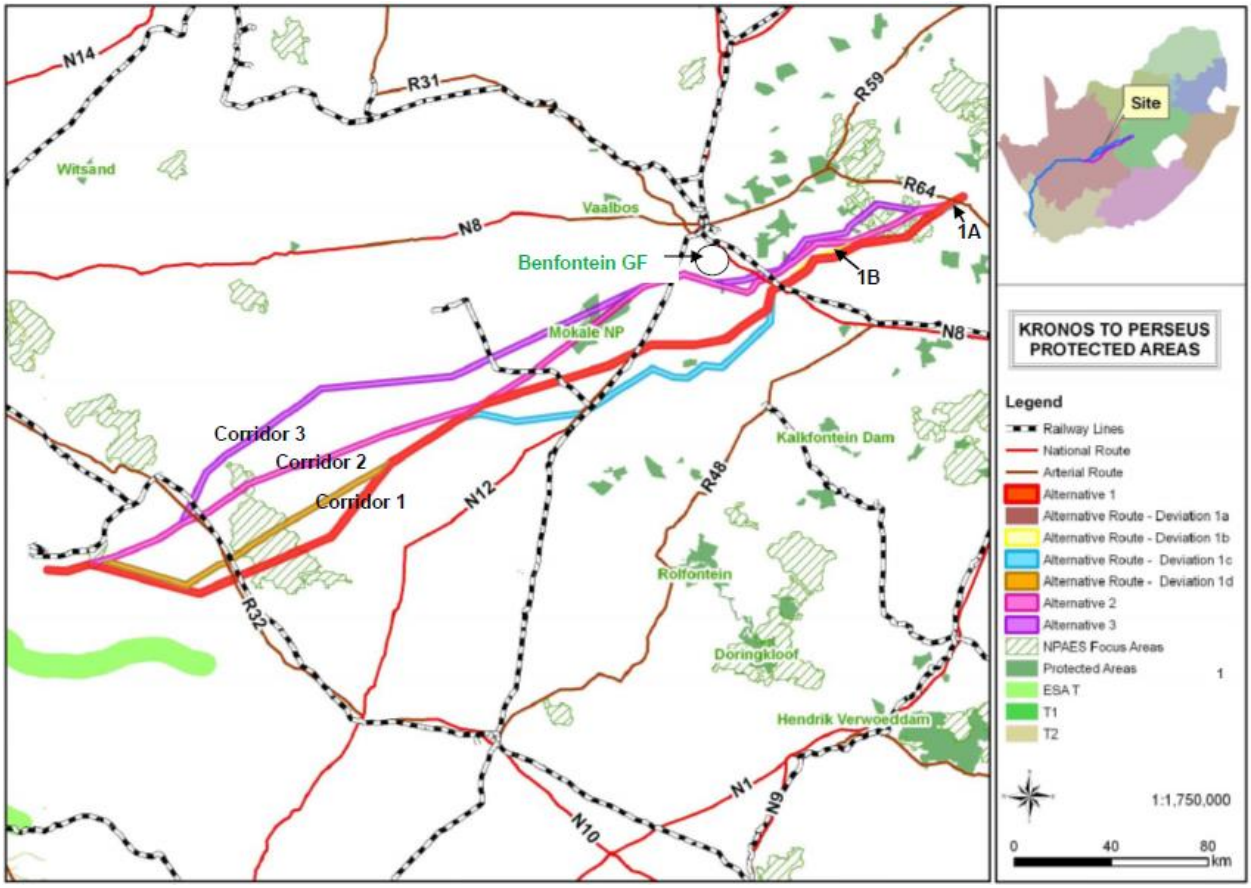


Figure 22: Protected Areas, private nature reserves, and NPAES focus areas along the proposed corridor alternatives

The proposed corridors will all traverse through a portion of the Freestate Highveld Grassland focus area for expansion (in close proximity to the Perseus substation). In addition, Corridors 1 and 2 will pass through a Gariep focus area, while Corridor 3 will pass just north of this Gariep focus area in proximity to the town of Prieska (Figure 22). Therefore, it is advisable that any electrical infrastructure in this area be planned in consultation with the South African National Biodiversity Institute (SANBI) as well as the Department of Environmental Affairs (DEA).

Comparisons and Preferred Corridors

The proposed power line corridors will impact on much of the same broad vegetation communities, albeit in various degrees. The vegetation and ecological features with the highest sensitivities are pans, riparian areas, moist grassland and rocky areas and ridges, as well as protected areas. Therefore, the corridor traversing the least vegetation of high sensitivity and no protected areas, or areas earmarked for protected area expansion should theoretically be the preferred route.

The corridors were found to be similar in the distribution of high sensitivity vegetation along the routes. However, Corridor 2 and Corridor 3 will traverse the protected area, Mokala National

Park, south west of Kimberly. All the proposed route alternatives will traverse through the Freestate Highveld Grassland Focus Area, with Corridor 1 traversing the eastern extent thereof, while Corridor 2 and Corridor 3 traverse through about the middle of the focus area. In the proximity to Prieska, Corridor 1 (including Deviation 1D) and Corridor 2 will traverse the Gariep Focus Area, whereas Corridor 3 will pass just north thereof.

A site preference ranking system was employed to assist decision making. The methodology and ranking are listed in Appendix F in the amended Vegetation Report. *The deviations proposed in July 2015 were not ground-truthed and therefore not included in this rating system*. This site preference rating did not conclude a significant difference between the route alternatives (Appendix F). The higher score and thus preference for Corridor 1, is because this corridor is situated south of the Asbestos Mountain range (Corridor 2 & 3 traverse over the mountain). Although it is likely that *Hoodia gordonii* also occurs within Corridor 1, it was confirmed to occur in Corridor 3 and 2. Corridor 1 (including its proposed deviations) are also likely to have the least occurrence of protected trees. In order to verify the corridor preference, the percentage of the perceived vegetation sensitivity per hectare (ha) of corridor (based on a 2km buffer of 1km on either side of the line) was calculated and given in Table 17.

From the calculation in Table 17, Corridor 1, with Deviation 1B was confirmed to have the least number of sensitivities per hectare of corridor, followed by Corridor 1 and Corridor 1 with Deviation 1A (highlighted in green). Deviation 1D also traverses the Gariep Focus Area and passes closer to the Asbestos Mountains and may impact on small inselbergs compared to the equivalent section of Corridor 1, therefore the higher percentage sensitivity in this deviation.

Table 17: Percentage (in hectare) of Corridor that comprises of high sensitivity

	Corridor 1	**Corridor 2**	**Corridor 3**	**Corridor 1 with ALL deviations**	**Deviation 1A, plus rest of 1**	**Deviation 1B, plus rest of 1**	**Deviation 1C, plus rest of 1**	**Deviation 1D, plus rest of 1**
% High sensitivity (Ha)	12428.14	14407.64	13873.98	14235.31	12423.4	12306.34	13280.22	15778.9
Corridor size (Ha)	75517.99	69453.55	75085.01	76715.15	75588.57	75418.97	77573.6	74691.77
% of High sensitivity	**16.46**	**20.74**	**18.48**	**18.56**	**16.44**	**16.32**	**17.12**	**21.13**

Table 18 below indicates the preferred corridor and summary of findings that influenced the route preference. Corridor 1 with Deviation 1B is preferred based on the lowest percentage sensitivity along the corridor. The percentage sensitivities within Corridor 1 and Corridor 1 with Deviation 1A are also comparatively low. Deviation 1C comes into close proximity to saltpans in the vicinity of Jacobsdal and if these can be adequately circumvented as per the wetland specialist recommendations, then deviation 1 C is also feasible as a preferred route. Although Deviation 1D impact on the highest percentage sensitivity (due to the Gariep Focus Area), even with all the deviations to Corridor 1, the percentage sensitivity that could be impacted on is comparable to that of Corridor 3, which is the second preferred option.

Table 18: Comparisons and order of Preference (Eyssell, 2015)

Route	Sensitive Vegetation	Order Of Preference
Corridor 1	• Traverse through the most eastern extent of the Freestate Highveld Grassland focus area and likely a smaller area than the other proposed corridors; • Some of the grassland area along this corridor is more impacted on by cultivation than other corridors; • Cross the Modder River in areas where some cultivation and other agricultural disturbances were noted; • Cross over the Orange River north west of Hopetown, within a naturally vegetated and hilly/mountainous area; • Traverse through the Gariep Focus Area (NPAES) east of Prieska, as well as east of Copperton; • Pass south of Doringberg, whereas Corridor 2 and Corridor 3 pass over the Doringberg; and • Traverse a number of inselbergs, koppies and ridges	Corridor 1 with Deviation 1B: **Preferred option** Corridor 1 and Corridor 1 with Deviation 1A **Preferred option 2** Corridor 1 with ALL Deviations **Second option**
Corridor 2	• Traverse the Freestate Highveld Grassland focus area; • 31km east of the town of Ritchie, this corridor bends and extent over the Modder River, without actually crossing the river. This section of Corridor 2 includes the Modder River in the south, inselbergs, and a pan in the northern portion of the bend. This leaves some cultivated areas along the Modder Rivier and about an area of 600m in width of medium sensitivity for the power line to cross in; • Cross over the Riet River in an area where no cultivation was noted. The vegetation was in a largely natural state; • Confirmed occurrence of two nationally protected trees, within this route corridor (*Boscia albitrunca* and *Acacia erioloba);* • Traverse through the Mokale National Park; • Cross over the Orange Rivier north west of Hopetown, within a naturally vegetated and hilly/mountainous area; • Traverse through the Gariep Focus Area (NPAES) east of Prieska, as well as east of Copperton; • Confirmed occurrence of *Hoodia gordonii* east of the N10. However, the locality is slightly more north and within Corridor 3, thus easier to avoid in Corridor 2; and • Traverse a number of inselbergs, koppies and ridges	**Third option**
Corridor 3	• Traverse the Freestate Highveld Grassland focus area;	**Second option**

Route	Sensitive Vegetation	Order Of Preference
	• Cross over the Riet River in an area where no cultivation was noted. The vegetation was in a largely natural state; • Confirmed occurrence of two nationally protected trees, within this route corridor (*Boscia albitrunca* and *Acacia erioloba);* • Traverse trough the Mokala National Park; • Pass just north of the Gariep Focus Area (NPAES); • Pass through a Gariep Focus Area just east of Copperton; • Cross over the Orange Rivier north west of Hopetown, within a naturally vegetated and hilly/mountainous area; • Confirmed occurrence of *Hoodia gordonii* east of the N10; and • Traverse a number of inselbergs, koppies and ridges.	

9.1.2 Vegetation Impacts and Mitigations

Any development activity in natural systems will impact on the surrounding natural environment and possibly in a negative way. To limit these impacts, the source, extent, duration and intensity of the potential impacts needs to be identified. Once the significance of the impacts is understood, the development could both adequately plan for and mitigate these impacts to a best practise and acceptable level. However, if the impacts are significant, especially in already threatened ecosystems and vegetation units, and no adequate mitigation measures could reduce or avert these impacts, then the development should not be allowed to proceed.

The most significant impact of electrical power lines is expected to occur during the construction phase, whereas the new towers and power lines, once in use, have relatively contained impacts on the vegetation.

The possible impacts, as described below, were assessed based on the Significance Rating Matrix provided in **Section 8.6** of this report.

Scoring Without Mitigation **(NM)** Scoring With Mitigation **(WM)**

Table 19: Analysis of the Significance of Potential Vegetation Impacts (Perseus-Kronos – for all three Corridors and Deviations)(Eyssell, 2015)

	Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
CONSTRUCTION PHASE	**1**. Destruction of natural vegetation	• Clearing of vegetation for tower erection, access roads, construction camps, Substation upgrade; • Damage to vegetation in access roads and construction area • Illegal disposal and dumping of construction material such as cement or oil as well as maintenance materials during construction; • Storage of metal structures within vegetation	3 2	3 3	2 1	2 2	5 4	50 32	High	Moderate
	2. Exposure of the soil to erosion and subsequent sedimentation of perennial and nonperennial rivers	• Removal of vegetation without proper rehabilitation or failure of rehabilitation	3 2	3 3	2 2	2 2	3 2 (if rehabilitated asap)	30 27	Moderate	Moderate
	3. Possible destruction of plants of conservation concern	• Construction activity where these plants potentially occur	3 2	3 3	2 2	2 2	3 3	30 27	Moderate	Moderate
	4. Spread of alien invasive vegetation	• Contaminated construction vehicles and tools; and • Alien invasive species spread from	3 2	3 3	3 2	3 2	3 3	36 27	High	Moderate

	Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
		current infestation into disturbed soils								
	5. *Positive* impact by removing alien invasive plants from the substation and power line route footprint, although care must be taken not to remove all vegetation at once, especially within the rainy season (could result in soil erosion and soil loss).	• Removing of existing invasive alien vegetation in areas proposed for the development and within servitudes	0	0	0	0	0	0	**Positive impact**	
	6. Disturbance to nonperennial and perennial rivers and loss of stabilising vegetation	• Construction activities within the buffer areas linear development such as access roads through the non-perennial rivers	3 2	3 3	2 2	3 2	3 3	33 27	Moderate	Moderate
	7. Soil compaction	• The movement of heavy machinery will result in soil compaction that would modify habitats, destroy vegetation and inhibit re-vegetation.	3 2	3 3	2 2	3 3	4 2	44 20	High	Moderate
OPERATIONAL PHASE	**1**. Bush encroachment which will reduce species diversity	• Removal of vegetation from servitudes, access roads, the footprint of alignment, as well as for substation upgrades could lead	3 2	3 3	2 1 (if timeous	2 2 if timeous action is	3 3	30 24	Moderate	Moderate

	Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
		to bush encroachment by trees such as *Acacia melifera* and the shrub *Rhigozum trichotomum*			action is taken)	taken)				
	2. Destruction of natural vegetation	• Maintenance vehicles driving within natural vegetation / quartz fields; • Altered fire regime-natural fire prevented.	3 2	3 3	2 1	2 2	3 3	30 24	Moderate	Moderate
	3. Possible increase in exotic vegetation	• Alien vegetation spreading from existing infestation into disturbed soil, especially in the absence of successful rehabilitation.	3 2	3 3	3 2	3 2	3 3	36 27	High	Moderate

Table 20: Mitigation Measures - **Vegetation**

Impact	Mitigation Measures
Destruction of natural vegetation: The construction of the power line route would inevitably require the removal of vegetation for the purpose of access roads, servitudes and the pylon footprint. Areas where structures are stored would flatten vegetation that could be detrimental to the persistence of the vegetation. In addition, the illegal disposal of construction material such as oil, cement etc. could destroy natural vegetation.	• The corridor with the least sensitivity should preferably be implemented. • Sensitive areas / vegetation such as hills, pans and riparian areas within the final corridor should be avoided by the actual route alignment. In most corridors, there is enough space to circumvent hills and to span pans and riparian areas. Where this cannot be done in a corridor, another one of the alternative corridors should be investigated. • Development within the Free State Highveld Grassland and the Gariep Focus Areas for protected areas expansion should be planned in consultation with the South African National Biodiversity Institute (SANBI) as well as the Department of Environmental Affairs.
Exposure to Erosion The removal of surface vegetation will expose the soils, which in rainy events could cause sedimentation of watercourses. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into	• The route impacting mostly on disturbed areas should take preference; • Do not allow erosion to develop on a large scale before taking action; • No construction / activities should be undertaken within moist soils / watercourses / pans and their associated buffers until a Water Use License was granted by the Department of Water Affairs (DWA); • Make use of existing roads and tracks, rather than creating new routes

Impact	Mitigation Measures
these eroded soil. Soils in the Mixed-Karoo comprised fine sand and clay and the area is prone to erosion in the event of good rainfall. Raindrops on bare soils disperses the clay fraction in the soil that settles into or block the soil pores on the surface, sealing it so that water cannot penetrate (Esler, *et al,* 2006).	through naturally vegetated areas; • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005); • Runoff from roads must be managed to avoid erosion and pollution problems; • Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. The grassland can be removed as sods and re-established after construction is completed; • Colonisation of the disturbed areas by plants species from the surrounding natural vegetation must be monitored to ensure that vegetation cover is sufficient within one growing season. If not, then the areas need to be rehabilitated with a grass seed mix containing species that naturally occur within the study area; • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
Removal / Destruction of protected plants and plants of conservation concern: The construction of the power line could result in the removal of plant species of conservation concern, impact on their habitat, pollinators and inevitably the persistence of these. This could put further strain on the already declining populations.	• Where possible, construction activities must be restricted to previously disturbed areas; • A suitably qualified person (botanist / horticulturist) should survey the final route alignment and tower footprints within the growing season of the plants, in order to confirm whether these plants will be impacted upon, prior to the commencement of construction; • Implement a Plant Rescue and Rehabilitation Plan: Where the plants of conservation concern are deemed to be under threat from the construction activity, the plants should be removed by a suitably qualified specialist and replanted as part of vegetation rehabilitation after the construction (Note, these plants may only be removed with the permission of the provincial authority); • Ideally, an on-site ecologist should be present when excavation takes place to ensure that any species not identified during the EIA phase, or the final walk down are protected from destruction. Note that the species

Impact	Mitigation Measures
	could be dormant for some time until favourable conditions arise; • It is recommended that the construction crew be educated about the sensitivities involved along the route as well as the potential sensitive species they could encounter; • Construction workers may not tamper or remove these plants and neither may anyone collect seed from the plants without permission from the local authority; • Cordon off the sensitive vegetation that house the protected plant species and the plants of conservation concern and protect from construction activities and vehicles; • Slight deviations of access road / pylon alignments must be permitted, so as to avoid plant populations of conservation concern (DWAF, 2005).
Potential increase in invasive vegetation: The seed of alien invasive plant species that occur on and in the vicinity of the construction areas could spread into the disturbed and stockpiled soil. Also, the construction vehicles and equipment were likely used on various other sites and could introduce alien invasive plant seeds or indigenous plants not belonging to this vegetation unit to the construction site.	• Alien invasive species that were identified within the study area and in specific along the final route alignment should be removed prior to construction-related soil disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation; • All alien seedlings and saplings must be removed as they become evident for the duration of construction; • Manual / mechanical removal is preferred to chemical control; • All construction vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.
Positive impact by removing alien invasive plants: By removing alien vegetation along the route alignment, within corridors and construction camps, the numbers of alien species, as well as the potential for these plants to spread into disturbed soil are reduced, provided that rehabilitation was successful.	• Compile and implement an alien invasive monitoring plan to remove alien invasive plant species along the chosen route alignments, prior to construction; • Rehabilitate all areas cleared of invasive plants as soon as practically possible, utilising specified methods and species; • Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. Monitoring should continue for at least two years after construction is complete and form part of the maintenance activities;

Impact	Mitigation Measures
	• Follow manufacturer's instruction when using chemical methods, especially in terms of quantities, time of application etc; • Ensure that only properly trained people handle and make use of chemicals; • Dispose of the eradicated plant material at an approved solid waste disposal site; • Only indigenous plant species naturally occurring in the area should be used during the rehabilitation of the areas affected by the construction activities.
Disturbance to non-perennial and perennial rivers: Removal of vegetation surrounding drainage lines and within riparian areas could result in a disturbance and potential loss of faunal habitat associated with the stream as well as loss of mature trees which could destabilise soil conditions. In addition, all watercourses (including nonperennial rivers) in South Africa are protected by legislation and must be classified as no-go areas along with protective buffer zones. Note that any activities within the watercourses (non-perennial rivers and natural channels included) are subject to authorisation by the Department of Water Affairs (DWA) by means of a Water Use License.	• No construction / activities can be undertaken within the riparian area unless a Water Use License was granted by the Department of Water Affairs; • Where access through drainage lines and rivers is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. Avoid roads that follow drainage lines within the floodplain; • Roads should be elevated above the non-perennial rivers so as to minimise the destruction of the drainage bed; • After construction, compacted soil access roads should be rip, mechanically break the surface to increase water infiltration; • Construction should take place outside of the rainy season when the flow of the non-perennial rivers is at a minimum; • Do not permit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area; • Linear infrastructure should span across the rivers. Where it is unavoidable to place the pylon footprint within the protective buffer zones, the construction activities must be restricted to as small a footprint possible and rehabilitation undertaken as soon as construction is complete; • It is advised that environmental audits be undertaken by an independent party during this construction period, especially in sensitive areas.
Soil compaction: The movement of heavy machinery will result in soil compaction that will modify habitats, destroy	• Construction (and maintenance) vehicles may not veer from the dedicated roads;

Impact	Mitigation Measures
vegetation and inhibit re-vegetation. Soil compaction as a result of construction vehicles and traffic, could lead to a decrease of water infiltration and an increase of water runoff.	• Once construction is complete, obsolete roads should be obliterated by breaking the surface crust and erecting earth embankments to prevent erosion, while vegetation should be re-established; • It is advised that environmental audits be undertaken by an independent party during this construction period, especially in sensitive areas.
Deterioration of natural vegetation and bush encroachment: The vegetation occurring along the constructed power line could degrade over time if suitable rehabilitation of the disturbed soils does not take place. Furthermore, maintenance work and vehicles could damage the vegetation along the route which could lead to soil erosion, habitat modification, trampling of vegetation as well as the destruction of protected plants and plants of conservation concern. *Tarchonanthus camphorates* (Camphor tree) and *Acacia mellifera* (Black thorn) occur within the studied area. Both species are known as indicator species of bush encroachment. Bush encroachment is the process which transforms grassy vegetation into a woody species-dominated one. This is recognised as a very serious problem throughout Sub- Saharan Africa, as it means that large areas of grazing lands are lost (or reduced in capacity), and it transforms habitats and reduces species diversity.	• Leave as much natural vegetation as intact as possible during construction; • Do not disturb soil or vegetation during maintenance; • Maintenance vehicles and activities should not veer from the dedicated roads; • Monitor rehabilitation and do not allow grazing to take place until such time that revegetation was found to be successful; • After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction; • Ensure that maintenance work does not take place haphazardly, but according to a fixed plan; • Monitor rehabilitation and ensure that bush encroachers and alien invasive species are dealt with in accordance to the EMP; • Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access; • Delay the re-introduction of livestock (where applicable) to all rehabilitated areas until an acceptable level of re-vegetation has been reached; • Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.
Destruction of natural vegetation: During the operational phase, maintenance vehicles could impact on rehabilitated and natural vegetation. In addition, the cleared servitudes could alter the fire regime.	• Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to; • Maintenance vehicles must not veer from dedicated access roads and activities should be restricted to the previously disturbed footprint;

Impact	Mitigation Measures
	• It is advised that environmental audits be undertaken by an independent party during this construction period, especially in sensitive areas.
Possible increase in exotic vegetation: If rehabilitation of the indigenous vegetation along the new power line route is unsuccessful or is not enforced, exotic and invasive vegetation may increase.	• Implement an alien invasive plant monitoring and management plan whereby the spread of alien and invasive plant species into the areas disturbed by the construction of the power line are regularly removed and re-infestation monitored.

9.1.3 Conclusions and Recommendations

The route alternatives do not differ significantly as to their sensitivity towards the proposed power line development. The preferred route was determined as **Corridor 1 with Deviation 1B**.

However, a number of second options are feasible. Corridor 1 with 1B are preferred based on the lowest percentage sensitivity along this corridor, while the sensitivities traversed by Corridor 1 and Corridor 1 with Deviation 1A are also comparable to the preferred option. Deviation 1D impacts on the highest percentage sensitivity (due to the Gariep Focus Area).

Corridor 1 (including deviation 1D), is situated south of the Asbestos Mountain range, while the other corridors traverse over the mountain. It is also thought that Corridor 1 with deviation 1A, will have a lesser occurrence of the protected trees *Boscia albitrunca* (Witgat / Sheppard's tree) and *Acacia erioloba* (Camel Thorn). Corridor 1 and its proposed deviations will impact on a smaller degree of the Freestate Highveld.

Although localised sensitivities are to be expected along all the route corridors (e.g. occurrence of threatened plant species), this study was broad scales and the final route alignment should be ground-truthed, and be allowed to deviate to accommodate the conservation of such local sensitivities.

However, even with all the deviations to Corridor 1, the percentage sensitivity that could be impacted on is comparable to that of Corridor 3, which is the second preferred option.

The power line development and substation expansions are not expected to have a large or significantly detrimental impact on vegetation, provided that sensitive vegetation is avoided or impacts thereon limited. This could be achieved by implementing the mitigation measures as set out in the vegetation report.

9.2 FAUNA ASSESSMENT

9.2.1 Key Findings

Much of the study area appears to be under relatively low intensive landuse, such as game farming and livestock, and is in natural to semi-natural condition, while some areas have been transformed through agriculture and urbanisation. In terms of terrestrial fauna, the main habitats available can be described as follows:

- short, open grassland, mostly in the eastern portion of the study area (Figure 23a);
- wooded savanna, with grass cover and scattered woody vegetation, including large trees (>3m) in places (Figure 23b); and
- low Karoo scrub, dominated by low shrubby and, in places grassy, vegetation with varying areas of exposed soil surface (Figure 23 a and b).

a **b**

Figure 23: Short, open grassland near the Eastern Edge of the Study Area approx. 30km south-west of Dealesville and wooded savanna, including *Acacia* spp trees, with Tsessebe *Damaliscus lunatus*, a threatened spp, in southern Mokala National Park, approx. 30km south-west of Jacobsdal (Harvey, 2013)

a **b**

Figure 24: Short open Karoo grassland approx. 18km north-west of Hopetown, and Karoo shrub land with occasional larger bushes approx. 15km east of Prieska (Harvey, 2013)

Rare and Threatened Mammal Species

Fifteen species of conservation importance are known to occur in the broader region (Friedmann & Daly 2004; Monadjem et al. 2010), and are expected to occur within portions of the study area (Table 21). Many of these are rare, low density species and may occur along portions of the route, although at low numbers within their required habitats. Furthermore, some of these have large home ranges (Honey Badger and Brown Hyena) (Skinner & Chimimba 2010) and, if present, any portion of the study area is likely to form a relatively small proportion of the area they routinely utilise. Many of the large species (antelope, rhinoceroses) are confined to Mokala National Park and possibly some private game farms. Black-footed Cat and Southern African Hedgehog are known from Mokala National Park and nearby in Benfontein Nature Reserve and will occur elsewhere in the region.

(CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, DD = Data Deficient)

Table 21: Rare and threatened mammals occurring or likely to occur within the study area

Common Name	Scientific Name	Conservation Status	Comment	Occurrence within the study area
Black Rhinoceros	*Diceros bicornis*	RD – CR	Occurs in a variety of habitats but populations now highly fragmented and small. Threatened by habitat loss and poaching.	Occurs in Mokala National Park and possibly on selected game farms. Will not occur outside such areas.
White-tailed Rat	*Mystromys albicaudatus*	RD - EN	A rare species, largely confined to grassland and fynbos, Threatened by degradation and loss of these habitats, primarily through agriculture, afforestation and grazing.	May occur patchily and at low densities in grassland habitats in the extreme eastern edge of the proposed routes.
Tsessebe	*Damaliscus lunatus*	RD - EN	Savanna species, threatened by habitat loss and mismanagement.	Occurs in Mokala National Park and possibly on selected game farms. Will not occur outside such areas.
Black-footed Cat	*Felis nigripes*	RD – VU	A rare species, occurring at low densities in semi-arid grassland, karoo and savanna. Threatened by habitat degradation and poisoning	Occurs widely but sparsely in open, grassy to lightly wooded and karoid habitats. Known to occur in Benfontein Nature Reserve and Mokala National Park.
White Rhinoceros	*Ceratotherium simum*	RD – NT	Occurs in a variety of savanna habitats but populations now highly fragmented and small. Threatened by habitat loss and poaching.	Occurs in Mokala National Park and possibly on selected game farms. Will not occur outside such areas.
Roan Antelope	*Hippotragus equinus*	RD - VU	Largely confined to protected areas and threatened by habitat loss and mismanagement	Occurs in Mokala National Park and possibly on selected game farms. Will not occur outside such areas.
Honey Badger	*Mellivora capensis*	RD – NT	Wide habitat use but occurs at low densities. Threatened by human persecution.	Relatively few records from the study area vicinity. May occur widely but sparsely in areas of natural vegetation.
Brown Hyena	*Parahyaena brunnea*	RD – NT	Occurs at low densities in semi-arid grassland, karoo and savanna. Primarily threatened through poisoning and predator-control activities.	May occur widely but sparsely in areas of natural vegetation, where some shelter is present, typically in the form of clumps of dense vegetation. Rare in the region and would primarily occur in the northern portion. Recorded from Mokala National Park.
Southern African Hedgehog	*Atelerix frontalis*	RD – NT	Found in a variety of semi-arid habitats. Threatened through habitat loss and poisoning.	May occur widely in the eastern portion of the study area in areas of natural vegetation, where some shelter is present. Known to occur in Benfontein Nature Reserve and Mokala National Park.
Geoffroy's Horseshoe Bat	*Rhinolophus clivosus*	RD – NT	Requires caves for roosting and occurs widely over surrounding habitats. Primarily threatened by destruction or disturbance of roosting sites.	May forage over the study area but unlikely to roost anywhere in or close to the development footprint.

Common Name	Scientific Name	Conservation Status	Comment	Occurrence within the study area
Dent's Horseshoe Bat	*Rhinolophus denti*	RD - NT	Requires caves for roosting and occurs widely over surrounding habitats. Primarily threatened by destruction or disturbance of roosting sites.	May forage over the study area but unlikely to roost anywhere in or close to the development footprint.
Darling's Horseshoe Bat	*Rhinolophus darlingi*	RD - NT	Requires caves for roosting and occurs widely over surrounding habitats. Primarily threatened by destruction or disturbance of roosting sites.	May forage over the study area but unlikely to roost anywhere in or close to the development footprint.
Straw-coloured Fruit Bat	*Eidolon helvum*	RD - NT	A widespread species in Africa, found in wooded habitats. It is a non-breeding visitor to South Africa. Threatened primarily by over-harvesting (this is threat is only active outside of South Africa).	Poorly known in South Africa, but has been recorded within the study area. Would be confined to wooded areas and will not breed and unlikely to roost regularly anywhere close to the proposed footprints.
Littledales' Whistling Rat	*Parotomys littledalei*	RD - NT	Widely but apparently patchily distributed, and may be threatened by stochastic events e.g. disease	May occur widely in areas with denser vegetation.
African Striped Weasel	*Poecilogale albinucha*	RD - DD	Occurs in grassland and lightly wooded savanna. Threatened by habitat destruction.	May occur widely but sparsely in areas of natural open to lightly wooded vegetation.

Rare and Threatened Amphibian Species

No rare or threatened amphibian species are known or expected to occur within the study area. The Giant Bullfrog *Pyxicephalus adspersus*, was previously listed as Near Threatened (Minter et al. 2004), but has recently been downgraded to Least Concern (Measey 2011; IUCN.org 2011), given that it has a wide distribution and is not threatened throughout much of its distribution.

Rare and Threatened Reptile Species

No rare or threatened reptiles are known or expected from the study area.

Protected areas and areas of strategic conservation importance

The corridors were overlaid with current protected areas. Overlaying shows that Corridor 2 and 3 traverse Mokala National Park, with Corridor 2 running through the centre of it (Figure 25). This reserve supports populations of a high diversity of mammals, including a number of species of conservation importance, and can be expected to support the full spectrum of reptiles and amphibians occurring locally, given the presence of appropriately managed, good quality habitat.

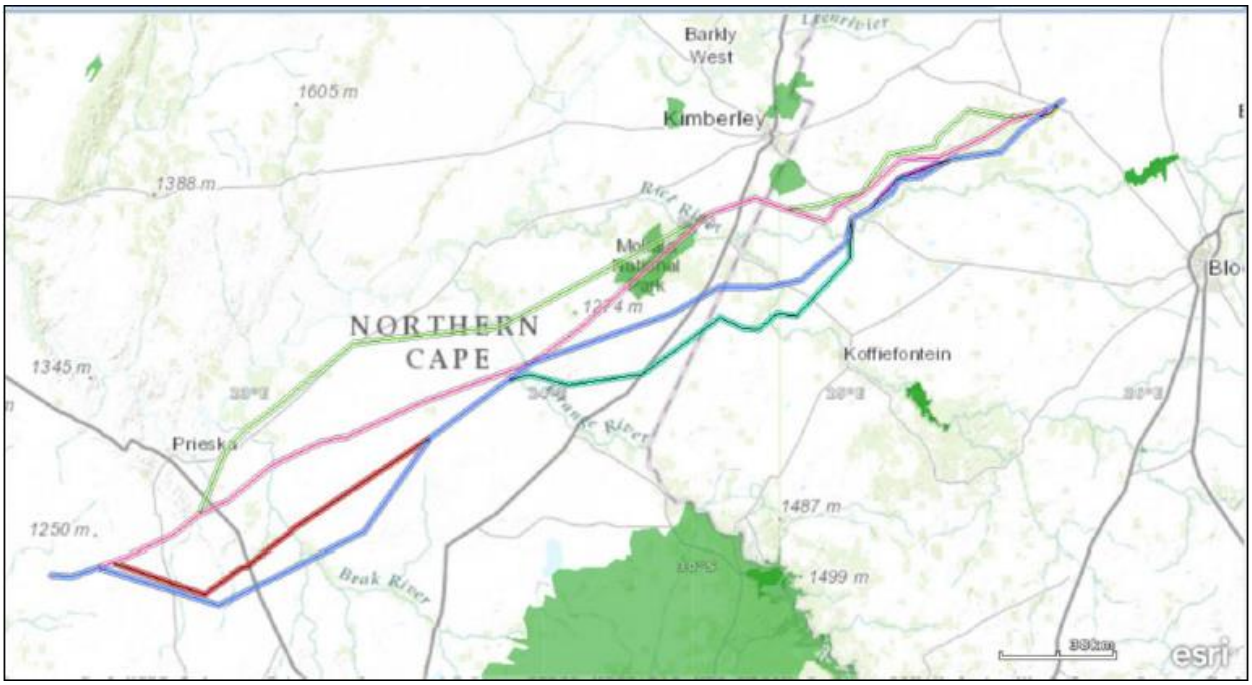


Figure 25: Proposed Corridors overlain with areas of strategic conservation importance (shown in green)

<u>Route Corridor Preferences</u>

Table 22: Route Corridor Comparison and Preference

Route	Description	Order Of Preference
Corridor 1 with deviations	• Does not cross any formally protected areas, and is thus considered to be the least sensitive.	Option 1
Corridor 2	• Is more sensitive, as it currently traverses Mokala National Park, a protected area managed for its biodiversity and known to have species of conservation importance present. • In this regard, Corridor 2 is more sensitive, given that its route through Mokala is longer (approx. 29km) and runs through the centre of the park	Option 3
Corridor 3	• Is more sensitive, as it currently traverses Mokala National Park, a protected area managed for its biodiversity and known to have species of conservation importance present. • Corridor 3 is slightly less sensitive than Corridor 2 as it traverses approx. 9km and could possibly be moved slightly north to avoid the park.	Option 2

9.2.2 Potential Fauna Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 23: Analysis of the Significance of Potential Fauna Impacts (Perseus-Kronos – for all three Corridors and Deviations) (Harvey, 2015)

Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
							Without Mitigation	With Mitigation
1. Disturbance	2 1	2 1	2 1	1 0	5 4	35 12	Moderate	Low
2. Habitat loss	3 2	2 1	2 1	5 3	4 2	48 14	High	Low
3. Alien Invasive Plant Spread	3 1	3 1	3 1	4 2	3 2	39 10	High	Low
4. Pollution During and Following Construction	1 0	3 0	1 0	2 0	3 1	21 0	Moderate	Minor

Table 24: Mitigation Measures - **Fauna**

Impact	Mitigation Measures
1. Disturbance A degree of disturbance will occur to fauna that are present within and immediately adjacent to the footprint area during construction. Animals will likely avoid these areas during this time, but should use such areas post-construction.	• Keep footprint areas to a minimum size and reduce noisy activities where possible.
2. Habitat loss A small amount of habitat loss will take place within the footprints of the towers. However, within the broader landscape, this will represent a very small area and is unlikely to have a major effect on local terrestrial fauna. The power lines themselves will be supported by the towers and will have no impact on terrestrial fauna. Although some clearance of taller vegetation may be required along the route, in general, vegetation clearance is expected to be minimal, given that much of the vegetation is low.	• Restrict foot print areas to the minimum size required • Avoid disturbance to and destruction of rocky outcrop habitats as far as possible • Utilise existing infrastructure where possible
3. Alien Invasive Plant Spread There is potential for alien invasive plants to increase as a result of disturbance associated with construction activities, particularly at tower installation sites and new road construction sites and close to rivers.	• Monitor construction sites (or at least a subsample thereof) to assess if alien plants establish • If alien plants begin to establish, design and implement an alien plant control and monitoring programme
4. Pollution During and Following Construction There is potential for waste products to be dumped into adjacent areas, following completion of the construction phase.	• Ensure that all waste products are removed following completion of construction phase

9.2.3 Conclusions and Recommendations

The fauna assessment determined that the study area is generally of medium value for terrestrial vertebrate biodiversity. Terrestrial vertebrate fauna is unlikely to be substantially negatively affected by this development. The following recommendations are made:

- **Corridor 1, including any of the proposed deviations,** is the most favourable route as it does not traverse a protected area. Corridor 2 and 3 are less favourable, given that they traverse Mokala National Park, however, if Corridor 3 can be moved northward so as to avoid Mokala National Park, then it is equally acceptable to Corridor 1.

- All attempts to minimise unnecessary disturbance and habitat loss during the construction phase should be employed.

- During construction, all efforts must be made to minimise pollution and disturbance to areas outside the demarcated development footprint - no waste of any kind must be allowed to enter the surrounding areas during construction.

- An alien plant control programme (including monitoring) should be designed and implemented for tower footprint areas and any new access roads created during the construction phase, to prevent the disturbance associated with construction from encouraging the proliferation of alien plants.

- Any alien plant clearance programmes should rely preferably on mechanical removal; if the use of chemicals is necessary, the chemicals used must be confirmed to have no negative effects of any indigenous biodiversity by an appropriate expert prior to their use.

9.3 AVIFAUNA ASSESSMENT

9.3.1 Key Findings

Bird species present in the study area

The first Southern African Bird Atlas Project (SABAP 1 – Harrison *et al*. 1997) and the second atlas project (SABAP 2 – www.sabap2.adu.org.za) recorded a combined total of 394 bird species across the broad study area. This does not mean that all of these species do occur on the alignments of the proposed power line, but it does give an indication of what could occur in the area. The full species list is shown in Appendix 2 of the Avifauna Report, provided in Appendix M of this report.

Table 25 is an extract of the species thought to be most important for this study, including Red-listed species and additional non Red-listed species which the authors believe are relevant to this study because of their propensity to interact with overhead transmission lines. A total of 97 species are included in Table below, with 1 listed as regionally Endangered, 13 listed as regionally Vulnerable, 18 as regionally Near-threatened (Barnes 2000), and 2 protected under the Bonn Convention.

For each species the preferred micro-habitat, likelihood of occurring on site and relative importance of site have been assessed. An indication of the ways in which the species could interact with the proposed power line has also been supplied. This is a large number of species to deal with, so in order to narrow the focus, the really heavily impacted species for which this study area is important have been shaded in grey in Table 25. These species are discussed in more detail in Section 2.3 in the Avifauna Report, provided in Appendix M of this report. The species cannot afford to face additional collision threats due to new power lines, making it essential that this impact is carefully managed for this project. In addition to these, other species worthy of mention include Lappet-faced Vultures, Black, White and Abdim's Storks, and medium-sized raptors which may perch or nest on towers including kestrels, Black-chested Snake-Eagles, Black Harriers, Southern Pale Chanting Goshawks, Steppe and Jackal Buzzards, Booted Eagles and Lanner Falcons.

Table 25: Summary of priority bird species associated with the proposed Perseus-Kronos 765 kV power line (most important species highlighted in grey)(Smallie, 2013)

Common name	Scientific name	SABAP 1	SABAP 2	Regional conservation status	Preferred micro habitat in this study area	Likelihood of occurring on site	Relative importance of site for national population of species	Likely interactions with proposed power line
Bustard, Kori	*Ardeotis kori*	X	X	VU	Open Karoo and *Acacia* watercourses	Definite	High	C, HD, D
Bustard, Ludwig's	*Neotis ludwigii*	X	X	VU	Open Karoo	Definite	High	C, HD, D
Buzzard, Jackal	*Buteo rufofuscus*	X	X		Any	Probable	Medium	C, HD, D, N, P
Buzzard, Steppe	*Buteo vulpinus*	X	X		Any	Definite	Medium	C, HD, D, N, P
Crane, Blue	*Anthropoides paradiseus*	X	X	VU	Open Karoo, cultivated land	Probable	Medium	C, HD, D
Crane, Grey Crowned	*Balearica regulorum*	X	X	VU	Open Karoo, cultivated land	Possible	Low	C, HD, D
Crow, Cape	*Corvus capensis*	X	X		Open Karoo	Definite	Low	C, HD, D, N, P
Crow, Pied	*Corvus albus*	X	X		Open Karoo	Definite	Low	C, HD, D, N, P
Duck, African Black	*Anas sparsa*	X	X		Any near water	Probable	Medium	C
Duck, Comb	*Sarkidiornis melanotos*	X	X		Any near water	Probable	Low to medium	C
Duck, Fulvous	*Dendrocygna bicolor*	X	X		Any near water	Probable	Medium	C
Duck, Maccoa	*Oxyura maccoa*	X	X		Any near water	Probable	Low to medium	C
Duck, White-backed	*Thalassornis leuconotus*	X	X		Any near water	Probable	Low to medium	C
Duck, White-faced	*Dendrocygna viduata*	X	X		Any near water	Probable	Low to medium	C
Duck, Yellow-billed	*Anas undulata*	X	X		Any near water	Probable	Medium	C
Eagle, Booted	*Aquila pennatus*	X	X		Open Karoo	Probable	Medium	C, HD, D, P
Eagle, Martial	*Polemaetus bellicosus*	X	X	VU	Open Karoo	Probable	Medium	C, HD, D, N, P
Eagle, Tawny	*Aquila rapax*	X	X	VU	Open Karoo	Probable	Medium	C, HD, D, N, P
Eagle, Verreaux's	*Aquila verreauxii*	X	X		Open Karoo	Probable	Medium	C, HD, D, N, P
Eagle-Owl, Cape	*Bubo capensis*	X	X		Rocky terrain	Unlikely		

Common name	Scientific name	SABAP 1	SABAP 2	Regional conservation status	Preferred micro habitat in this study area	Likelihood of occurring on site	Relative importance of site for national population of species	Likely interactions with proposed power line
Eagle-Owl, Spotted	*Bubo africanus*	X	X		Any	Probable	Medium	C, HD, D, P
Eagle-Owl, Verreaux's	*Bubo lacteus*	X	X		Any	Probable	Medium	C, HD, D, P
Falcon, Amur	*Falco amurensis*	X	X		Open Karoo	Probable	Low to medium	C, D, P
Falcon, Lanner	*Falco biarmicus*	X	X	NT	Any	Definite	Medium	C, HD, D, N, P
Falcon, Peregrine	*Falco peregrinus*		X	NT	Any	Probable	Medium	C, HD, D, N, P
Falcon, Pygmy	*Polihierax semitorquatus*	X	X		Open Karoo	Possible	Low	C, D, P
Falcon, Red-footed	*Falco vespertinus*	X	X		Open Karoo	Possible	Low	C, D, P
Falcon, Red-necked	*Falco chicquera*	X			Open Karoo	Possible	Low	C, D, P
Fish-Eagle, African	*Haliaeetus vocifer*	X	X		Any close to water	Possible	Low to medium	C, HD, D, N, P
Flamingo, Greater	*Phoenicopterus ruber*	X	X	NT	Any water	Probable	Medium	C, D
Flamingo, Lesser	*Phoenicopterus minor*	X	X	NT	Any water	Probable	Medium	C, D
Goose, Egyptian	*Alopochen aegyptiacus*	X	X		Any close to water	Definite	Low to medium	C, D, N, P
Goose, Spur-winged	*Plectropterus gambensis*	X	X		Any close to water	Definite	Low	C, D
Goshawk, Gabar	*Melierax gabar*	X	X		Open Karoo	Possible	Low	C, HD, D, N, P
Goshawk, Southern Pale Chanting	*Melierax canorus*	X	X		Any	Definite	Medium	C, HD, D, N, P
Grebe, Black-necked	*Podiceps nigricollis*	X	X		Any water	Possible	Low	C
Grebe, Great Crested	*Podiceps cristatus*	X	X		Any water	Possible	Low	C
Grebe, Little	*Tachybaptus ruficollis*	X	X		Any water	Probable	Low	C
Guineafowl, Helmeted	*Numida meleagris*	X	X		Any	Definite	Medium	C, HD, D, P
Harrier, Black	*Circus maurus*	X	X	NT	Any	Possible	Medium	C, HD, D, P
Harrier, Montagu's	*Circus pygargus*		X		Open Karoo	Possible	Low	C, HD, D, P
Harrier, Pallid	*Circus macrourus*	X	X	NT	Open Karoo	Possible	Low	C, HD, D, P

Common name	Scientific name	SABAP 1	SABAP 2	Regional conservation status	Preferred micro habitat in this study area	Likelihood of occurring on site	Relative importance of site for national population of species	Likely interactions with proposed power line
Harrier-Hawk, African	*Polyboroides typus*	X	X		Any	Possible	Medium	C, HD, D, P
Heron, Black-headed	*Ardea melanocephala*	X	X		Any close to water	Definite	Medium	C
Heron, Goliath	*Ardea goliath*	X	X		Any close to water	Possible	Low	C
Heron, Grey	*Ardea cinerea*	X	X		Any close to water	Probable	Medium	C
Heron, Purple	*Ardea purpurea*	X	X		Any close to water	Possible	Low	C
Ibis, African Sacred	*Threskiornis aethiopicus*	X	X		Any close to water	Probable	Medium	C, P
Ibis, Glossy	*Plegadis falcinellus*	X	X		Any close to water	Probable	Medium	C, P
Ibis, Hadeda	*Bostrychia hagedash*	X	X		Any	Probable	Medium	C, P
Kestrel, Greater	*Falco rupicoloides*	X	X		Open Karoo	Definite	Medium	C, HD, D, N, P
Kestrel, Lesser	*Falco naumanni*	X	X	VU	Open Karoo	Definite	Medium	C, HD, D, P
Kestrel, Rock	*Falco rupicolus*	X	X		Open Karoo	Definite	Medium	C, HD, D, P
Kite, Black	*Milvus migrans*	X	X		Any	Probable	Low	P
Kite, Black-shouldered	*Elanus caeruleus*	X	X		Any	Probable	Low	P
Kite, Yellow-billed	*Milvus aegyptius*	X	X		Any	Possible	Low	P
Korhaan, Blue	*Eupodotis caerulescens*	X	X	NT	Open Karoo	Probable	Medium	C, HD, D
Korhaan, Karoo	*Eupodotis vigorsii*	X	X		Open Karoo	Definite	Medium	C, HD, D
Korhaan, Northern Black	*Afrotis afraoides*		X		Open Karoo	Definite	Medium	C, HD, D
Korhaan, Red-crested	*Lophotis ruficrista*	X	X		Open Karoo	Possible	Low	C, HD, D
Lark, Melodious	*Mirafra cheniana*	X	X	NT	Open Karoo	Possible	Low	HD, D
Lark, Red	*Calendulauda burra*	X		VU	Open Karoo	Unlikely		
Lark, Sclater's	*Spizocorys sclateri*	X	X	NT	Open Karoo	Possible	Low	HD, D
Lark, Short-clawed	*Certhilauda chuana*	X	X	NT	Open Karoo	Possible	Low	HD, D

Common name	Scientific name	SABAP 1	SABAP 2	Regional conservation status	Preferred micro habitat in this study area	Likelihood of occurring on site	Relative importance of site for national population of species	Likely interactions with proposed power line
Marsh-Harrier, African	*Circus ranivorus*	X	X	VU	Any close to water	Possible	Low	C, D
Marsh-Harrier, Western	*Circus aeruginosus*	X			Any close to water	Unlikely		
Osprey, Osprey	*Pandion haliaetus*	X	X		Any close to water	Possible	Low	C, P
Owl, Barn	*Tyto alba*	X	X		Any	Probable	Medium	C, D, P
Owl, Marsh	*Asio capensis*	X	X		Any close to water	Possible	Low	C
Oxpecker, Red-billed	*Buphagus erythrorhynchus*	X	X	NT	Woodland	Possible	Low	HD, D
Painted-snipe, Greater	*Rostratula benghalensis*	X	X	NT	Any close to water	Possible	Low	C
Pelican, Pink-backed	*Pelecanus rufescens*	X		VU	Any close to water	Possible	Low	C
Plover, Chestnut-banded	*Charadrius pallidus*	X	X	NT	Pans	Possible	Low	C, D
Pochard, Southern	*Netta erythrophthalma*	X	X		Any close to water	Possible	Low	C
Raven, White-necked	*Corvus albicollis*	X	X		Any	Unlikely		
Secretary bird	*Sagittarius serpentarius*	X	X	NT	Open Karoo	Definite	Medium to high	C, HD, D
Shelduck, South African	*Tadorna cana*	X	X		Any close to water	Probable	Medium	C
Shoveler, Cape	*Anas smithii*	X	X		Any close to water	Possible	Low	C
Snake-Eagle, Black-chested	*Circaetus pectoralis*	X	X		Open Karoo	Probable	Medium	C, HD, D, P
Snake-Eagle, Brown	*Circaetus cinereus*	X	X		Open Karoo	Possible	Low	C, HD, D, P
Sparrowhawk, Black	*Accipiter melanoleucus*	X	X		Woodland	Unlikely		
Spoonbill, African	*Platalea alba*	X	X		Any water	Probable	Low	C
Stork, Abdim's	*Ciconia abdimii*	X	X	Bonn	Open Karoo, cultivated	Probable	Low to medium	C, P

Common name	Scientific name	SABAP 1	SABAP 2	Regional conservation status	Preferred micro habitat in this study area	Likelihood of occurring on site	Relative importance of site for national population of species	Likely interactions with proposed power line
					land			
Stork, Black	*Ciconia nigra*	X	X	NT	Any close to water	Probable	Low to medium	C, P
Stork, Marabou	*Leptoptilos crumeniferus*	X		NT	Open habitat	Possible	Low	C
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	X	X	EN	Any close to water	Unlikely		
Stork, White	*Ciconia ciconia*	X	X	Bonn	Open Karoo, cultivated land	Probable	Low to medium	C, P
Stork, Yellow-billed	*Mycteria ibis*	X	X	NT	Any close to water	Probable	Low to medium	C, P
Teal, Cape	*Anas capensis*	X	X		Any water	Probable	Low	C
Teal, Hottentot	*Anas hottentota*	X	X		Any water	Probable	Low	C
Teal, Red-billed	*Anas erythrorhyncha*	X	X		Any water	Probable	Low	C
Tern, Caspian	*Sterna caspia*	X	X	NT	Large wetlands	Possible	Low	C
Thick-knee, Spotted	*Burhinus capensis*	X	X		Open Karoo	Definite	High	C, HD, D
Vulture, Cape	*Gyps coprotheres*	X		VU	Open Karoo	Probable	Medium	C, HD, D, P
Vulture, Lappet-faced	*Torgos tracheliotus*	X	X	VU	Open Karoo	Possible	Low to medium	C, HD, D, P
Vulture, White-backed	*Gyps africanus*	X	X	VU	Open Karoo	Definite	Medium to high	C, HD, D, N, P
Weaver, Sociable	*Philetairus socius*	X	X		Any	Definite	Medium	HD, D, P, N

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

C = Collision with overhead cables; HD = Habitat destruction; D = Disturbance of birds during construction; N = Nesting on towers; P = Perching on power line towers.

White-backed Vultures

This species is classified as regionally Vulnerable but globally Endangered, with some pairs estimated 300 in the Northern Cape (Barnes 2000, Hockey *et al.* 2005, BirdLife International 2013). Despite being locally common in parts of South Africa, the population is thought to be in decline because of anthropogenic threats such as habitat loss, poisoning, and collision with or electrocution on power infrastructure (Barnes 2000). White-backed Vultures nest in large trees (often *Acacia erioloba*), but can also use electricity towers, making them vulnerable to collision and electrocution (Barnes 2000). There are a number of colonies in the greater Kimberley area (of particular relevance to the proposed alignments in the Ritchie area), and an estimated 2% of this population is killed annually in power line collisions (Murn *et al.* 2002, Hockey *et al.* 2005). They can be expected to use appropriate self-supporting towers of the proposed power line if it is placed within their range (as was observed during the fieldwork, with 18 birds seen on a 132 kV tower on Alternative 3; J. Shaw pers. obs., Figure 26), which will therefore place them at risk. The electromagnetic field effects on birds breeding on transmission lines are also not yet understood but may include effects on breeding success.

The approximate position of the known breeding colonies of this species is shown in Figure 26 below. In addition to plotting the co-ordinates of these colonies, a group of species experts (Mark Anderson, Angus Anthony, Campbell Murn) was asked for advice on how far they believed the new power line should be built from a breeding colony of this species. These experts felt that we have insufficient understanding of the species to answer this question adequately. One expert, Mark Anderson, recommended that this EIA include an updated aerial census of the breeding colonies in the area. In order to be cautious in this regard, this author has suggested a buffer of 10km needs to be allowed between the line and any colonies, and that all stands (clumps) of *Acacia erioloba* in this broader area should be treated as potential breeding habitat for this species, and ideally avoided by the power line. Figure 26 shows that several of these buffer areas are currently bisected by the proposed Corridor 2 and 3, and to a lesser extent by Corridor 1. This situation is discussed more in Section 4 of the Avifauna Report (Appendix M).

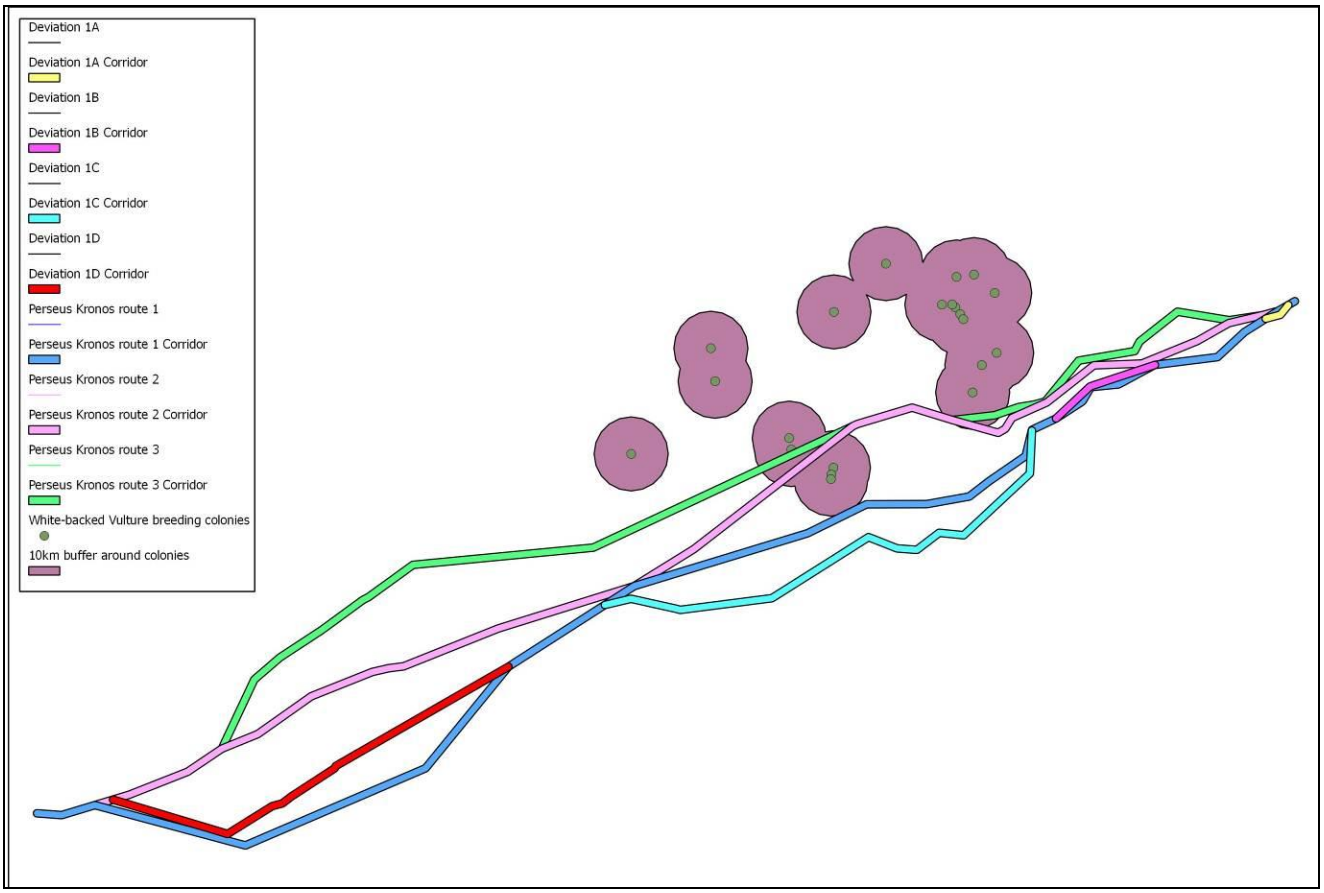


Figure 26: White-backed Vulture breeding colonies and 10km buffers in relation to the proposed corridors

Bird sightings in the study area

Priority species seen during field work were recorded and can be seen in Figure 27 below. Care should be taken not to place too much emphasis on the exact locations of the sightings, as birds in this environment are highly mobile, and react to the localised rainfall which can occur in this region. In addition, the field work was not representative of variation in conditions on site, and time was not apportioned evenly across the study area.

More broadly, good numbers of the species identified in Figure 27, as well as Ludwig's Bustards, Blue Cranes, Blue Korhaans and Verreaux's Eagles were seen in the Upper Karoo and Dry Highveld Grassland bioregions during a large terrestrial bird road census which was conducted four times across the Karoo from May 2010-April 2011 (Shaw 2013). In addition, several satellite tagged Ludwig's Bustards often spend their summer months at a site 16 kilometres to the south of Petrusburg. While this is some distance from the proposed alignments, it highlights the importance of the area for these bustards. All of this data provides confirmation of the presence of several key species in the vicinity of the proposed power line.

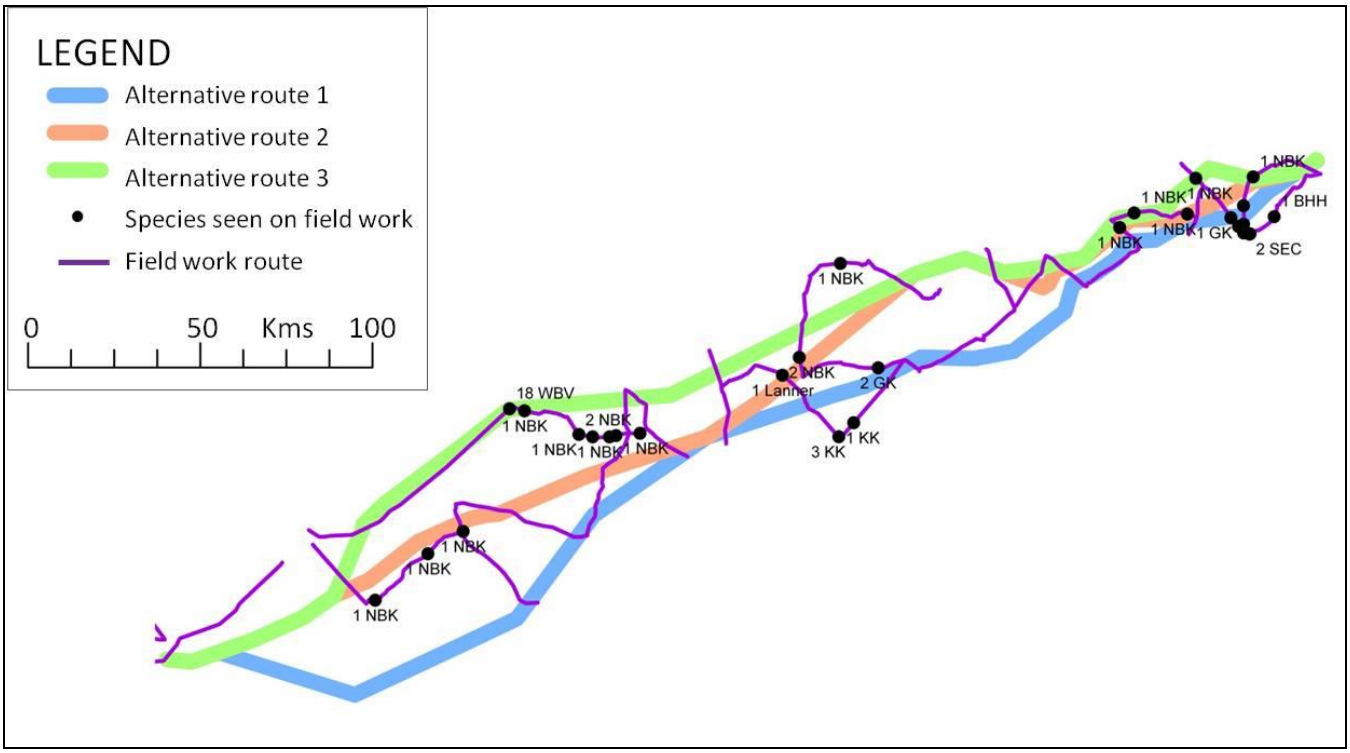


Figure 27: Priority bird species recorded during field work in the study area

(KK=Karoo Korhaan, SEC=Secretary bird, NBK=Northern Black Korhaan, GK=Greater Kestrel, Lanner=Lanner Falcon, BHH=Black-headed Heron, WBV=White-backed Vulture)

Deviations 1A to 1D were not investigated during field work

Power line mortality surveys on Hydra-Kronos 400kV

Of specific interest to this study are mortality data from an unmarked section of existing 400kV line in the area; 55 kilometres of Hydra-Kronos which lies 14 kilometres to the south-east of Corridor 1. This was surveyed quarterly for two full years (April 2010-April 2012) for power line mortalities as part of a wider study on the impact of power line collisions on Ludwig's Bustard (Shaw 2013). Results from this study indicated that at least nine species are impacted by transmission power lines in this area (Table 26), six of which are priority species (Table 25). As expected, bustards were most affected, with high numbers of Ludwig's and Kori Bustards killed.

Table 26: Number of bird collisions recovered from a section of the Hydra-Kronos 400kV line(2010-2012) by species (data from Shaw 2013)

Recent collisions are those that died in the two year study period, and total collisions include historic remains.

Species	Recent collisions	Total collisions
Ludwig's Bustard	42	95
Kori Bustard	8	22
Karoo Korhaan	2	7
Northern Black Korhaan	4	6
Pied Crow	1	2
Secretary Bird	1	3
Crow	0	1
Feral Pigeon	1	1
Red-knobbed Coot	0	1
White Stork	0	1
Unidentified bird	0	1

Important Bird Areas (IBAs), Coordinated Avifaunal Roadcount Project (CAR) and Coordinated Waterbird Counts Project (CWAC)

These are three bird conservation and monitoring initiatives in South Africa. The CAR project counts large terrestrial bird species using repeated vehicle based transects (Young *et al.* 2003), and the CWAC project counts water birds at established sites each year (Taylor *et al.* 1999). The Important Bird Areas (IBA) programme identifies and conserves sites internationally that are critical for the long-term survival of bird species that are globally threatened, have a restricted range, and are restricted to specific biomes/vegetation types (Figure 28). Sites which have significant populations of water birds are also considered (BirdLife South Africa 2013).

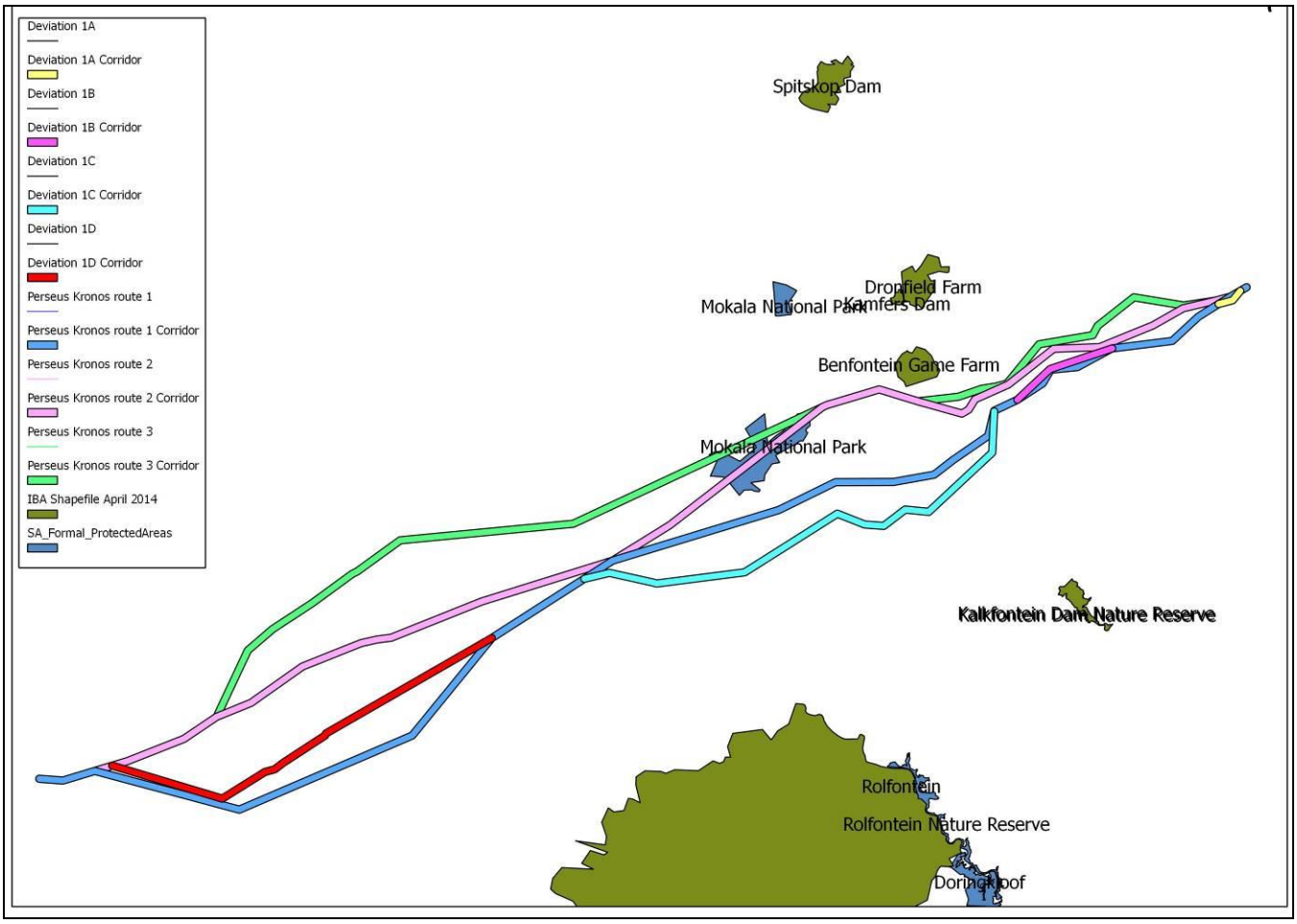


Figure 28: Protected areas and Important Bird Areas in the study area (some sites are both)

IBAs

Four IBAs fall within 30 kilometres of the proposed line (BirdLife South Africa 2013), although no sites are crossed by the proposed corridors (Figure 28).

Benfontein Game Reserve (SA033) holds:

- some breeding White-backed Vultures;
- possibly breeding Blue Cranes;
- Secretary birds;
- Tawny Eagles; and
- Ludwig's Bustards.

There is a large pan on this site which is used by numerous Greater and Lesser Flamingos when water is present.

Dronfield Farm (SA031) holds:

- average of 75 pairs of breeding White-backed Vultures;
- Martial Eagles;
- Secretary birds; and

- Lanner Falcons.

Kamfers Dam (SA032) - important for Lesser and Greater Flamingos, with very high numbers of these species found throughout the year (sometimes >80,000 birds). Lesser Kestrels also use this site.

Soetdoring Nature Reserve (SA049) - important for:

- water birds including both flamingos;
- Blue Cranes;
- White-backed Vultures;
- Tawny and Martial Eagles;
- Blue Korhaans;
- Secretary birds; and
- Kori Bustards.

All of these are priority species for this project.

The Avifauna Specialist's suggested route alongside existing lines from Kronos-Hydra-Perseus would necessitate running through the Platberg-Karoo Conservancy IBA (SA037) which holds vital populations of two globally threatened species; the Lesser Kestrel and the Blue Crane. Other threatened species that the site is important for include Tawny and Martial Eagles, Kori and Ludwig's Bustards, Pallid and Black Harriers, Blue Korhaans, Greater Flamingos, Black Storks, Secretary birds, South African Shelducks and Lanner Falcons (BirdLife South Africa 2013). Although most of these threatened species are physically large, a host of small terrestrial species also call this area home, many of which rely upon riverine woodland (e.g. Karoo Lark), thicket found mostly on slopes, and/or rocky slopes and outcrops (e.g. Karoo Long-billed Lark, Karoo Chat).

Provided that these areas (IBAs) are avoided by the power line, the impacts of the facility on these small species associated with these habitats should be acceptable. It is difficult to balance the likely lessened impact of running the proposed transmission line along this existing power line corridor against the conservation effort of the Platberg Karoo Conservancy IBA. Such IBA boundaries must be considered as 'soft' as they are a broad indication of where the birds reside, and since birds are mobile, developments outside of IBAs can also impact on bird populations within them. One could argue that no developments such as the proposed one should be allowed within an IBA, but this is a massive area which encompasses several urban nodes (including De Aar) and the Hydra Substation. Therefore, this area already has a significant number of power lines and is likely to receive more in the future due to its strategic position between the coal reserves in the north-east of the country, and the Western Cape.

CAR

The two most relevant precincts (congregations of routes) are the Southern Free State and Eastern Karoo precincts. The Southern Free State precinct has fairly good coverage of the eastern part of the proposed power line route. These CAR routes predominantly run though grassy Karoo, and have high densities of Abdim's and White Storks, Blue and Northern Black Korhaans, Ludwig's Bustards, Blue Cranes and Secretary birds. This area is considered important on a national scale for conservation of these species, especially the Blue Korhaan for

which this is a stronghold; it is more common here than anywhere else in the world (Young *et al.* 2003). To the south run the Eastern Karoo CAR routes, on which have been reported the highest densities of Ludwig's Bustards and White Storks in the country and amongst the highest for Kori Bustards, Karoo, Blue and Northern Black Korhaans, Secretary birds and Blue Cranes. All of these species are extremely vulnerable to collision with overhead power lines, as discussed previously. There is good correspondence between where high densities of Blue Cranes and Ludwig's Bustards occur, suggesting that somehow they may be selecting for similar habitat. The CAR report considers collision with overhead lines to be the single most important threat to these two species (Young *et al*. 2003).

CWAC

The Avifauna experts looked at data collected at the nearest ten CWAC sites to the proposed line (all within 30km). As well as the usual water birds and waders expected as such sites, collision-prone ibises, herons, geese and ducks are common. Notable species which are well represented at these sites include Lesser and Greater Flamingos, African Fish-Eagles, African Marsh-Harriers and White, Abdim's and Yellow-billed Storks (ADU 2013).

Other avifaunal hot spots in the study area

Although from a large terrestrial bird collision perspective the entire alignment of the line is high risk, certain areas can be identified that pose high risk based on other factors. These are described below:

Mokala National Park
Corridors 2 and 3 pass through this National Park (Figure 28), which is enough to fatally flaw these alternatives from a biodiversity perspective. There are approximately 20 White-backed Vulture nests at this site (Ronelle Visagie pers. comm.), and breeding of this species has occurred at this site for at least 40 years (Murn *et al*. 2002).

Kimberley and surrounds
The greater Kimberley area may host up to 7% of the South Africa, Lesotho and Swaziland population of White-backed Vultures (Barnes 2000). Several loose colonies of these vultures breed in the broader area (six were surveyed by Murn *et al.* 2002). Most relevant to the proposed alignments are the Susanna and Riet River colonies (Murn *et al.* 2002) which are situated within 30km of Corridors 2 and 3; these birds are highly mobile so would be at risk with these alignments.

Orange River Crossing
This is a significant river, which must be crossed by all the alternative routes. This area is home to numerous bird species, many of which commute up and down the river; this river is therefore a significant flight path. It could also be home to several breeding species, perhaps the most notable of which with respect to power lines is the African Fish Eagle. It will be necessary to confirm whether any species such as this breed near the final alignment when the avifaunal walk through is done, and develop case specific management recommendations if necessary.

The Brak, Riet and Modder River crossings and surrounds
These are important avifaunal features for the same reasons as discussed above for the Orange River. All the proposed alignments cross the Brak and Riet Rivers, and Corridor 1 crosses the Modder River and also runs within a few kilometres of it for approximately 20 kilometres.

Preferred Corridors

Table 27: Assessment of avifaunal factors for each corridor route

Factor	Alternative route 1	Alternative route 2	Alternative route 3	Deviation 1A	Deviation 1B	Deviation 1C	Deviation 1D	Kronos-Hydra-Perseus
Length of line adjacent to existing high voltage lines (defined as within 1 km or so, but with potential to be placed within 150 m between outer conductors)	6 km	29 km	87 km	6 km	6 km	6 km	6 km	~480 km
Length of line	384 km	379 km	387 km	384.6 km	383.4 km	396 km	376 km	~480 km
Key avifaunal features crossed or close to alignment	Modder, Riet, Brak and Orange Rivers, WBV colonies	Riet, Brak and Orange Rivers, Kimberley WBV colonies	Riet, Brak and Orange Rivers, Kimberley WBV colonies	Modder, Riet, Brak and Orange Rivers, WBV colonies	Modder, Riet, Brak and Orange Rivers, WBV colonies	Modder, Riet, Brak and Orange Rivers, WBV colonies	Modder, Riet, Brak and Orange Rivers, WBV colonies	Modder, Riet, Brak and Orange Rivers
Length of line within protected areas or IBAs	None	29 km in Mokala NP	13 km in Mokala NP	None	None	None	None	137 km in Platberg-Karoo IBA SA037
Final overall score out of 10	**4**	**0 - Fatal flaw**	**0 - Fatal flaw**	**4**	**4**	**6**	**4**	**8**

From the above table, Corridor 2 and 3 are fatally flawed as they pass through Mokala National Park and a high risk White-backed Vulture area. Deviations 1A and 1B differ very little from Corridor 1 for avifauna and are assigned the same score as Corridor 1. Deviation 1C is significantly further from the White-backed Vulture areas and is hence the most preferred route. Deviation 1D still passes too close to vulture areas and so is assigned the same score as Corridor 1.

However, the Avifauna Specialist continues to strongly recommend that the option of upgrading or recycling existing 400kV lines in the Kronos-Hydra-Perseus corridor be fully examined first.

9.3.2 Potential Avifauna Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 28: Analysis of the Significance of Potential Avifauna Impacts (Perseus-Kronos – for all three Corridors and Deviations) (Smallie, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
1. Collision	Collision of birds with earth wires and conductors during maintenance – key species being Ludwig's Bustard, Kori Bustard, Blue Crane, Secretary bird, Greater and Lesser Flamingo	4 3	5 5	4 4	4 4	4 2	68 32	Very High	Moderate
2. Habitat destruction	Destruction of bird habitat during construction of the power line, and to a lesser extent maintenance	2 2	3 3	1 1	3 3	4 4	36 36	Moderate	Moderate
3. Disturbance	Disturbance of birds, during construction and to a lesser extent maintenance	3 3	2 2	2 1	2 2	3 2	27 16	Moderate to low	Low
4. Nesting	Nesting of birds on towers during operational phase	3 2	0 0	1 1	4 4	3 2	24 14	Moderate to low	Low
5. Electrical Faulting	Electrical faulting on lines, caused by birds	3 2	1 1	1 1	4 4	3 2	27 16	Moderate to low	Low

Table 29: Mitigation Measures (Avifauna)

Impact	Mitigation Measures
1. Collision	It is essential that the option of upgrading or recycling existing 400kV lines to produce the necessary 765 kV capacity be examined fully before a new line is considered further. This is of critical importance in ensuring that no new kilometres of line be added to the network unless absolutely necessary. Part of this exercise should be to evaluate the long-term need for transmission lines and ensure that we do not keep adding lines without excellent justification, and without exhausting all other alternatives. Failing this, it will be essential that an alternative routing adjacent to (not more than 150 m between outer conductors) existing 400 kV lines in the Kronos-Hydra-Perseus corridor be examined. This would hopefully provide partial mitigation for the impact of collision, something not possible with the suggested alternatives, which are also all problematic in their proximity to key avifaunal features. In addition, the following will be essential. With our current inability to accurately predict what constitutes a high risk section of line (Shaw *et al.* 2010, Shaw 2013), the most effective anti-collision markers available at the time must be installed along the entire length of the power line, with 100% of each span marked. This installation must be done according to Eskom best practice at the time, but should include the following at least: markers must alternate between a light and dark colour to provide contrast against a dark and light background respectively. These markers must be no more than 20 m apart on each earth wire and must be placed along the full length of the earth wire (not only the middle two-thirds as done previously). It is Eskom's responsibility to ensure the integrity of these devices for the full lifespan of the power line. If these devices become damaged or their effectiveness is in any way compromised with time they must be replaced. Likewise if significantly more effective devices become available, these must be installed on the power line. In addition, a site specific EMP (avifaunal walk through) must be conducted to identify high risk sections of this power line near water sources for birds which fly at night, and these sections must be installed with the most effective nocturnal anti-collision markers available at the time. It is also Eskom's responsibility to monitor the impacts of this power line and the effectiveness of the mitigation measures installed. It is therefore recommended that sample sections of this power line be monitored systematically by the Eskom-EWT Strategic Partnership. This should include patrols at least every three months along sample sections of line according to the methodology used previously by the Partnership.
2. Habitat destruction	A construction EMPr (avifaunal walk through) must be conducted to identify any particularly

Impact	Mitigation Measures
	sensitive habitats and environmental best practice must be followed during construction and maintenance activities. An on-site ECO must be responsible for ensuring compliance and minimising habitat destruction during construction. All existing roads and storage sites must be used where possible.
3. Disturbance	A site specific avifaunal walk through for the construction EMP must be conducted and environmental best practice must be followed during construction and maintenance activities. An on-site ECO must be responsible for ensuring compliance and minimising disturbance during construction. If any breeding raptors or other Red-listed bird species are identified during the site-specific EMPr, case-specific management measures must be developed by an avifaunal specialist. If the line is placed close to existing lines they must be searched for eagle nests.
4. Nesting	Note that any intervention with nesting once line is operational must be subject to national and provincial legislation and Eskom nest management guidelines. Suggestion - use a cross rope suspension configuration to minimise the chances of nests being built.
5. Electrical faulting	Fit Bird Guards on self-support towers as per Eskom transmission guidelines, and use a cross rope suspension configuration.

9.3.3 Conclusions and Recommendations

Corridor 2 and 3 are fatally flawed as they pass through Mokala National Park and a high risk White-backed Vulture area. **Deviations 1A and 1B differ very little from Corridor 1** for avifauna and are assigned the same score as Corridor 1. **Deviation 1C is most preferred route** as it is significantly further from the White-backed Vulture areas. **Deviation 1D still passes too close to vulture areas and so is assigned the same score as Corridor 1.**

However, the Avifauna Specialist continues to strongly recommend that the option of upgrading or recycling existing 400kV lines in the Kronos-Hydra-Perseus corridor be fully examined first[2].

In order to mitigate for the impacts, the following recommendations need to be implemented:

- The option of recycling or upgrading existing 400kV lines (running from Kronos-Hydra-Perseus) instead of building a new line should first be fully examined, and the findings of that exercise be made available to the specialists.
- If the above thorough examination of the recycle/upgrade reveals that it is not viable, then the next best choice will be to ensure the least impactful route is chosen. All of the proposed alternatives are problematic from an avifaunal perspective because they do not run alongside existing high voltage lines, and are close to several key features. We therefore recommend that this new power line is routed alongside existing lines in the Kronos-Hydra-Perseus corridor.
- The alignment must avoid all pans along its route by at least several hundred metres.
- The alignment must avoid White-backed Vulture breeding colonies by 10km, and must avoid large stands of *Acacia erioloba* by as far as possible. This feature must be identified during the avifaunal walk through.
- Given our current inability to accurately predict which sections of line pose a high collision risk, a suitable anti-bird collision line marking device must to be fitted on earth wires from pylon to pylon for the entire length of the power line. It is extremely important that Eskom identify an effective and durable marking device and installation method by the time this line is constructed. This includes the need to have a suitable and approved nocturnal device for those sections of line close to pans likely to hold flamingos, or act as flight paths for these birds. On previous projects of this nature, Eskom have argued that no approved nocturnal device exists at the time of construction with the result that no such devices were installed. This is not an acceptable excuse. It is Eskom's responsibility to ensure that such a device exists in time for construction of this line.
- It is essential that an avifaunal walk through is conducted during the development of the site specific Environmental Management Plan for the line, and is particularly important that Eskom allows sufficient time and budget for this study to be thorough. This is critical to identify and mitigate for large eagle nests on site, and to develop management recommendations to ensure that as far as possible these birds are not disturbed during the construction of the new line. The walk through will also identify sections of line that pose a high collision risk for birds which fly at night so that they can be marked with nocturnal devices, and identify particularly sensitive habitat requiring protection.

[2] **Please note:** This option is disregarded as a feasible alternative as it is not part of the Cape Corridor Strengthening Phase 5 Grid Plan (See Need and Desirability Section 1.1.1.).

- It will be Eskom's responsibility to ensure that the line marking devices remain in working order or are replaced timeously throughout the lifespan of the power line.
- It will be essential that a sample of the line is monitored at least every three months during the first three years of its operation in order to detect any collision hot-spot areas, and evaluate the effectiveness of the mitigation measures. This monitoring should best be done by the Eskom-Endangered Wildlife Trust Strategic Partnership. Although this recommendation may appear stringent, in our opinion the fact that systematically collected data on the collision impact and effectiveness of mitigation measures of existing lines is not more widely available is unacceptable. There is no available data on collision rates of 765 kV lines in South Africa since no systematic monitoring has been conducted to date. This means we do not know how severe collision mortality might be on such a large structure and must estimate using collision rates from lower voltage lines. This situation can no longer be accepted when conducting EIAs for new lines.
- All construction, maintenance and decommissioning activities in any natural habitat along the route of the power line should be carried out in accordance with best environmental practice principles so as to minimise disturbance of any natural habitat. Particularly sensitive areas will also be identified during the avifaunal walk through process.
- All nests on this line (and others) should be managed according to Eskom Transmission nest management guidelines and relevant provincial and national legislation.
- Potential tower types have not yet been chosen, but the Avifauna recommends cross rope suspension to minimise issues for large eagles. This configuration does not provide much nesting area, and will also reduce risk of faulting.

9.4 WETLAND ASSESSMENT

9.4.1 Key Findings

The Corridors and Deviations were studied in a 2km wide corridor and the number of wetlands and riparian / drainage lines will thus be greatly higher than the line will actually cross. The number of wetlands and drainage lines / riparian areas does however provide an overview into the densities of watercourses and thus provides a general idea which corridor would be ecologically the better option. The less number of watercourses in a corridor, the less impact the line will have. It is important to note that within 500m of any watercourse a Water Use Licence Application (WULA) would likely be required (Figure 29).

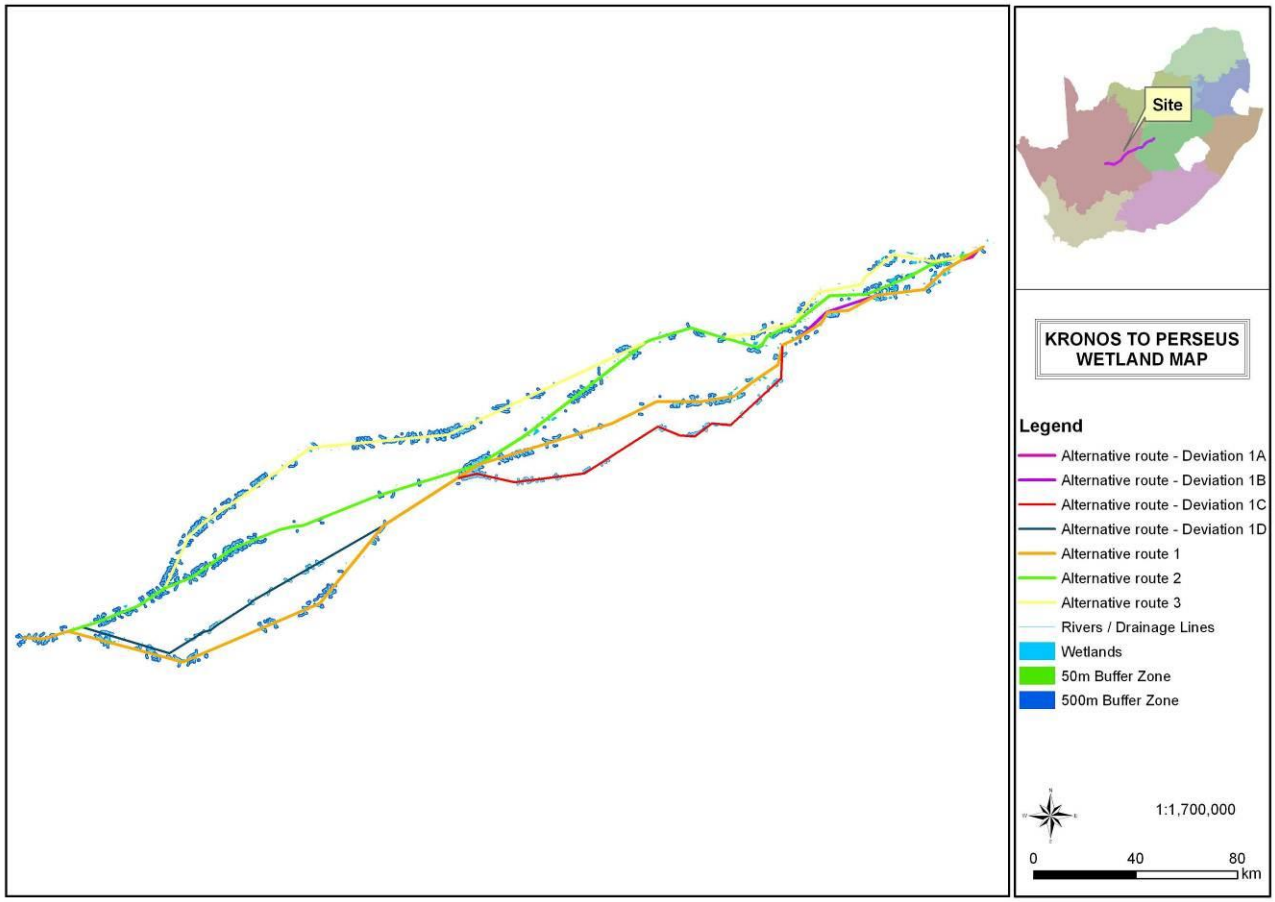


Figure 29: Wetlands, drainage lines and riparian areas along the power line corridors with a 500m buffer zone (Bootsma, 2015)

Preferred Corridors

Corridor 1
Corridor 1 has the least amount of wetlands such as pans or drainage lines/riparian areas with the total number of drainage lines/riparian areas numbering 206 and the total number of wetlands numbering 129. Corridor 1 does not transect any large mountainous areas or any national parks and is therefore the preferred option.

Corridor 2
Corridor 2 has the highest amount of wetlands with the total numbering 164. The total number of drainage lines/riparian areas is 233. Corridor 2 also transects approximately 28km through the Mokala National Park. Further Corridor 2 also passes over a mountainous area near the town of Prieska. Corridor 2 is thus the least preferred route.

Corridor 3
Corridor 3 has the highest number of drainage lines/riparian areas with the total numbering 244. The total number of wetlands within Corridor 3 is 140. Corridor 3 transects approximately 15km of the Mokala National Park. Corridor 3 also transects a large mountainous area near Prieska. This Corridor is thus the not a preferred route.

Deviation 1A
Corridor 1 with Deviation 1A has 206 drainage lines and riparian areas and 129 wetlands. This corridor is not a preferred route.

Deviation 1B
Corridor 1 with Deviation 1B (which is further from a river and avoids various structures) has the least amount of watercourses and does not transect and national parks or any large mountainous areas and is therefore the preferred option.

Deviation 1C
Corridor 1 with Deviation 1C has 200 drainage lines and riparian areas and 153 wetlands. This corridor is not a preferred route.

Deviation 1D
Deviation 1D further avoids a river crossing, pans, soil erosion and reduces the line distance. This corridor has the second least number of wetlands and is the second preferred.

A summary of results and the preferred Corridors is represented in Table 30 below.

Table 30: Perseus-Kronos Transmission Line and Substation Upgrade Summary

Route / Substation	Notes	Order of preference
Corridor 1	• 206 Drainage Lines/Riparian Areas • 129 Wetlands	Not Preferred
Corridor 2	• 233 Drainage Lines/Riparian Areas • 164 Wetlands • 28km through Mokala National Park • 18km Over mountainous area	Not Preferred
Corridor 3	• 244 Drainage Lines/Riparian Areas • 140 Wetlands • 15km through Mokala National Park • 18km Over mountainous area	Not Preferred
Corridor 1 with deviation 1a	• 206 Drainage Lines/Riparian Areas • 129 Wetlands	Not Preferred
Corridor 1 with deviation 1b	• **202 Drainage Lines/Riparian Areas** • **121 Wetlands**	**Most Preferred**
Corridor 1 with deviation 1c	• 200 Drainage Lines/Riparian Areas • 153 Wetlands	Not Preferred
Corridor 1 with deviation 1d	• 213 Drainage Lines/Riparian Areas • 124 Wetlands	Second Preferred

9.4.2 Potential Wetland Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 31: Analysis of the Significance of Potential Wetland Impacts (Kronos to Perseus – for all three Corridors and Deviations) (Bootsma, 2015)

	Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
CONSTRUCTION PHASE	Changing the quantity and fluctuation properties of the watercourse	- Development within water resources e.g. tower footprint within wetland, pan or riparian area, thereby diverting or impeding flow; - Lack of adequate rehabilitation resulting in invasion by woody invasive plant species.	3 1	3 2	3 1	2 1	3 2	33 14	Moderate	Low
	Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount)	- Earthwork activities to construct towers; - Clearing of surface vegetation will expose the soils, which in rainy events would wash down into wetlands, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil; - Disturbance of soil surface; - Disturbance of slopes through creation of roads and tracks; - Changes in runoff characteristics; - Erosion (e.g. gully formation, bank collapse).	5 2	3 2	5 3	2 1	4 3	60 18	High	Moderate

	Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
	Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate)	- Disposal or discharge of human (including partially treated and untreated) sewage during the construction phase of the development	2 1	3 2	3 1	2 1	3 2	27 16	Moderate	Moderate
	Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons	- Runoff from road surfaces; - Discharge of solvents, and other industrial chemicals.	2 1	2 2	3 1	2 1	3 2	27 10	Moderate	Low
	Changing the physical structure within a water resource (habitat)	- Encroachment to achieve maximum commercial returns; - Deposition of wind-blown sand; - Loss of fringing vegetation and erosion; - Alteration in natural fire regimes.	3 2	3 2	2 1	3 2	3 2	33 14	Moderate	Low
OPERATIONAL PHASE	Changing the quantity and fluctuation properties of the watercourse	- Vehicles driving in / through watercourses; - Damage to vegetated areas	3 1	3 2	3 1	2 1	3 2	33 14	Moderate	Low
	Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount)	- Vehicles impacting on surface vegetation.	5 2	3 2	5 3	2 1	4 3	60 18	High	Moderate
	Alteration of water quality – increasing the amounts of nutrients (phosphate,	- Disposal or discharge of human (including partially treated and untreated) sewage during the operational phase (maintenance) of	2 1	3 2	3 1	2 1	3 2	27 16	Moderate	Moderate

	Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
	nitrite, nitrate)	the development.								
	Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons	- Runoff from road surfaces; - Discharge of solvents, and other industrial chemicals.	2 1	2 2	3 1	2 1	3 2	27 10	Moderate	Low
	Changing the physical structure within a water resource (habitat)	- Loss of vegetation	3 2	3 2	2 1	3 2	3 2	33 14	Moderate	Low

Table 32: Mitigation Measures (Wetland)

Impact	Mitigation Measures
Changing the quantity and fluctuation properties of the watercourse	**Construction Phase** • No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable, only a tower footprint and no access roads can be considered. This is subjected to authorization by means of a water use license. • Construction in and around watercourses should be restricted to the dry season. • A temporary fence or demarcation must be erected around the works area to prevent access to sensitive environs. The works areas generally include the servitude, construction camps, areas where material is stored and the actual footprint of the tower. • Prevent pedestrian and vehicular access into the wetland and buffer areas as well as riparian areas. • Consider the various methods of stringing and select whichever method(s) that will have the least impact on watercourses e.g. shooting a pilot cable and pull cables with a winch, or flying cables over. • Stringing should preferably not make use of vehicles in watercourses. If unavoidable, plan stringing activities in wetlands areas to take place within the drier winter months and use equipment with the smallest possible footprint e.g. quad bikes. • Plan stringing through watercourses to take place at pre-determined points such as where the wetland

Impact	Mitigation Measures
	width (and thus area to be impacted) is the smallest. • Access roads and bridges should span the wetland area, without impacting on the permanent or seasonal zones. • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Management of on-site water use and prevent stormwater or contaminated water directly entering the watercourse • Management of point discharges. • Planning of construction site must include eventual rehabilitation / restoration of indigenous vegetative cover. • Alien plant eradication and follow-up control activities prior to construction, to prevent spread into disturbed soils, as well as follow-up control during construction. • The amount of vegetation removed should be limited to the least amount possible. • Rehabilitation of damage/impacts that arise as a result of construction must be implemented immediately upon completion of construction. **Operational Phase** • Maintenance activities should not take place within watercourses or buffer zones. Where unavoidable, the footprint needed for maintenance must be kept to a minimum. This is subjected to authorization by means of a water use license. • Where possible, maintenance within watercourses must be restricted to the drier winter months. • Maintenance activities should not impact on rehabilitated areas. • Maintenance workers should respect and also maintain fences that are in place to prevent livestock from entering rehabilitated areas, until such time that monitoring found that rehabilitation s successful and the fences removed. • Maintenance should not impact on natural vegetation. • Maintenance vehicles must stay on dedicated roads/ servitudes.
Changing the amount of sediment entering water resource and	**Construction Phase** • Construction in and around watercourses must be restricted to the dryer winter months.

Impact	Mitigation Measures
associated change in turbidity (increasing or decreasing the amount)	• A temporary fence or demarcation must be erected around the works area to prevent water runoff and erosion of the disturbed or heaped soils into wetland areas. • Access roads and bridges should span the wetland area, without impacting on the permanent or seasonal zones. • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005). • A vegetation rehabilitation plan should be implemented. Grassland can be removed as sods and stored within transformed vegetation. The sods must preferably be removed during the winter months and be replanted by latest springtime. The sods should not be stacked on top of each other or within sensitive environs. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks. • Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction and that plan must be implemented immediately upon completion of construction. • Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. Ideally, the rehabilitated pylon footprints, especially on slopes and along riparian and wetland areas, must be fenced to prevent livestock grazing and trampling. Once rehabilitation was observed to be successful during monitoring, the fenced may be removed (at least two years). • Negotiate with landowners to delay the re-introduction of livestock (where applicable) to all rehabilitation areas until an acceptable level of revegetation has been reached, especially against slopes. • During the construction phase measures must be put in place to control the flow of excess water so that it does not impact on the surface vegetation. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. • Runoff from roads must be managed to avoid erosion and pollution problems. • Implementation of best management practices. • Source-directed controls.

Impact	Mitigation Measures
	• Buffer zones to trap sediments. • Active rehabilitation. **Operational Phase** • Rehabilitated vegetation should not be impacted on by maintenance. • Maintenance vehicles must remain on dedicated roads and servitudes. • Maintenance activities should not take place within watercourses or buffer zones. Where unavoidable, the footprint needed for maintenance must be kept to a minimum. This is subjected to authorization by means of a water use license. • Where possible, maintenance within watercourses must be restricted to the drier winter months. • Maintenance activities should not impact on rehabilitated areas and where soil or vegetation disturbances took place, this should be rehabilitated immediately.
Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate)	**Construction Phase** • Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone. • Establishment of buffer zones to reduce nutrient inputs in diffuse flow. • Implementation of appropriate stormwater management around the excavation to prevent the ingress of run off into the excavation. **Operational Phase** • Maintenance workers are not allowed to sue watercourse and associated buffers as ablution facilities. • Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone.
Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons	**Construction Phase** • After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land shall be left in a condition as close as possible to that prior to use. • Maintenance of construction vehicles. • Control of waste discharges.

Impact	Mitigation Measures
	• Guidelines for implementing Clean Technologies. • Maintenance of buffer zones to trap sediments with associated toxins. **Operational Phase** • Ensure that maintenance work does not take place haphazardly, but, according to a fixed plan, from one area to the other. • After maintenance, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land shall be left in a condition as close as possible to that prior to use. • Ensure maintenance vehicles are in proper order and well maintained. • Control of waste discharges. • Guidelines for implementing Clean Technologies. • Maintenance of buffer zones to trap sediments with associated toxins.
Changing the physical structure within a water resource (habitat)	**Construction Phase** • Other than approved and authorized structure, no other development or maintenance infrastructure is allowed within the delineated wetland and riparian areas or their associated buffer zones. • Demarcate the wetlands and riparian areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas. • Linear developments (e.g. roads) should span the watercourse. • Weed control in buffer zone. • Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. • Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance of the power line and take immediate corrective action where invasive species are observed to establish. **Operational Phase** • Maintenance activities should not take place within watercourses or buffer zones. Where unavoidable, the footprint needed for maintenance must be kept to a minimum. This is subjected to authorization by means of a water use license.

Impact	Mitigation Measures
	• Where possible, maintenance within watercourses must be restricted to the drier winter months. • Maintenance activities should not impact on rehabilitated or naturally vegetated areas.

9.4.3 Conclusions and Recommendations

From a wetland and riparian ecological perspective, **Corridor 1 with deviation 1B is the preferred option** due to the fact that it has the least amount of wetlands and drainage lines/riparian areas as well as not crossing any national parks or large mountainous areas. **Corridor 1 with deviation 1D is second preferred**. Corridor 2 is the least preferred corridor as it contains the most wetlands and transects further over a national park (28km) as well as crossing a mountainous area for 17km. Corridor 3 has the highest number of drainage lines/riparian areas as well as crossing approximately 15km of national park and 17km over a mountainous area and is therefore the not a preferred option.

Linear developments such as the proposed transmission line are rarely able to avoid crossing any watercourses whatsoever. Where alternatives have been investigated and watercourse crossings have been shown to be necessary it is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology.

In the case of the proposed power line mitigation should focus on:

- Rehabilitation / restoration of indigenous vegetative cover;
- Management of point discharges during construction activities;
- Alien plant control activities;
- Implementation of best management practices regarding stormwater and earthworks;
- Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone during construction activities;
- Implementation of appropriate stormwater management around the excavation to prevent the ingress of run-off into the excavation; and particularly; and
- Prevention of erosion, and where necessary rehabilitation of eroded areas.

9.5 AGRICULTURE ASSESSMENT

9.5.1 Key Findings

Soils

Due to the prevailing climatic restrictions (Section 2.2 in the Agricultural Report, Appendix M in this report), the various land type mapping units occurring within the study area were grouped by their overall broad soil pattern. The general soil characteristics are given in Table 33 below (the colours correspond to the map units in figure 30). The soils were classified according to MacVicar *et al.* (1977). From the table and the map below, it can be observed that the majority of the routes in this section cross a mixture of Ag and Fb soil patterns (shallow soils), along with Ae soils (deeper) and Db soils (clayey duplex soils).

Table 33: Broad soil patterns occurring in the Perseus-Kronos Study Area

Broad Soil Pattern	Description and main soil characteristics	Dominant soil forms	Dominant soil potential
Ae	Red, freely-drained, mostly structureless soils, not highly weathered, often calcareous. Depth will vary from shallow (<300 mm) to deep (>1200 mm). Some surface rock/calcreete may occur in places	Hutton, Mispah	Low to high (depth dependent)
Ag	Red, freely-drained, mostly structureless soils, not highly weathered, usually calcareous. Depth is diagnostic dominantly shallow (<300 mm). Some surface rock/calcrete/dorbank may occur in places, occasionally plentiful.	Hutton, Mispah	Low (shallow depth)
Ah	Red and yellow, freely-drained, mostly structureless soils, not highly weathered, often calcareous. Depth is usually at least moderately deep (>800 mm). Soil texture is diagnostic sandy (<15% clay).	Hutton, Clovelly	Moderate (sandy texture, very free drainage)
Da	Red duplex soils (where a relatively sandy topsoil overlies (often abruptly) a subsoil clay layer). Soils are often saline and/or sodic, with extensive low-lying areas in the landscape. The soils are also susceptible to erosion if disturbed.	Estcourt, Sterkspruit, Valsrivier, Swartland	Low (erodible, saline)
Db	Non-red duplex soils (where a relatively sandy topsoil overlies (often abruptly) a subsoil clay layer). Soils are often saline and/or sodic, with extensive low-lying areas in the landscape. The soils are also susceptible to erosion if disturbed.	Estcourt, Sterkspruit, Valsrivier, Swartland	Low (erodible, saline)
Fb	Mixed soil pattern, usually shallow (<450 mm), with some lime in parts of t the landscape. Surface stones and rock outcrops may occur extensively in places. Soil texture and colour will vary, usually reddish-brown, sandy/loamy soils.	Mispah, Glenrosa, Hutton	Low (shallow, often stony)

Fc	Mixed soil pattern, usually shallow (<450 mm), with regular lime throughout the landscape. Surface stones and rock outcrops may occur extensively in places. Soil texture and colour will vary, usually reddish-brown, sandy/loamy soils.	Mispah, Glenrosa, Hutton	Low (shallow, often stony)
Ia	Deep alluvial deposits, usually in low-lying positions, including river floodplains. Soil textures and colours will vary (dependant on depositional mechanisms), but soils are often saline and/or sodic.	Oakleaf, Valsrivier, Swartland	Low to moderate (often saline)
Ib	Much surface rock outcrops (diagnostic >60% of the landscape). Terrain is often steeper than surrounding areas, with shallow (<300 mm) soils, usually reddish-brown, not highly weathered, sandy/loamy.	Mispah, Glenrosa, Hutton	Very low (rock with shallow soils)

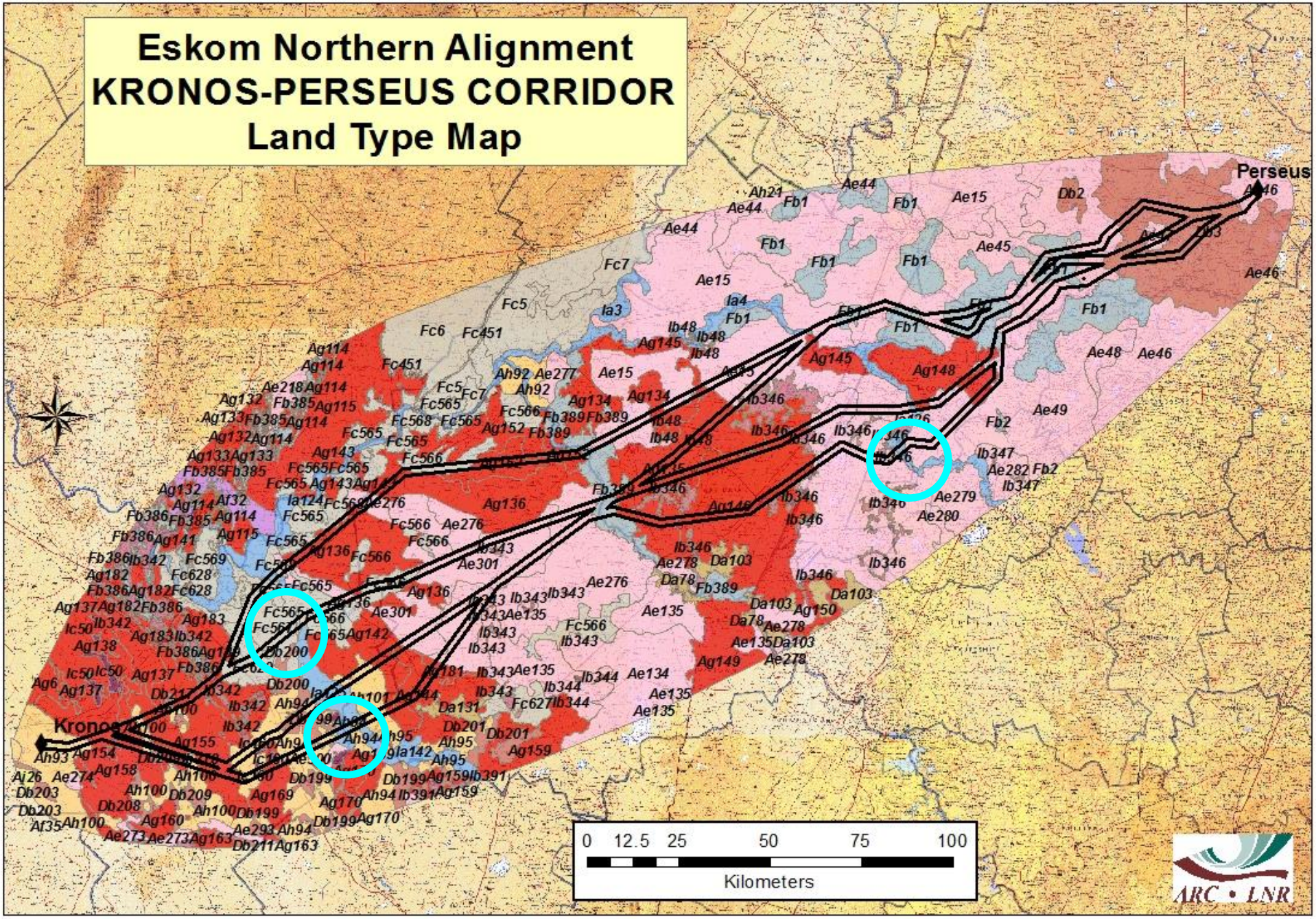


Figure 30: Kronos-Perseus Land Types

Agricultural Potential

Most of the soils in the area are shallow, with only limited zones with deeper soils. However, despite potentially favourable soils for cultivation occurring in places, the over-riding restriction is the climatic limitation of the low rainfall and high evaporative loss from the soil surface. This means that the only potential means of cultivation is by irrigation, and the soils and potential irrigation water are likely to be somewhat saline.

Corridor 1

Corridor 1 crosses a mixture of soils. The only soil patterns where deeper soils might be expected would be the **Ae, Ah, Db** (clayey) and **Ia** zones, which occur mainly in the central and eastern parts. Two significant areas of cultivation (mainly irrigation) occur close to the Gariep and Riet Rivers (as shown by the blue circles in Figure 30).

Corridor 2

Similar to Corridor 1, this Corridor 2 crosses a mixture of soils. The only soil patterns where deeper soils might be expected would be the **Ae, Ah, Db** (clayey) and **Ia** zones, which occur mainly in the central and eastern parts. Two significant areas of cultivation (mainly irrigation) occur close to the Gariep and Riet Rivers (as shown by the blue circles in Figure 30).

Corridor 3

Corridor 3 also crosses mainly shallow soils in the west, with deeper soils in places in the east. The only soil patterns where deeper soils might be expected would be the **Ae, Ah, Db** (clayey) and **Ia** zones, which occur mainly in the central and eastern parts. Two significant areas of cultivation (mainly irrigation) occur close to the Gariep and Riet Rivers (as shown by the blue circles in Figure 30).

The dryland (rain-fed) agricultural potential of the whole study area is thus very low. ence of widespread cultivation, which only becomes evident to the east of Dealesville. The impIn the far eastern end of the route, despite the somewhat increased rainfall, there is little evidact of a transmission line (with a comparatively small footprint) will be comparatively small.

Deviations

At the scale of the available soil information (1:250 000), the relatively short deviation routes of **Deviation 1A** and **Deviation 1B** will not make a significant difference to the impacts of any of the alternative routes. Both **Deviation 1C** and **Deviation 1D** are longer, but run parallel to Corridor 1 and cross virtually the same broad soil types in more or less the same proportion. Therefore, the impacts will again be very similar.

9.5.2 Potential Agricultural Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 34: Analysis of the Significance of Potential Agricultural Impacts (Perseus-Kronos – for all three Corridors and Deviations) (Paterson, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Loss of Agricultural Soil	Due to the construction of the transmission line (mainly the tower sites), as well as a parallel adjacent access road.	3 2	3 3	1 1	4 4	3 2	33 20	Moderate	Moderate
Increased Soil Erosion	Due to the loss of surface vegetation and the exposure of bare soil at the surface, again caused by construction activities. This could take the form of removal by *wind erosion* (especially in areas where the topsoil texture is fine and sandy) or by *water erosion* (this will be limited to stream beds and watercourses, but such flash flooding events, though rare, may be severe).	3 2	3 2	1 1	4 3	3 2	33 16	Moderate	Moderate to Low

Table 35: Mitigation Measures (Agricultural)

Impact	Mitigation Measures
Loss of Agricultural Soil	• Avoid, wherever possible, any areas of cultivation, especially areas under irrigation, such as alongside streams/rivers.
Increased Soil Erosion	• minimum amount of vegetation should be removed; • great care should be taken where the transmission line crosses any stream or river course, so that damage to the river banks or adjacent areas is not caused; • all possible soil conservation measures (culverts, run-off channels, amongst others) should be implemented in the construction of access roads (especially in sloping areas); and • Regular monitoring of tower sites and access roads is done to ensure no worsening of soil erosion.

9.5.3 Conclusions and Recommendations

From the information contained in Table 33, as well as the Soil Map in Figure 30, it can be seen that for most of the corridor, the three corridors cross similar soil patterns. There is therefore little to choose between the three corridors as far as soils and agricultural potential is concerned. The two proposed crossing places for the Gariep River appear to have poor soils which are not cultivated, but at the Riet River, the southern crossing (Corridor 1 and Deviations 1C and 1D) would appear to have the possibility of more irrigated areas in the immediate vicinity than the northern crossing (Corridors 2 and 3)

The conclusion is therefore:

Recommended Route: **Corridor 2 and Corridor 3** (equally).
Least Recommended: Route Corridor 1 and Deviations 1C and 1D.

9.6 VISUAL ASSESSMENT

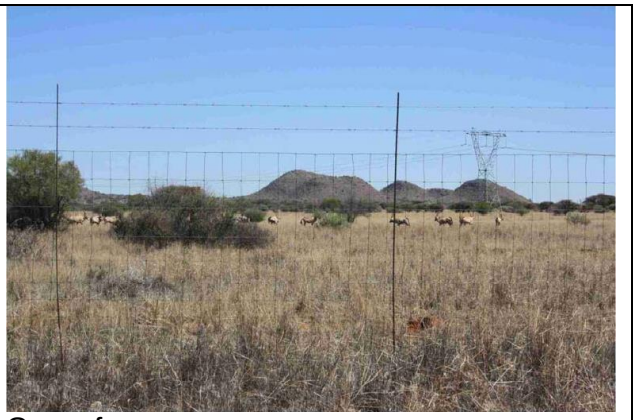
9.6.1 Key Findings

Landscape Character: The study area consists of both vacant and uninterrupted land as well as cultivated, residential, subsistence farming and mining. Human settlements are scattered throughout the study area and the landscape are degraded around these settlements. The various landscape characters identified within the study area are illustrated in Figure 31.

Visual Character: Visual character is based on human perception and the observer's response to the relationships between and composition of the landscape, the land uses and identifiable elements in the landscape. The description of the visual character includes an assessment of the scenic attractiveness regarding those landscape attributes that have aesthetic value and contribute significantly to the visual quality of the views, vistas and / or viewpoints of the study area (ALA, 2013).

 Kimberly Thornveld	 Boshof Grassland
 Orange River Agriculture	 Mines


Farmsteads


Game farms

Historical Sites


Stock Farming


Mokala National Park

Figure 31: Landscape character of the study area

Landscape and Visual Sensitivity

The sensitivity of the landscape character is an indication of “the degree to which a particular landscape can accommodate change from a particular development, without detrimental effects on its character” (GLVIA, 2002). A landscape with a high sensitivity would be one that is greatly

valued for its aesthetic attractiveness and have ecological, cultural or social importance through which it contributes to the inherent character of the visual resource.

The majority of the study area is considered to have moderate landscape character sensitivity due to the undulating topography and relative undeveloped condition of the landscape, the generally high visual quality[3] and the related tourism value that is placed on the visual resource. Moderate terrain variability mainly occurs through the study area where a moderate VAC[4] can be expected. Generally the vegetation cover is shrub land and scattered trees which will provide very little visual screening for the proposed transmission line.

The landscape character is considered moderately susceptible to change, whether it is a low intensity change over an extensive area or an acute change over a limited area. Generally, the vegetation occurring in the study area is rigid and recovers very slowly from surface disturbances.

Previous human induced activities and interventions have negatively impacted the original landscape character. In this case, the mines and agricultural farms that are scattered through the study area, the informal settlements with their subsistence farming and existing infrastructure around towns, including transmission lines, roads, amongst others, can be classified as landscape disturbances and elements that cause a reduction in the condition of the affected landscape type and detrimentally affect the quality of the visual resource.

The following map reference and photographs are an illustration of the landscape character relating to the three proposed Corridors. The photographs were taken during the site visit:

[3] Explanation of the Visual Quality is provided in Section 4.1.3.1 of the Visual Report provided in Appendix M of this Report
[4] Explanation of VAC is provided in Section 4.1.3.2 of the Visual Report provided in Appendix M of this Report.

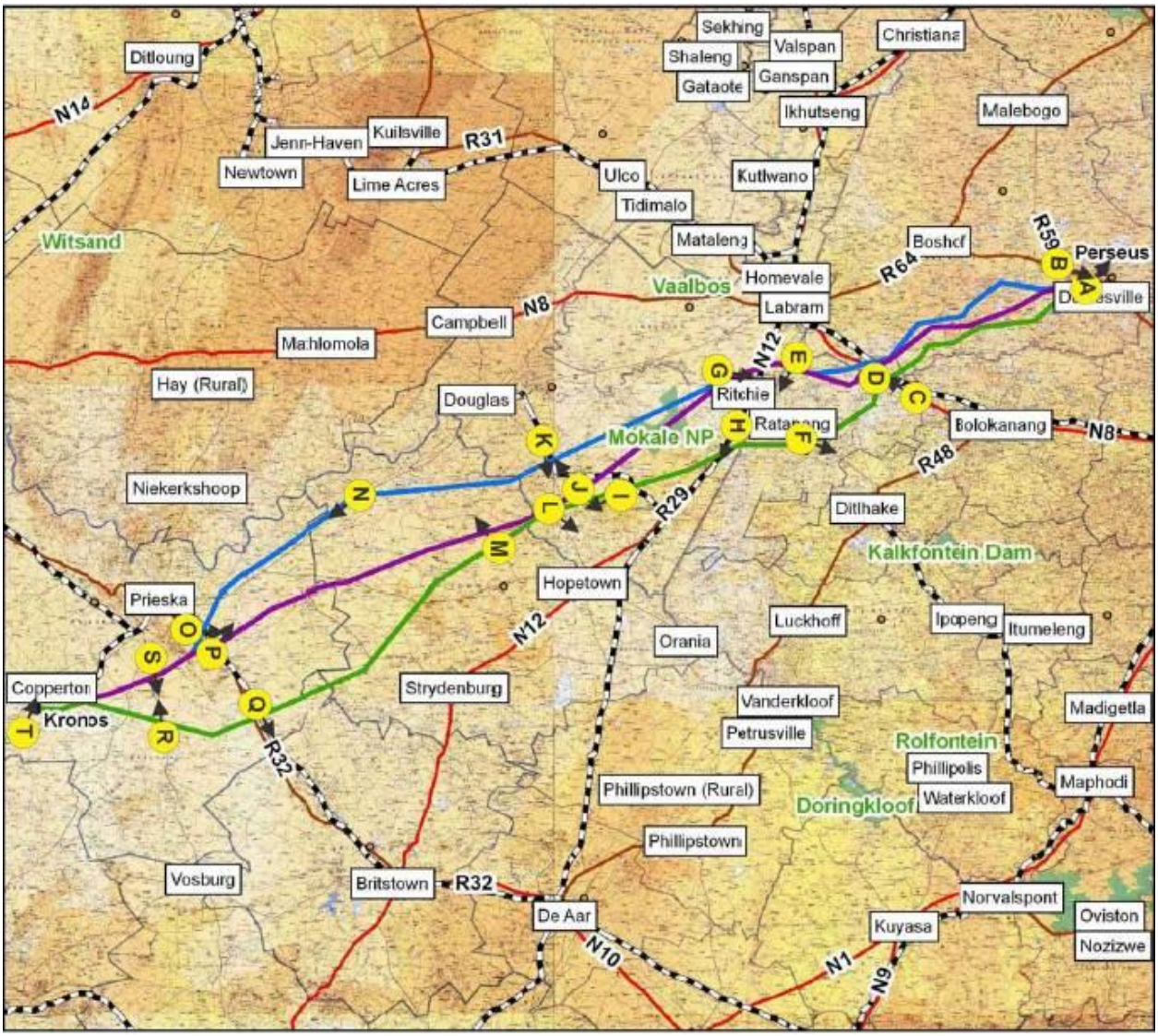


Figure 32: Photo Reference Map

Please note: Deviations 1A to 1D were not investigated during field work.

View **A**: View towards Perseus Substation

View **B**: View from R64 towards all the alternative corridors crossing

View **C**: View from N8 towards Corridor 1

View **D**: View from N8 towards Corridors 2 and 3

View **E**: View from a local road towards Corridors 2 and 3

View **F**: View from R705 towards Corridor 1

View **G**: View from a local road towards Corridor 2 and 3

View **H**: View from N12 towards Corridor 1

View **I**: View from a local road towards Corridor 1

View **J**: View from a local road towards Corridor 2

View **K**: View from R385 towards Corridor 3

View **L**: View from R385 towards Corridor 1

View **M**: View from R369 towards Corridor 1

View **N**: View from R375 towards Corridor 3

View **O**: View from N10 towards Corridor 3

View **P**: View from N10 towards Corridor 2

View **Q**: View from N10 towards Corridor 1

View **R**: View from R403 towards Corridor 1

View **S**: View from R403 towards Corridor 2 and 3

View **T**: View towards Kronos Substation

9.6.2 Potential Visual Impacts and Mitigations

Landscape impacts are alterations to the fabric, character, visual quality and visual value which will either positively or negatively affect the landscape character. During the construction and operational phases, the project components are expected to impact on the landscape character of the landscape types it traverses.

Within the receiving environment, specific viewers (visual receptors) experience different views of the visual resource and value it differently. They will be affected because of alterations to their views due to the proposed project. The visual receptors are grouped according to their similarities. The visual receptors included in this study are:
• Residents;
• Tourists; and
• Motorists.
To determine visual receptor sensitivity a, commonly used rating system is utilised. This is a generic classification of visual receptors and enables the visual impact specialist to establish a logical and consistent visual receptor sensitivity rating for viewers who are involved in different activities without engaging in extensive public surveys[5].

Empirical research indicates that the visibility of a transmission tower, and hence the severity of visual impact, decreases as the distance between the observer and the tower increases. The landscape type, through which the transmission line crosses, can mitigate the severity of visual impact through topographical or vegetative screening. Bishop *et al* (1988) noticed that in some cases the tower may dominate the view for example, silhouetted against the skyline, or in some cases be absorbed in the landscape. A complex landscape setting with a diverse land cover and topographical variation has the ability to decrease the severity of visual impact more than a mundane landscape (Bishop *et al*, 1985).

A visibility analysis has been completed for each of the three alternative alignments and deviation routes (APPENDIX 1, Visual Report, provided in Appendix M of this report). According to Bishop *et al* (1988), visual receptors within 1 km from the alignment are most likely to experience the highest degree of visual intrusion, hence contributing to the severity of the visual impact. This is considered as the zone of highest visibility after which the degree of visual intrusion decreases rapidly at distances further away.

The following Impact Tables provide a summary of the anticipated landscape and visual impacts that may occur as a result of the construction and operation of the transmission line.

[5] The sensitivity of the identified visual receptors is discussed in Section 5.2.1 in the Visual Report in Appendix M of this report.

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 36: Landscape Impacts (Perseus-Kronos – for all three Corridors and Deviations) (Axis Landscape Architects, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
CONSTRUCTION PHASE									
Visual quality of the landscape	Due to the presence of foreign elements and a loss of vegetation cover.	3 2	3 2	3 2	2 2	3 3	33 24	Moderate	Low
OPERATIONAL PHASE									
Visual quality of the landscape	Due the presence of a power line.	3 2	3 2	3 2	3 2	3 3	36 24	Moderate	Low

Construction phase

The activities that are expected to cause landscape impacts and associated with the construction phase, are the establishment of:

- Construction camps;
- Construction of access roads; and
- Clearance of the site.

These activities will create surface disturbances which will result in the removal of vegetation and the exposure of the underlying soil.

The extent of the disturbances will generally affect a relatively small footprint area. Access roads to the towers are expected to be a two-track dirt road which will create the minimum disturbance. During construction, the area around the individual towers will be disturbed.

The construction camps and lay-down yards are anticipated to disturb a much larger area. The size and location of the construction camps will play a major role in the severity of the landscape impact. Due to a lack of technical information, two options are considered namely; the location of construction camps in remote, virgin land, or in/adjacent existing settlements. The initial presence of a construction camp in an undeveloped landscape will cause a temporary and localised alteration to the landscape character. A construction camp located in or adjacent to an existing town or settlement will easily be associated with the town and therefore the presence of the town mitigates the impact. The mitigating result is most effective, the bigger the town or settlement is.

Considering the moderately *low* VAC throughout most of the study area, the disturbed condition of parts of the landscape and the recovery rate of the endemic vegetation, the *severity of landscape impact* during the construction stage is expected to be *moderate* for Corridors 1 and *high* for Corridor 2. The impact will extend over the entire length of the different alignments and may vary in degrees of severity along the linear length as it transects landscape types of varying VAC. Surface disturbances are also minimised through, for example, utilising existing roads.

The *severity of the landscape impact* can however be mitigated to a *low* severity for all the Corridors except a high severity for Corridor 2. Sensitive placement of the construction camp, limited surface disturbance and prompt rehabilitation are prerequisite conditions if the severity of impact is to be reduced.

Operational phase

Surface disturbances created during construction may remain for an extended period during the operational phase. These are seen as residual affects carried forward from the construction phase and can be completely or substantially mitigated if treated appropriately during the construction phase.

An additional impact will be caused as a result of the presence of the completed transmission line, i.e. that of the evenly spaced towers of the lines, buildings and structures. The industrial

character and the near monumental vertical scale of the towers will contrast with the diverse landscape character that prevails through most of the study area.

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 37: Visual Impacts on Residents (Kronos to Perseus – for all three Corridors and Deviations) (Axis Landscape Architects, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
CONSTRUCTION PHASE									
Construction camp and laydown yard	May cause unsightly views	3 2	3 2	3 2	2 2	3 3	33 24	Moderate	Low
OPERATIONAL PHASE									
The presence of a power line	Intrudes on existing views and spoils the open panoramic views of the landscape.	1 1	2 2	1 2	1 2	3 3	15 14	Low	Low

Generally, the study area is sparsely populated except around the human settlements, farms and towns. These communities are normally situated along main transportation routes, near agricultural areas or adjacent rivers or water resources.

Residential areas and farm residents will experience an intrusion on their views due to the presence of the proposed Transmission Line. It is unpractical to discuss all, but they are recognised as the general population of the study area and are identified as affected visual receptors.

Considering the distribution of residents across the study area, it can be concluded that the entire study area has a low density of residents with the exception of higher concentrations of residents in the towns and human settlements.

Construction phase

During the construction phase, unsightly views may be created by the presence of construction camps and the lay-down yards. The duration of the potential visual impact will be temporary which will result in an anticipated *moderately low* significance of visual impact for all the alternatives. The visual exposure to the construction activity will initially be limited and only local residents will experience views of the site preparation activity. As the structures increase in scale and height, the ZVI increases, resulting in a greater number of affected viewers and a subsequent increase in visual exposure.

The cleared sites, construction camps and material lay-down yard will appear unsightly and out of character. Large scale construction elements such as cranes, will be highly visible and increase awareness of the construction activity over a considerable area. The visual intrusion caused during the construction stage will be moderate, but will be temporary in nature.

Operational phase

The residents of the residential areas and farming communities next to the power lines may experience a *moderate* degree of visual intrusion due to their distance to all the Corridors.

The presence of a transmission line in the visual field of the residents in this part of the study area will spoil the uncluttered panoramic views they currently experience. The silhouette of a transmission line on the horizon will be visible from a great distance and thus increase the ZVI considerably, potentially impacting on more residents.

Table 38: Visual Impacts on Tourists (Kronos to Perseus – for all three Corridors and Deviations) (Axis Landscape Architects, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
CONSTRUCTION PHASE									
Construction camp and laydown yard	May cause unsightly views	3 2	3 2	3 2	1 1	3 3	30 24	Moderate	Low
OPERATIONAL PHASE									
The presence of a power line	Intrudes on existing views and spoils the open panoramic views of the landscape.	3 2	3 2	3 2	1 1	3 3	30 24	Moderate	Low

The study area is known for its Karoo and grassveld landscapes especially in the Mokala National Park. These characteristics provide the basis for the tourism industry which plays a role in the economy of the Northern Cape Province. The entire study area is considered to have a *moderately high* tourism potential. The Deviation 1A would pass through a highly sensitive historical region due to the occurrence of a large number of battle field sites.

The type of tourist that visits this area is expected to travel considerably through the study area by vehicle. This implies that they will experience a large part of the study area in a relative short time span.

Construction phase

The temporary duration of the construction phase is expected to cause some visual impacts, especially Corridor 2. The location and size of the construction camps and lay-down yards will be crucial in regulating the impact. Detail information is not available and it is anticipated that the visual impact will occur localised and that a small number of tourists will be adversely affected by these project components during construction.

Their exposure to possible unsightly views of the construction camps and the associated activity will however be minimal and localised.

The potential visual impact on tourists during the construction phase of the proposed project can be mitigated with relative ease except for Corridors 2. The greatest factor to consider is the location of the construction camps from potential views that may be experienced from scenic routes or tourist hotspots.

Operational phase

Considering the extent of the proposed corridors, a number of tourists will be affected during their visit to the study area. Although it is difficult to pinpoint particular locations in the study area that are of specific tourist value, since the entire study area bares some value, the most obvious concentration of tourists can be expected in the north western part of the study area where the Mokala National Park is situated. For these tourists, Corridor 2 will create alterations to their views. The presence of a transmission line in this undeveloped landscape will spoil the views that are experiencing. It can be concluded that Corridor 2 will cause a *high* visual intrusion in the views expected by tourists travelling through the study area**.**

The study area generally has a *moderately low* VAC which will cause a greater ZVI. The severity of the visual impact will be *high* for Corridor 2 and *moderate* for all the other alternatives corridors, causing a *moderate* significant visual impact.

Table 39: Visual Impacts on Motorists (Perseus-Kronos – for all three Corridors and Deviations) (Axis Landscape Architects, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
CONSTRUCTION PHASE									
Construction camp and laydown yard	May cause unsightly views	2 1	2 2	2 2	1 2	3 3	24 14	Moderate	Low
OPERATIONAL PHASE									
The presence of a power line	Intrudes on existing views and spoils the open panoramic views of the landscape.	2 1	2 2	2 2	1 2	3 3	24 14	Moderate	Low

The major routes in the study area are the N8, N10, N12, R64, R705, R385, R369, R375, R403 and R357 connecting the towns and informal settlements. The secondary road network in the study area carries a much lower volume of motorists. Many of the roads are gravel roads which are mostly utilised by the local residents. Their duration of views will be temporary and it is expected that the visual intrusion that they will experience will be moderately low.

Construction phase

The potential visual impact that may be experienced by motorists during the construction phase is considered to be minimal. Limited information is available and the number, location and size of the construction camps and lay-down yards are essential for accurately assessing the visual impact. It is anticipated that views of the construction camps and lay-down yards of Corridor 1 and 2 will be visible from the major roads. The possibility that a construction camp will be established at this location is high and can be motivated from an accessibility point of view, due to the proximity to a major route.

The presence of the construction camp and lay-down yards may create unsightly views. Motorists' visual exposure to the impact will be brief and the severity of visual impact will be moderately low. The significance of potential visual impact is expected to be low.

Operational phase

The N8, N10 and N12 are the most prominent, carrying the highest volume of traffic. Corridor 2 will be the most visible from the N12 and N8 and Corridor 1 will be most visible from the N8. The severity and significance of visual impact for the proposed Corridor 1 and 2 on motorists will be *moderate* and *low* for the other alternative corridors.

Table 40: Mitigation Measures - **Visual**

Impact	Mitigation Measures
GENERAL	• Proceed with extension/upgrade of the substation during the off peak tourism season; • Where areas are going to be disturbed through the destruction of vegetation, for example the establishment of the construction camp, the vegetation occurring in the area to be disturbed must be salvaged and kept in a controlled environment such as a nursery, for future re-planting in the disturbed areas as a measure of rehabilitation.
ACCESS ROUTES	• Make use of existing access roads where possible; • Where new access roads are required, the disturbance area should be kept as small as possible. A two-track dirt road will be the most preferred option; • Locate access routes so as to limit modification to the topography and to avoid the removal of established vegetation; • Avoid crossing over or through ridges, rivers, pans or any natural features that have visual value. This also includes centres of floral endemism and areas where vegetation is not resilient and takes extended periods to recover; • Maintain no or minimum cleared road verges; • Access routes should be located on the perimeter of disturbed areas such as cultivated/fallow lands as not to fragment intact vegetated areas; and • If it is necessary to clear vegetation for a road, avoid doing so in a continuous straight line. Alternatively, curve the road in order to reduce the visible extent of the cleared corridor.
TRANSMISSION TOWERS	• Avoid crossing over or through ridges, rivers, pans or any natural features that have visual value. This also includes centres of floral endemism and areas where vegetation is not resilient and takes extended periods to recover; • The preferred type of tower is the compact cross-rope or the cross-rope suspension tower. These two tower types are the most visually permeable and create an extremely low degree of visual obstruction; • Avoid changing the alignment's direction too often in order to minimise the use of the self-supporting strain tower. This tower type is the most visually intrusive as the steel lattice structure is more dense than the other two tower types, hence creating more visual obstruction; • Where practically possible, provide a minimum of 1 km buffer area between the transmission line and sensitive visual receptors; • Rehabilitate disturbed areas around pylons as soon as practically possible after construction. This should be done to restrict extended periods of exposed soil;

Impact	Mitigation Measures
	• Align the route along the foot slopes of hills, mountains and ridges. This is to maximise the backdrop screening effect of the topography that will reduce presenting the Transmission line in silhouette; • Plan the route so that the route crosses existing main routes as close to 90° as possible as this will reduce the time that the line is in the view shed of the passing motorist / viewer; • Align the route through areas of existing visual clutter and disturbance such as alongside railway lines, existing Transmission lines, roads and other visible infrastructure, rather than through pristine or undisturbed areas where possible. However, the cumulative effect of adding to the visual clutter prior to the final placement should be evaluated; • Avoid areas where the current land uses, such as game farm, lodges, etc. often rely on the absence of human visual intrusion; and • The galvanising of the pylon should be allowed to weather to a matt grey finish rather than be painted silver, as is often the case. This allows the structures to blend in with the existing environmental colours more readily than the silver that is highly reflective especially early morning and late afternoon. Should it be necessary to paint, it is recommended that a neutral matt finish be used.
CLEARED SERVITUDES	• Locate the alignment and the associated cleared servitude so as to avoid the removal of established vegetation; and • Avoid a continuous linear path of cleared vegetation that would strongly contrast with the surrounding landscape character. Feather the edges of the cleared corridor to avoid a clearly defined line through the landscape.
CONSTRUCTION CAMPS AND LAY DOWN YARDS	• If practically possible, locate construction camps in areas that are already disturbed or where it isn't necessary to remove established vegetation like for example, naturally bare areas; • Utilise existing screening features such as dense vegetation stands or topographical features to place the construction camps and lay-down yards out of the view of sensitivity visual receptors; • Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance; and • Screen the construction camp and lay-down yards by enclosing the entire area with a dark green or black shade cloth of no less than 2m height.

9.6.3 Conclusions

Corridor 1 is regarded as the most preferred alternative. The impact of Corridor 1 on visual receptors varies between residents, tourists and motorists. Corridor 1's great advantage lies in the less significant visual impact on tourists and residents as compared to the other alternatives. The public association with transmission lines and major public roads is a common perception which makes the co-existence of these two features more acceptable.

Deviation 1A to 1D:
The four Deviations have been evaluated against international accepted criteria to determine the impact they will have on the landscape character and the viewers that have been identified in the study area.

- Landscape impacts: All the deviations will have the greatest landscape impact in the construction phase on sensitive landscape types, the extent for is rated *Medium*. The operational phase is characterised by a *moderate to low* landscape impact on a regional scale.
- Impacts on residents: The severity can be reduced in both the construction and operational phases through mitigation measures.
- Impacts on tourists: Both the construction and operational phases are characterised with a *low* visual impact with mitigation.
- Impacts on motorist: *Low* impacts on motorists are expected in both the construction and operational phases.

9.7 ECOTOURISM ASSESSMENT

9.7.1 Key Findings

Tourism Products and Services within the Proposed Perseus-Kronos Study Area

Magersfontein Battlefield
The Battle of Magersfontein was fought on 11 December 1899, at Magersfontein near Kimberley on the borders of the Cape Colony and the independent republic of the Orange Free State. British forces under Lieutenant General Lord Methuen were advancing north along the railway line from the Cape in order to relieve the Siege of Kimberley, but their path was blocked at Magersfontein by a Boer force that was entrenched in the surrounding hills. The British had already fought a series of battles with the Boers, most recently at Modder River, where the advance was temporarily halted.

Today, there are memorials dotted around the battlefield site and it has become a destination for tourists interested in South African Battlefields and tourists interested in cultural heritage in general. Although the proclaimed battle field site is fairly concentrated to a specific area, the tranquil sense of place adds value to the tourism product and creates a much more dramatic story line. Tourists can experience the site on a guided or self-guided basis.

The proposed power line project will have an impact on the sense of place and the tranquil nature of the surrounding environment of the battle site (Figure 33). It should be noted that the site has international significance.

Figure 33: Magersfontein Battlefield and Memorials

Mokala National Park
Mokala is a relatively a new National Park that is situated within the Kalahari Bushveld BioRegion. The name Mokala means camel thorn tree *(Acacia erioloba)* in the Setswana language and it is the characteristic tree in the area. The major biodiversity characteristics are the interesting habitat with the diverse ecosystem processes within a transition zone between the Karoo biomes and arid savanna bushveld, including seven major vegetation habitat units.

A variety of herbivore species are found in the Mokala National Park with dominant species being gemsbok, springbok and wildebeest. Mokala National Park also has high value species such as black rhino and a population of disease free buffalo. A number of rare species such as roan, sable and white rhino as well as the endangered tsessebe are also found in the Mokala National Park.

The Park is located in the Northern Cape Province, 80 km south west of Kimberley, and west of the Cape Town N12 road. Mokala NP was proclaimed on the 19 June 2007. The park consists of a total land area of 19611 hectares (ha). Within a year of proclamation, the park was expanded through the acquisition of a 3396 ha property (Lilydale section, not yet proclaimed) on the Riet River. Mokala NP lies within the Pixley ka Seme District Municipality in the Northern Cape Province.

Ecotourism facilities in the Park range from luxury bungalows to camping in the following camps:

- Mosu Lodge: 15 Bungalows
- Lilydale Rest Camp: 12 Self Catering Units
- Mofele Lodge/Environmental Education Centre: Group Camp
- Haak en Steek Camp: Rustic Cottage
- Motsweding Camping Site: Camping Site

Activities in the park include the following:

- Mosu Restaurant
- Matopi Picnic Area
- Kameeldoring Picnic Area
- Fly fishing
- Game drives
- Guided tours of rock art

The expansion strategy of the park should be considered in terms of the proposed development of the transmission lines. Although, one of the alternatives does not traverse the National Park, all three alternatives traverse the expansion area of the Park as determined by SANParks in their expansion strategy (Figure 34).

In order to achieve its national mandate of conserving representative samples of South Africa's different ecological landscapes, the establishment of ecologically sustainable parks remains a priority for SANParks. In this regard, the development of an expanded Mokala NP revolves around three prime objectives, namely:

- The conservation of a representative sample of the regions prominent ecological patterns associated at the boundary of two biomes (Nama-Karoo & Savanna) and ecological processes (e.g., koppie-lowland interfaces, biome interfaces, large herbivore, fire, riverine etc) in a contiguous functional conservation area.
- The establishment of an economically sustainable park.
- Developing a park that is socially sustainable through the development of entrenched social linkages across the local area.

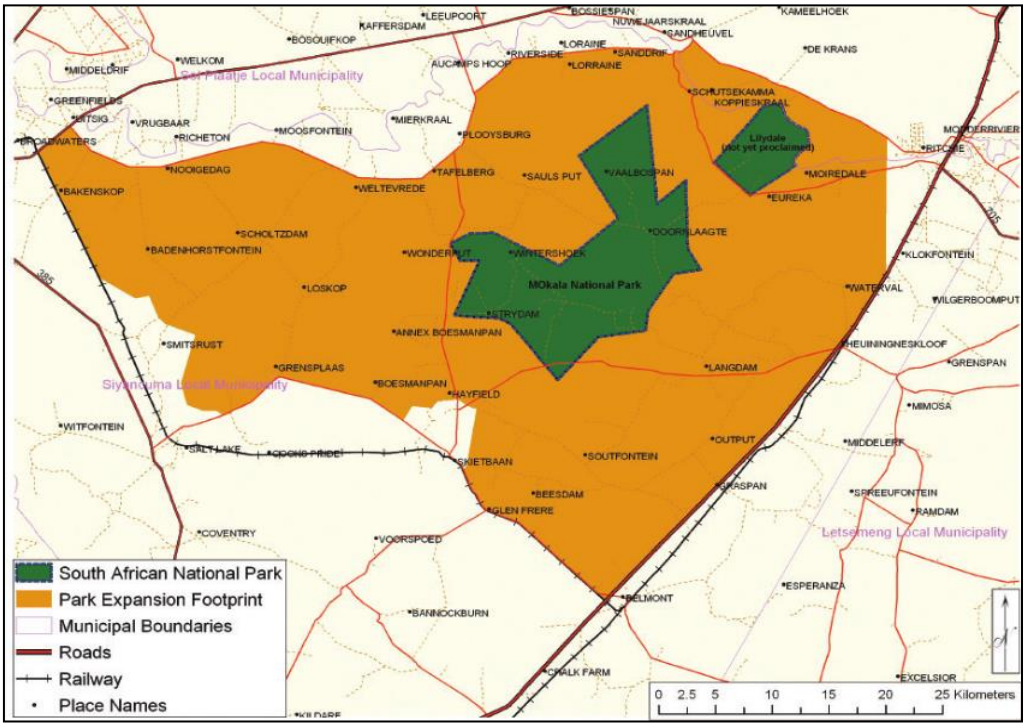


Figure 34: Mokala National Park Expansion Strategy

Private Hunting Farms and Lodges

There are numerous hunting lodges and hunting farms dotted along the proposed alignment of the transmission lines. These hunting lodges and hunting farms provide opportunities for local and international hunters to experience hunting in a pristine natural environment. This is one of the unique selling features of their products.

For the purposes of this study, only a select number of these lodges were identified as a representative group for the area. The impacts of the transmission lines on these properties/lodges were then identified and assessed. The mitigation measures should however be applied to all hunting lodges/hunting farms identified.

Examples which were identified include the following:

- **Magersfontein Safaris**
    - The hunting farm was established in 1963 and has 7000 hectares available to hunt on and additional hunting concessions in the surrounding area. It is unique in that not only does it offer the hunter a thrilling hunting experience, it has the tranquil surrounding of bushveld and is also steeped in history with no less than three memorials and a museum, all dedicated to the epic Battle of Magersfontein.
    - Tucked away in the heart of the hills of the historic Anglo-Boer War battlefield, on a private family game farm, lies the Magersfontein Lodge.
    - The lodge is similar to the original architecture of the region during the early 1900s. It caters for those who wish to escape from the hustle and bustle of everyday city life.


Figure 35: Example of hunting farm/lodge (Magersfontein Safaris)

- **Amakhulu Safari Lodge**
  - Amakulu Safari Lodge is a 1225 ha is hunting located approximately 30 km from Kimberley. They conduct hunting on the property and make use of service providers to take their guests out hunting trips.
  - A key selling feature is the natural aspects of the property and the tranquil sense of place. The lodge has got very impressive distant views and this could potentially be spoiled by the construction of a transmission line.

The Lodge offers the following:

- 7 En-suite rooms
- Pool
- Bar
- Dining area.

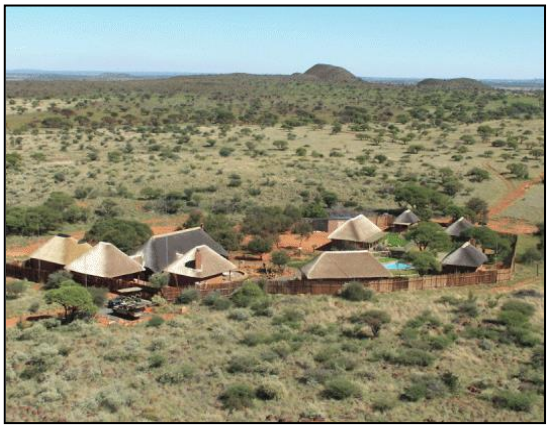


Table 41: Other tourism attractions in Study Area

Attractions/Amenities/Locations	Photographic description
Open Landscapes: - Pristine, natural environment in most the study area. - Ecotourists love wide open, pristine spaces.	
Fly Fishing: - There are fly fishing opportunities in the Riet River and in the Orange River. - Lilydale farm, now incorporated into the Mokala National Park, is a very well known fly fishing destination in the area.	
The Orange River - The Orange River is an attraction in most areas which it traverses. Very often, people develop tourist facilities and activities on the river. - This should be considered when constructing the transmission lines. Ecotourism facilities are often developed next to open water.	

Architecture - The Karoo Region is well known for its interesting architecture. - The numerous villages and homesteads in the area are a tourism attraction on their own.	

9.7.2 Potential Ecotourism Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 42: Impacts on Existing Ecotourism Products / Attractions (Milburn, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Construction Phase									
Corridor 1	The construction activities, camp and laydown areas may have a negative effect on the quality of product which ecotourism destinations in the study area can provide to the market place.	2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Corridor 2		4 3	2 1	2 2	5 3	5 4	65 36	Very high	High
Corridor 3		3 2	2 1	2 2	3 3	5 4	50 32	High	Moderate
Deviation 1A	Construction camps, laydown areas and construction activities may impact existing tourism products / accommodation establishments in study area	2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Deviation 1B		2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Deviation 1C		2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Deviation 1D		2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Operational Phase									
Corridor 1	Ecotourism products rely on pristine natural environments with limited human impact to generate an income. The transmission lines could therefore impact on the quality of product	2 1	5 4	2 2	5 3	4 3	56 30	High	Moderate
Corridor 2		4 3	5 4	2 2	5 3	5 4	80 48	Very high	High
Corridor 3		3 2	5 4	2 2	5 3	5 4	75 44	Very high	High

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Deviation 1A	The presence of the power line has a negative impact on the value of tourism offerings in the study area and potential impact on income for product owners	2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Deviation 1B		2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Deviation 1C		2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low
Deviation 1D		2 1	2 2	2 2	3 3	3 1	27 8	Moderate	Low

Table 43: Impacts on future expansion of protected areas for all three Corridors and Deviations (Milburn, 2015)

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Construction Phase									
Corridor 1	The construction activities, camp and laydown areas may take place in areas which have been identified for the establishment of protected areas or the expansion of existing protected areas	2 1	2 1	2 2	3 3	3 2	27 14	Moderate	Low
Corridor 2		4 3	2 1	2 1	3 3	5 4	55 32	High	Moderate
Corridor 3		3 1	2 2	2 2	3 3	5 4	50 32	High	Moderate
Deviation 1A	Construction camps, laydown areas and construction activities may impact existing tourism products / accommodation establishments in study area	1 1	1 1	2 2	3 3	3 2	14 14	Low	Low
Deviation 1B		1 1	1 1	2 2	3 3	3 2	14 14	Low	Low
Deviation 1C		1 1	1 1	2 2	3 3	3 2	14 14	Low	Low
Deviation 1D		1 1	1 1	2 2	3 3	3 2	14 14	Low	Low
Operational Phase									

Impact	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Corridor 1	Protected areas are established to natural environments with high conservation value. This mainly includes areas with minimal human impact and areas which have fully functioning ecosystems	2 1	5 4	2 2	5 3	3 3	42 30	High	Moderate
Corridor 2		4 3	5 4	2 2	5 3	5 4	80 48	Very high	High
Corridor 3		3 2	5 4	2 2	5 3	5 4	75 44	Very high	High
Deviation 1A	The presence of the power line has a negative impact on the value of tourism offerings in the study area and potential impact on income for product owners	1 1	1 1	2 2	3 3	3 2	14 14	Low	Low
Deviation 1B		2 1	2 1	2 2	3 3	3 2	27 14	Moderate	Low
Deviation 1C		1 1	1 1	2 2	3 3	3 2	14 14	Low	Low
Deviation 1D		1 1	1 1	2 2	3 3	3 2	14 14	Low	Low

Table 44: Mitigation Measures (Ecotourism)

Impact	Mitigation Measures
Impacts on Ecotourism Products	• Establish an ecotourism / conservation forum for the project by engaging with all tourism associations (local and provincial) to ensure that on-going communication is provided to all role players and to ensure that all ecotourism products are aware of the construction timeframes. This will enable ecotourism destinations to plan accordingly in terms of occupancies and potential down times. • Conduct construction activities within the off-peak tourism seasons and outside of the hunting season which has been established for the Free Sate and Northern Cape Provinces. It should be noted that the hunting periods differ on a species specific basis but the main hunting periods are from April to September. • Provide dedicated contact point for the purpose of providing an opportunity for product owners to obtain information on the project and to provide information on impacts or problems on an on-going basis. A response structure should also be setup to support this contact point. This will enable localized impacts to be mitigated more effectively and efficiently. • All impacts on fauna or flora within high conservation/ecotourism value land should be rehabilitated immediately to a completely natural state. This should be done by managing removed vegetation in a manner which can be re-planted. • Compile booklets which interpret the project and where the power is going and what value the project is adding to the local and provincial economy. Very often, when eco-tourists see the value in a development project, they are willing to accept the associated impact on the environment.
Impacts on Establishment and Expansion of Protected Areas	• Engage with SANParks and Provincial conservation authorities to ensure development within proposed conservation areas is managed accordingly. • Annual meetings with relevant stakeholders should be conducted to obtain updated management guidelines and expansion strategies (Preferably in GIS format)

Impact	Mitigation Measures
	• Implement management guidelines and action items in terms of the relevant management plan of the Protected Area in question.

9.7.3 Conclusions and Recommendations

The ecotourism industry in the study area is really focused on the Mokala National Park and the hunting farms in the surrounding region. Therefore, the impacts associated with the proposed development will also mainly affect these areas more specifically.

It should be noted that the study area is of a substantial size and the impacts associated with the proposed transmission lines and sub-station upgrades will be fairly localized occurrences. The impacts of these localized occurrences on ecotourism products should however not be underestimated.

The proposed Deviations to Corridor 1 will minimize the impacts identified for this section of the Proposed Northern Alignment Project. All of the critical impacts have been considered and the deviations have been carefully planned to ensure that the impacts on the ecotourism elements can be avoided as far as possible.

It is recommended that the project proceed on condition that **Corridor 1, inclusive of the Deviations**, be selected as the preferred project alternative and be developed accordingly. Should the mitigation measures be implemented as discussed, there is no reason why this project cannot proceed. No fatal flaws from an ecotourism point of view were identified.

9.8 HERITAGE ASSESSMENT

9.8.1 Key Findings

Please note: Below is an excerpt of the "*Archaeological context for the Stone Age of the Northern Cape, Bushmanland and Namaqualand"* taken from the Heritage report. Only the relevant areas of the study area are included below. The detailed context of the whole region is provided in Section 5.2 in the Heritage report (Appendix M).

The Northern Cape and Namaqualand, that includes the area known as Bushmanland, are arid regions with limited sources of surface water (Mitchell 2002). The territory occupied by Bushmanland broadly lies south of the Orange/Gariep River stretching to the west of Kenhardt and east of Springbok in Namaqualand. A widespread presence of hunting-gathering and herder groups within these regions has been documented by early travellers with the data often applied to identify historical territorial ranges (Burchell 1812; Campbell 1815, 1822; Stow 1872, 1910; Bleek & Lloyd 1911; Mossop 1935; Engelbrecht 1936; Arbousset & Daumas 1968; Lye 1975; Dunn 1978; Deacon 1996).

Earlier (ESA) and Middle Stone Age (MSA) lithics occur over most of the surface area with a more recent presence of Later Stone Age (LSA) occupations (Beaumont et al. 1995). The region in general contains very numerous small shallow pans, also known as dolines, of 100 to 200 m in diameter but also many larger pans. Areas around pan environments tend to display higher densities of lithics (Morris 2005b; van der Ryst & Küsel 2011, 2012).
Stone circles have also been recorded in this area. These features may represent residential structures being the bases of huts or windbreaks, storage structures, stock enclosures or hunting blinds (Kinahan 1986; Noli & Avery 1987; Parsons 2004; Jacobson 2005; Veldman 2008; Orton 2012a-c). These low structures are not well studied but some research has been undertaken further east along the Orange River (Sampson 1968), in the Seacow Valley in the eastern Karoo (Sampson 1986), at Bloubos northwest of Upington (Parsons 2004) and in Namibia (Veldman 2008). Stone circles have recently also been discovered at De Aar in the central Karoo (Orton 2011c).

Pastoralist communities that herded sheep, goat and cattle and speaking Khoi languages were well-established in these regions (Mitchell & Whitelaw 2005). Substantial herder encampments occur along the Orange River floodplain (Morris 2013a).

Beaumont et al. (1995) found differences in the geographical distribution of LSA hunter-gatherer localities and the herder sites of pastoral groups. Beaumont et al. (1995) were of the opinion that increasing pressure brought about by the presence of herders in the Orange/Gariep River Basin resulted in the displacement of hunters to marginal areas such as Bushmanland. This came about largely in the last millennium when the archaeological remains of hunting and gathering settlements are commonly found near water sources (Morris 2011c).

1:50 000 Topocadastral Map Survey

- **2824CD Koedoesbergdrift**

Morris (2003, no page numbering) recorded Acheulean and LSA sites on the farm Koodoosberg 141 'on the south bank west of Kudusberg Drift'. However, no detail is available on localities.

Van Ryneveld (2005a) found a number of sites on Roodepan and recommended a Phase 2 mitigation for MSA site RP16 at 28˚50'37.5"S; 24˚18'23.1"E.

Note that areas to the north of this map such as Klipdrif (Canteen Koppie at 28°32.30' S; 24°31.50'E) have high levels of ESA and some MSA and LSA lithics (Beaumont 1990a). Hutten (2013a) too identified low density scatters of mainly LSA lithics at Klipdrif.

- **2824DC Spytfontein**

Van Ryneveld (2012) points out that the immediate regional context of the greater Kimberley area constitutes a Stone Age cultural landscape. Platfontein 68 and Wildebeest Kuil 69 are particularly important. WBK1 Wildebeestkuil Rock Art Centre (S28°40'10.5"; E24°38'59.0") is a declared Provincial Heritage Site. WBK2 Stone Age S28°42'19.1"; E24°38'51.7" was apparently subsequently demolished (Destruction 2004).

Important heritage resources occur on nearby sites, namely Ronaldsvlei to the east of Spytfontein has MSA lithics (28°47'59.71"S 24°43'4.98"E) (Nel 2008). Stone Age lithics (28°47'59.71"S 24°43'4.98"E) have been recorded, a colonial graveyard (28°51'53.08"S 24°41'33.95"E) and the Magersfontein Battlefield site are situated at 28°57'41.79"S 24°41'19.87". The general region includes Spytfontein to De Aar South African War and Stone Age Archaeology Landscape Areas. Spytfontein stone walling is 10 kilometres north of the Magersfontein Battlefield Site (Becker 2011, 2013).

- **2824DD Beaconsfield**

The area is termed the Fieldsview, Kimberley and Beaconsfield Cultural Landscape Areas (Becker 2013). According to Becker (2013: 2) 'Fieldsview is bordered by the footprints of the San and the cultural landscape is a display of the manner in which the //Xam people lived'.

Hutten (2013a) recorded three sites with concentrations of low density stone artefacts.

Note that in other areas low densities of lithics have been reported, for example Beaumont (2013) recorded only five artefacts, probably MSA, on 6.4 ha area on the Remaining Extent of farm Middelplaas 140 situated ~45 km ENE of Daniëlskuil, in the Barkly West Magisterial District 28° 02' 45.7" S, 24° 00' 22.4" E (2824AA KOOPMANSFONTEIN).

- **2825CB Blaauwbosch:** No data found

- **2825CD Cheddar:** No data found

- **2825DA Elandsfontein:** No data found

- **2825DB Dealesville:** No data found

- **2922CD Volstruisbult (Vogelstruispan, Hoekplaas, Klipsgat Pan)**

This is an important area where care should be taken in the positioning of future infrastructural development. Several AIAs recorded heritage resources (Kaplan 2010; Van Schalkwyk 2011a; Orton 2012a, 2012b).

Kaplan (2010) found mainly LSA lithics in low-density and some diffuse scatters. No workshops were identified. He was of the opinion that sufficient recordings were made during the AIA of the lithics. These comprised mainly large flakes, cores, chunks, end scrapers, large utilized and retouched blade tools, and utilized and retouched flakes in fine grained quartzite, highly weathered hornfels and indurated shale. Several formal tool types such as adzes, scrapers, retouched and utilized flakes, bladelets were recorded. Van Ryneveld (2006) found no heritage resources on portions of the 2922CD and 3022AB maps during her investigation for the reopening of the old Copperton Mine. Orton (2012a-c) observed good visibility for archaeological features during his surveys of the generally flat area with uphill slopes, pan sites and silty deflation hollows that fill with water after rains.

Kaplan and Wiltshire (2011) documented ESA with weathered handaxes and some MSA and LSA sites near pan environments. At Modderpan on Struisbult densities of up to 50 artefacts and more per square were documented. The site has been graded as 3A – local, high significance. The MSA includes large flakes, radial and bipolar cores, points, end scrapers, large utilized and retouched blade tools with utilized and retouched flakes on quartzite, hornfels, banded ironstone, haematite, gneiss and vein quartz. The LSA exhibits lower densities. Direct manufacturing activities for LSA lithics were recorded at exposures of quartzitic bedrock and on boulders of vein quartz (Kaplan & Wiltshire 2011). Similar findings were noted in the AIA report for Nelspoortje (Farm 103, Portions 4 and 5 and Hoekplaas 146) near Copperton where significant MSA and LSA lithic occurrences and also lithic quarries were identified during the survey for the Garob to Kronos line (Van der Walt 2013).

Van Schalkwyk (2011a) documented surface MSA and LSA lithics on or at the foot of small hills. He proposed the avoidance of such areas through buffer zones. In the event that the localities are impacted upon by proposed development, Phase 2 mitigation should be undertaken under a permit from SAHRA.

The following extract from a report by Kaplan and Wiltshire (2011: 9) on the SAHRIS website illustrates the intensity of development for solar and wind energy facilities in this particular region:
'*A recent heritage impact study by van Schalkwyk (2011) dealt with the scoping phase of four wind farms across the Northern Cape and the Eastern Cape. One of these lies about 25km east of Struisbult. Another three energy projects are planned on Vogelstruisbult 104 (F. Gresse, pers. Comm. 2011) and therefore this application on Struisbult is one of at least six possible energy related projects (wind and/or solar). SAHRA needs to take cognisance of the cumulative impact of these applications on the heritage resources documented in the area thus far and clear recommendations to all the relevant stakeholders will be required from SAHRA in the decision-making process'*. Subsequently Orton (2012a-c) and others undertook several AIA's.

On Vogelstruis Bult 104 Orton (2012a) recorded discrete sites with LSA occupations and with a background noise of ESA and MSA lithics. Several dense scatters of lithics have also been recorded. The author assigns low significance to most occurrences but recommend that some of the LSA with high significance should be mitigated in the case of future impact (Orton 2012a).

The LSA localities tend to focus on pan environments, for example Perdepan (Orton 2012a). An engraving site along the road between Copperton and Van Wyksvlei was recorded. The rock art comprises scraped engravings of eland and ostrich as well as very recent (historical) images of horses with riders, a chariot and some writing (Orton 2012a).

At Hoekplaas (Orton 2012b) notes background scatters of ESA and MSA artefacts that he rated of very low archaeological significance. There are three pans with several discrete LSA sites around the central pan. Gravel has been quarried at the pan, revealing a buried MSA deposit. In view of this observation Orton (2012b) points out the probability of other important subsurface material close to pan environments.

At Klipsgat Pan (Orton 2012c) again recorded scatters of ESA and MSA artefacts that he rated of very low archaeological significance. For the large number of discrete LSA sites recorded around ephemeral pans and the hill Orton (2012c) suggested mitigation measures in the event that they are impacted by future developments.

Kiberd (2006) excavated at Bundu Pan (29°45'05"S; 22°12'25"E) on the eastern edge of Bushmanland approximately 25 to 30 km northwest of Copperton and to the east of Prieska. Stratified ESA, MSA and LSA deposits were found. A range of Pleistocene fauna include some extinct species such as a giant hartebeest (Kiberd 2006).

- **2922DB Prieska (Oos)**

Van Ryneveld (2005b) recorded a particularly large MSA site (S1, approximate 29°33'S; 22°51'E). Locally-available fine-grained cryptocrystalline silicas (CCS) materials were used extensively whereas other rock types such as hornfels and banded ironstone also featured in the production of the lithics. The lithics are conjectured to be from an eroded context with a shallow remaining sub-surface deposit. The northern part of Karabee 50, for which an application for an EMP was lodged at SAHRA (see below) is on this map.

- **2922DC Groveput:** No data found.

Note that SAHRA (2012) received notification of an ‘application for an environmental management plan in respect of prospecting rights for Portions of Farm Karabee 50 and Prieskaspoort 51, Prieska District’ on this map.

- **2922DD Redlands:** No data found.

Farm names such as Bosjemansvlei 49 reflect a historic presence of San groups. The EMP for 2922DC GROVEPUT referred to above includes a portion of Karabee 50 that falls onto the Redlands map.

- **2923AC Kalkkrans**

Beaumont et al. (1995: 240) observed that ‘thousands of square kilometres of Bushmanland are covered by a low density lithic scatter’. At Kalkkrans Beaumont (2007) recorded an absence of artefacts in or on the Hutton Sands. Hillside rubbles, calcretes and Rooikoppie surface exposures exhibited a low density of lithics. Fine-grained CCS were mostly used in the manufacture of the lithics but quartzite was also utilized in some cases. He infers a date of > 0.6 Myr (Beaumont & Vogel 2006). He recorded more recent artefacts, mostly thick irregular flakes and some cores, on quartzite and banded ironstone at two Rooikoppie exposures, one in the

mining area, at 29°19'15.5" S, 23°11'06.9" E and the other further north, at 29°18'38.3"S; 23°09'47.5" E. Several isolated MSA flakes were also recorded.

- **2923AD Kwartelspan**

Morris 2010/2011 recorded lithics in very low densities across the entire site and rated these occurrences of not high significance. Almond (2010) rated the palaeontological sensitivity of the near-surface sediments at Greefspan as low.

- **2923BB Douglas**

Van Ryneveld (2007) established the presence of MSA lithics at 29°02'45.1"S; 23°46'09.5"E of low significance. Low densities were recorded over the whole of the assessed area. Hornfels and fine-grained dolerite were used to produce scrapers, flakes and flake-blades. An examination of a sub-surface stratigraphic section in a graded road to a depth of 30cm mirrored surface frequencies of artefacts. The presence of similar lithics on mine dumps is ascribed to proximity to the Vaal River.

Burials of humans in small pots, in deposits and often in association with grave goods such as a grooved stone, have been documented along the Riet River and in the area of its confluence with the Vaal River near Douglas in the Northern Cape (Humphreys 1974, 1982, 2007; Morris et al. 2006). The burials date to the contact period.

- **2923BC Pampoenpan:** No data found

- **2923BD Torquay:** No data found

- **2923CA Rooisloot**

Gaigher (20124) has not identified any heritage resources during his investigation. According to Gaigher (2012:44) Stone Age sites in the demarcated area and surrounds are not well known or described 'this far west in the Northern Cape'. Farm names such as Bosjesmansvlei 48 do suggests a San presence in the area.

- **2923CB Jagpan:** No data found.

- **2923CC Groot Doring:** No data found.

However, farm names such as Bosjesmansvlei 4/Boesmanspan do suggests a San presence in the area. Areas around Varschekuil, Groot Varsche Kuil, Klein Varsche Kuil, Lammertjiespan and Doornbergfontein should be inspected.

- **2923CD Kareekloof:** No data found

- **2923DA Leeuberg:** No data found

- **2923DB Rooidam:** No data found.

- **2924AA Plooysburg**

Morris (2005c) found no significant archaeological traces during an AIA of Abrahamoos Fontein near Plooysburg. Morris and Seliane (2005/2007) examined areas on the plain above the present river channel (29°02.129'S; 24°03.092'E) and on a subsequent visit in 2007 a quarry at

29°02.297' S 24°03.196' E. Very low densities of MSA artefacts were found at the base of the shallow surface soil above the calcretes. The authors do caution that LSA burials have been recorded nearby at Weltevrede and Driekopseiland and that this should be borne in mind (see also Douglas 2933BB).

- **2924AC Salt Lake:** No data found

- **2924AB Kolkop**

Various heritage resources including many rock engraving sites at Doornlaagte, Scholtz Fontein North, Goede Hoop and Kameel Doorns, other Stone Age sites, and historical structures have been recorded in the Mokala National Park. Nearby localities relating to the Anglo-Boer War are known (Morris 2007a; Van Schalkwyk 2008). The visual impact of any development should be a consideration.

- **2924AD Belmont**

Webley and Orton (2012) identified MSA and possibly LSA lithic scatters around koppies and pans. Dolerite boulders on the southern hill exhibit grinding surfaces and historical grafitti was recorded on the northern koppie. A circular stone structure near the railway line may be the remains of an historic fortification. The area has numerous historic heritage resources (Becker 2013). Also note that the Cultural Landscape of the adjoining property incorporates the Battle of Graspan (Webley & Orton 2012; Hutten 2013b). In view of this a study of the visual impact of developments should also take the Cultural Landscape of the adjoining farm into account.

An engraving site was noted on a map at approximately 29°22'S; 24°24'E (SAHRIS H33825-2110-236-0002_Appendix_A_0.pdf). Becker (2013) also refers to sites with engravings to the south of Belmont.

- **2924BA Modderrivier**

The following paragraph is quoted from Becker (2013:63) in a HIA for the railway line from Kimberley to De Aar: '*The Spytfontein, Magersfontein, Modderrivier, Belmont, Heuningneskloof, Witput and Graspan areas are heritage sites of provincial significance and also present a significant display of South Africa's historical battlefield history. The railway line as indicated above forms part of the historical landscape and is a display of historical events that occurred during the South African War. The proposed development areas are embedded in the cultural heritage landscapes of the Kimberley to De Aar area. The fact that various historical battlefield landscape sites, evidence of the //Xam indigenous communities and the railway historical resources are positioned alongside the line means that the section is of high significance. The threats to these identified heritage resources are immediate*'.

- **2924BB Jacobsdal**

Van Jaarsveld (2006) notes that the area was intensively surveyed by Garth Sampson for the Orange/Gariep River salvage scheme. Artefacts from all periods of the southern African Stone Age and also material from the historic period have been documented (Sampson 1984, 1985, 1986, 2010). Taking these studies into account, Van Jaarsveld (2006) points out that the entire study area comprises one huge Stone Age site. During an assessment by helicopter four sites have been recorded on landing, ranging from the MSA to the LSA.

- **2925AA De Werf**

The following extract from the Xhariep District Municipality Capacity Building Programme Integrated Environmental Programme Final Draft October 2004 reports no heritage resources:
'3.*5.13 Sites of archaeological interest*
Various discussions had been undertaken with appropriate role players, including the Local Municipalities. No such sites had been identified'.

- **3022BA Jonkerwater and 3022AB Springbokpoortjie:** No archaeological data found.

It is a flat terrain with numerous low hills and rocky ridges that forms part of the low-relief Kaiingveld of eastern Bushmanland (Almond 2011a).

- **3022BB Poortjie:** No data found

- **3023AA Sodium:** No data found.

The farm name Schilderspan Pan 33 and the name of the pan itself, Schilderspan, could possible refer to nearby rock art, but this is obviously merely a suggestion.

The following map shows the location of identified heritage sites in the study area:

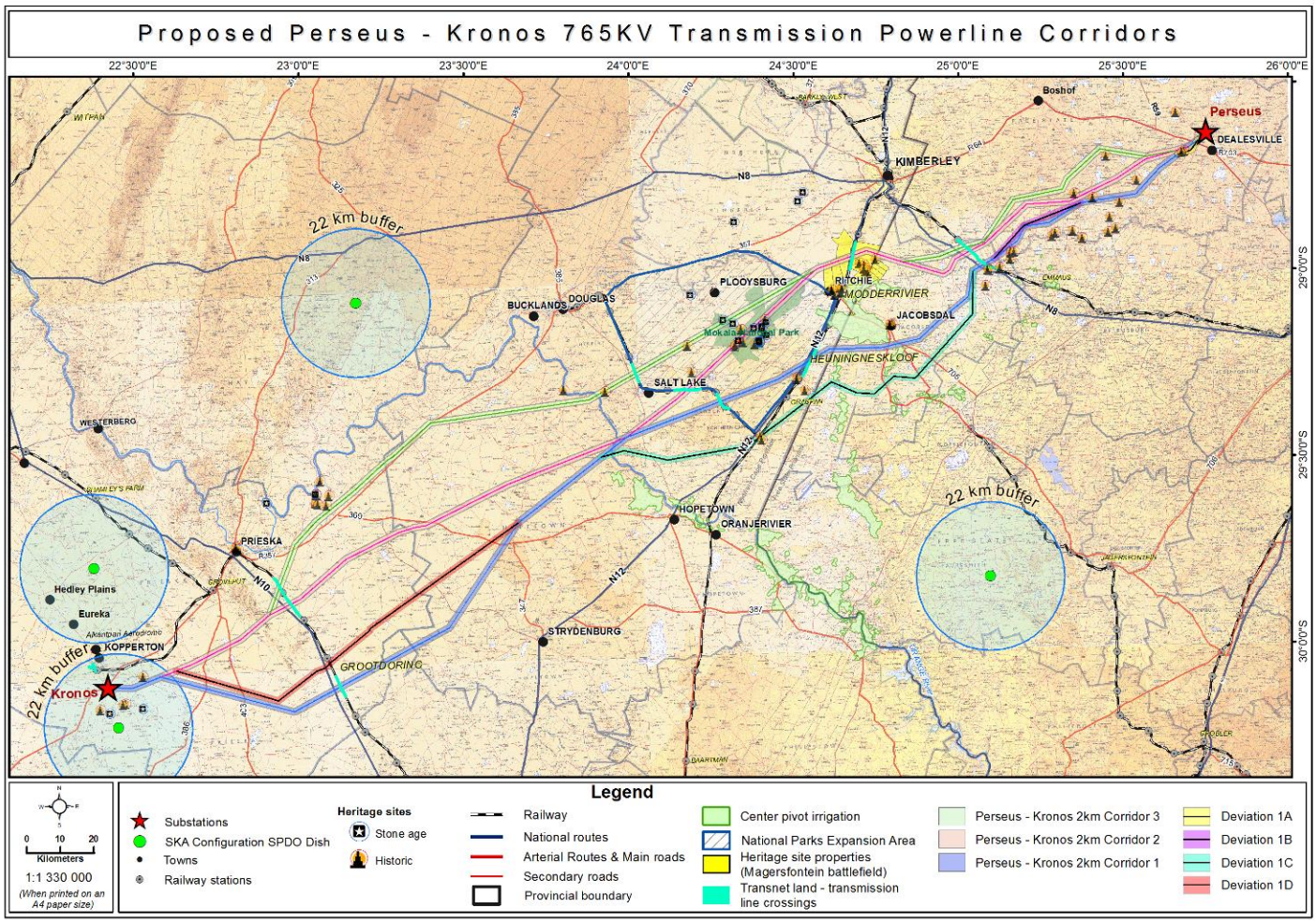


Figure 36: Identified Stone Age and Heritage Sites in the Study Area

Archaeological Sites

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

Significance: High on a regional level – Grade III

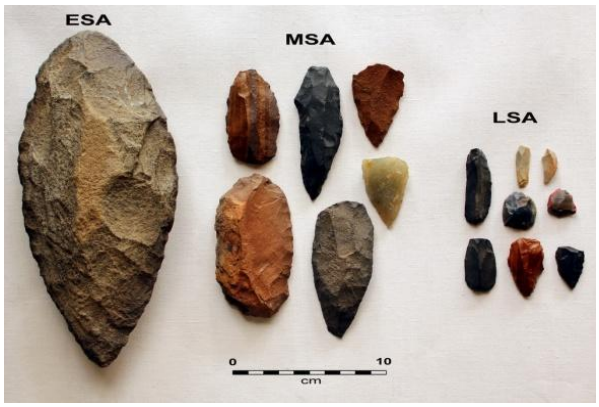


Figure 37: Stone tool typology and engravings in the region

The stone tools (on the left) are not from the region and are only used to illustrate the difference between Early (left), Middle (middle) and Later Stone Age (right) technology.

Built Environment

These are complex features in the landscape, being made up of different yet interconnected elements. Fortunately transmission lines do not usually impact on towns. Most towns in the region have, according to various databases, about 20 buildings that are listed to be of provincial heritage significance.

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

Significance: High on a regional level – Grade III

Figure 38: Buildings found in an urban environment

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
Significance: High on a regional level – Grade III

Figure 39: Examples of farmsteads and farming related features identified in the region

Cemeteries

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 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
Significance : High on a local level – Grade III

Figure 40: Local cemeteries

Public Monuments

Although most of these usually occur in urban areas, some also occur in rural areas where some event of significance took place.

NHRA Category: Buildings, structures, places and equipment of cultural significance
Protection status: General Protection - Section 37: Public Monuments and Memorials
Significance: Medium on a regional level – Grade III

Figure 41: Monuments in town and the rural area

Heritage Assessment Criteria and Grading

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 a 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 applicable of mitigation measures would allow the development activities to continue.

In terms of Section 7 of the NHRA, the sites currently known or which are expected to occur in the study area are evaluated to have the following significance:

Stone Age sites are viewed to have medium significance on a regional level and have Grade III significance.

Farmsteads are viewed to have medium significance on a regional level and have Grade III significance.

Graves and cemeteries are viewed to have high significance on a local level and have Grade III significance.

9.8.2 Potential Heritage Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 45: Analysis of the Significance of Potential Heritage Impacts (Perseus-Kronos – for all three Corridors and Deviations) (Van Schalkwyk, 2015)

Environmental Parameter	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Pre Colonial Stone Age Sites	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. tower positions or access/ inspection roads	3 2	3 3	2 2	5 5	3 3	39 36	High	High
Colonial Period - farmsteads	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	3 2	3 3	2 2	3 3	2 2	22 22	Moderate	Moderate
Colonial Period - cemeteries	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	2 2	3 3	3 3	3 3	2 2	22 22	Moderate	Moderate
Colonial Period – industrial heritage	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	3 2	3 3	1 2	4 4	2 2	22 22	Moderate	Moderate
Colonial Period –	The various features are subject to damage. Easier to identify and therefore easier to	4 4	5 3	5 5	4 4	4 4	72 68	Very high	Very high

Environmental Parameter	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
public monuments and battle fields	avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole								

Table 46: Mitigation Measures (Heritage)

Impact	Mitigation Measures
Stone age sites	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.
Colonial Period - farmsteads	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.
Colonial Period - cemeteries	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.
Colonial Period - public monuments & battle fields	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.
Colonial Period – Industrial Heritage	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, but only as last case scenario.

At present there are no grounds, based on heritage resources, for deciding between the corridors. From this it is deduced that all three of the corridors would be equally suitable for development of the power line. However, the corridors would pass through a highly sensitive region due to the occurrence of a large number of battle field sites. This is specifically the case with the new Deviation 1A, which, it is believed, would have a visual impact on Anglo Boer War battlefield sites at Rhoodelaagte and Belmont (Figure 36).

9.8.3 Conclusions and Recommendations

Although there are **no fatal flaws that would prevent the proposed development from taking place in any of the corridors** it is a highly sensitive region due to the occurrence of a large number of battle field sites. It must be remembered that heritage sites are not only fixed features in the environment, occurring within specific spatial confines, but they are also finite in number. Avoiding of impacts on sites is therefore the preferred form of mitigation. In areas where a high density of sites occurs, if at all possible, exclusion zones where no development is to take place, should be set aside. If that is not possible, mitigation can only be achieved through archaeological investigation.

As the exact coordinates for the power line and the individual tower structures are not yet available, it is difficult to determine what the final impact of the proposed development would be. Therefore, for the project to continue, the following is proposed:

- Mitigation should be based on avoiding of sites rather than anything else. To achieve this, a full "walk down" of the selected corridor must be done prior to construction taking place, to document all sites, features and objects, in order to propose adjustments to the routes and thereby to avoid as many impacts as possible.
- In addition, the management measures (included in the EMPr) should be implemented prior to construction taking place.
- The corridors would pass through a highly sensitive region due to the occurrence of a large number of battle field sites. However, it is perceived that the impact of the proposed development on these sites would largely be visual in nature. This is specifically the case with the newly proposed Deviation 1A (Figure 36), which would have a visual impact[6] on battle field sites at Roodelaagte and Belmont.
- No impact on heritage sites, features or objects can be allowed without a valid permit from SAHRA.

[6] Excerpt from the Visual Report regarding visual impact on the battle filed sites:
The entire study area is considered to have a moderately high tourism potential. The Deviation 1A would pass through a highly sensitive historical region due to the occurrence of a large number of battle field sites. The type of tourist that visits this area is expected to travel considerably through the study area by vehicle. This implies that they will experience a large part of the study area in a relative short time span.

9.9 SOCIO-ECONOMIC ASSESSMENT

9.9.1 Key Findings

The impacts, which were also the findings of this assessment, were determined based on the amount of land that would be taken out of production as a result of the project, and the resulting loss in agricultural output, value, employment, and income.

The impacts of this corridor on agricultural output, value, employment, and income are summarised below:

Agricultural Output & Value:

A total of roughly 476 hectares of land would be taken out of production in this section, resulting in the loss of 383 hectares in output per annum (from land used for construction of towers), assumed to be equally distributed among the six magisterial districts (i.e. 64 hectares per district). This is a simplifying assumption to aid the analysis.

The total impact in monetary value would be just over R17.4 million, based on current (2014) per hectare agricultural production value of between R40 000 and R50,000 per ha per annum. This loss in value is assumed to be equally distributed among the magisterial districts, for purposes of this analysis. These impacts are summarized below for hectarage and output value.

Table 47: Socio-economic - Agricultural Impacts

AGRICULTURAL IMPACTS	
	KRONOS-PERSEUS, 2014
Item	**Impact Value**
Hectares (total)	476
Hectares (cultivated)	386
Rand Value 1/	R 17,374,835
Note:	1/, based on current (2014)
	per hectare values.
Sources:	NDA, Statistics SA and ADEC.

Based on analysis of existing agricultural conditions of Section 2 of the Socio-economic Report (Part 1, Agriculture), it is expected that Boshof would experience the greatest impacts of loss in agricultural output. The impacts in the rest of the districts are also expected to vary accordingly in line with their relative shares of the regional agricultural base.

Employment & Earnings:

The equivalent of one full-time job would be lost, yielding an impact of R24,300 in lost earnings per annum. This is based on estimated monthly earnings of R3,000, which is above the minimum wage of around R2,600. Whilst relatively nominal, the impact would be primarily borne by casual and unskilled workers.

Table 48: Socio-economic - Employment Impacts

AG. EMPLOYMENT IMPACTS,		
	KRONOS-PERSEUS, 2014	
Category	**Number**	**Earnings 1/**
Skilled	0.13	R 4,584
Unskilled	0.22	R 8,043
Casual & seasonal	0.32	R 11,688
TOTAL	**0.7**	**R 24,316**
Note:	1/, based on current monthly	
	earnings of R3,000 per month.	
Sources:	NDA, Statistics SA & ADEC.	

Limitations: *There are a number of caveats relating to these impact estimates. It must be emphasised that these total impacts are based on average production and value data for the Impact Area and its component magisterial districts. Thus, the data do* ***not*** *represent the specific impacts to any individual farmers, producers, or property owners.*

Local Area Impacts: The assessment of the baseline and impacts for the immediate local (impact) area along the proposed power lines was collected directly from a sample of farmers based on personal telephone interviews in the Jacobsdal region. The main concerns from the farmers included impacts on: farming irrigation; centre pivots; disruption on water irrigation schemes; power line infrastructure on future planned agricultural projects; depreciation on land values, game farming; and livestock farming. All these concerns as well as other negative impacts that may be posed by the establishment of the power line, are detailed in Section 3 of the Socio-economic report.

Due to the above negative impacts, the affected farmers propose to detour the path of the power lines to avoid existing irrigation farming and game hunting areas. This calls for relocating the power lines to an existing Eskom power line corridor or a new corridor that would lie, as far as a possible, to the south of the study area. These deviations are presented below in order of preference.

Deviation 1. Eskom could relocate the power lines to the south of Jacobsdal. This would follow an existing corridor where Eskom already has existing power lines. In geographic terms, this

would take the power lines to Oppermans, roughly halfway between Jacobsdal and Kalkfontein (See figure 42). This is the best option for the farmers around Jacobsdal area, as the power lines would be as far away as possible from existing and potential farming areas.

Deviation 2. Eskom could construct the power lines to the south of Kimberly in order to keep them out of existing and potential game farming areas (See figure 42). Game hunting enterprises can only strive in an environment that is not "polluted" by power lines and support infrastructure.

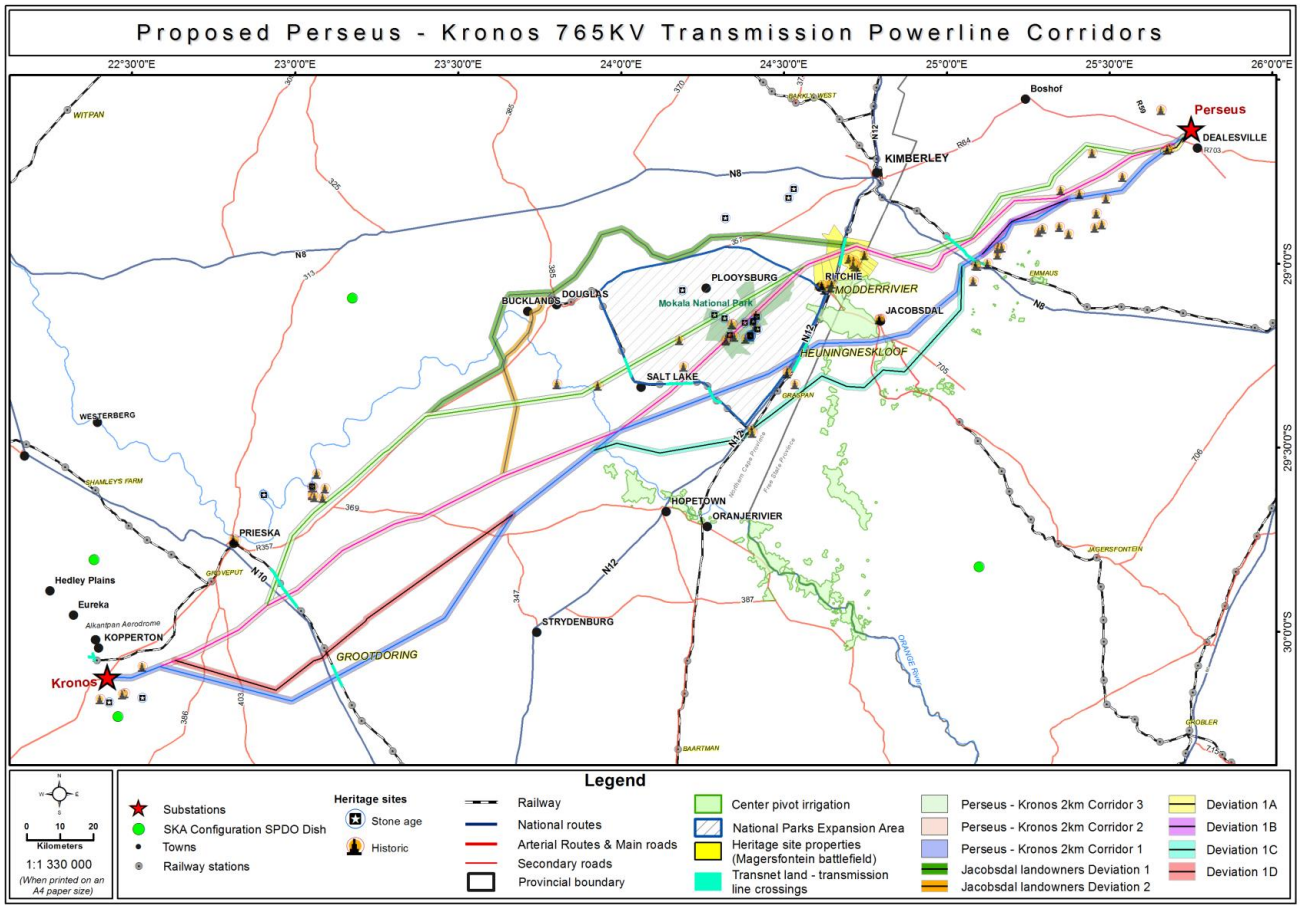


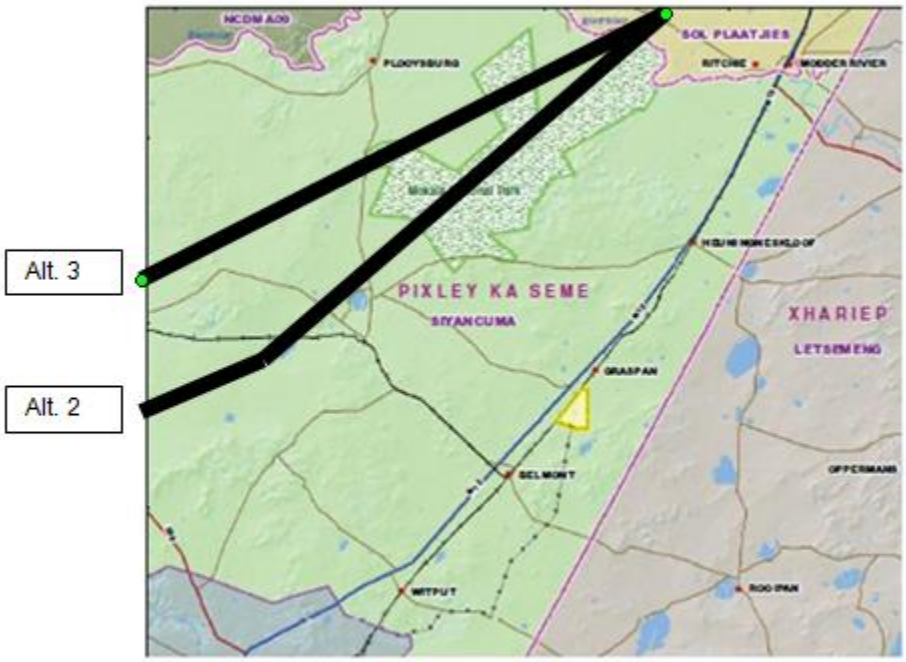
Figure 42: Proposed deviations lines by Jacobsdal farmers (Deviations 1 and 2)

TOURISM ECONOMIC IMPACTS

There are several tourism sites, natural areas, and towns located within or near one or more of the Power Line Corridor Alternative routes through the area. These sites would be most likely to be impacted by development and operation of the power lines. Several key tourism sites and towns are discussed below.

Mokala National Park:

Mokala National Park is the only major reserve within the power line corridor. As illustrated below, the route for Alternative Corridor 2 and 3 could dissect the park if developed as proposed. An inexact review of maps suggests that Corridor 3 would skirt the park's northern boundary, crossing into the park at two separate places. Corridor 2 would pass through the entire length of the park, from northeast to southwest. Corridor 1 would bypass the park completely. Without direct field reconnaissance and/or computer simulation, it would be nearly impossible to determine the exact locations where the power line corridors pass through the park or the extent of visual disturbance at various specific sites for view sheds within the park.



Alternate Corridors 2 and 3 in relation to Mokala Natl. Park (hatched green).

Visitors to Mokala National Park are there to enjoy its natural serenity, big game, and other wildlife. The presence of overhead power lines traversing the park, especially as suggested by the routing of Alternative Corridor 2, would have a negative impact on the typical visitor experience, since such lines will interfere with the natural view sheds provided by the park and with opportunities for wildlife photography.

Within this "high-level" assessment of economic impacts, is it not possible to determine a precise level of downgrade in the visitor experience. Such level can only be determined effectively through surveys, market analysis, and comparability assessments. However, professional experience suggests that overhead power lines (especially in Corridor 2) will distract from the overall visitor experience and will reduce the tendency of certain patrons to visit the park. Assuming that 25% or one-quarter of visitors would not attend due to their pre-trip knowledge of the visual interference, then the overall impact would reduce current attendance by over 5,100. Given the growth trends in attendance, the number of fewer visitors to the park would increase over time to a projected 7,660 per annum by 2018.

Local Game Farming Impacts

The impacts on game hunting are visual or visual pollution. According to leading game farm operators, foreign hunters refuse to come and hunt in an area that is "spoilt" by power lines. The impact on game farming would extend some 20 km on either side of the power line. This translates into a view shed of up to 40 km across. The plain and flat character of the area has much to do with this implied "exclusion zone" for the proposed power lines.

The owner of one of the leading game farms has categorically stated that he will shut down his enterprise after 17 years of successful business operations, if the power lines are constructed over his land. This will involve the closure of a lodge, loss of revenue of R2 to R3 million per annum, plus eight jobs. In addition, the lodge is built on a heritage site commemorating the Magers Anglo-Boer war of 1889. The owners of this farm feel the proposed power lines will not just shut down his game hunting business but may also affect other farms in the area. It must be recalled that game farmers run composite business set-ups that include irrigation farming and livestock grazing as a mixed-use business model. Failure of one component is likely to affect the performance of the other lines of business.

URBAN SETTLEMENT ECONOMIC IMPACTS

The proposed Perseus-Kronos power line development has small settlements situated around farmsteads, along the rail lines and highways. This section of the corridor is situated close to the region's largest city, Kimberley, an important administrative, economic and transport hub for the broader region. However, neither Kimberley nor other large towns are located directly within the path of the proposed power line. Settlements within the corridor lack significant urban infrastructure, and they mainly serve as farmsteads.

There are several transportation nodes and roadways passing through the corridor. Alkantpan Aerodrome is located immediately north of the Kronos sub-station. The R357 Regional Road passes through this point providing a link to Prieska, to the north. The N10 (to the east of Kronos) traverses the proposed Power Line Corridor from southeast to northwest, linking settlements to the north and south of the corridor. Route 12 links Kimberley to areas in the south, passing through the corridor. Several relevant settlements within or near the power line corridor are described below.

Dealesville:

A town located in Tokologo Municipality (in Lejweleputswa District Municipality, Free State), just east of Perseus substation but outside of the Power Line Corridor. The town is surrounded by salt pans and natural springs and is located 55km southwest of Boshof, 70km northeast of Bloemfontein, and 111km southeast of Kimberley.

Demographic Base: Dealesville had a population of 5,445 (Census 2011), with a household base of 1,625. In 2011, the town had 930 employed residents, plus 442 unemployed, yielding an unemployment rate of 32.2%.

Land Use & Economic Activity: Dealesville is predominantly a mixed-farming area. As noted previously in this report, an anthropology research station is also located nearby, at Florisbad, 35km to the east.

Heuiningneskloof:
The small community of Heuiningneskloof is located on N12 within the path of Corridor 1. This community has access to the rail line, serving agriculture in the region. There are less than 20 housing units within this community, based on a review of satellite images.

Salt Lake:
A salt pan located between Corridors 2 and 3, not far from the Free State-Northern Cape provincial boundary. Because of its proximity to these corridors, it is included within the primary impact area. Satellite images suggest that the pan is being mined for salt. As such, it is an active economic node. There is some settlement relating to this activity, with about 20 housing units visible from satellite images.

Copperton:
A mining town located about ten kilometres northwest of the Power Line Corridor, close to the proposed Kronos Substation. The town is situated in the central Karoo region and forms part of Siyathemba Local Municipality (in Pixley ka Seme District, Northern Cape).

Demographic Base: The population of Copperton was only 59, occupying 37 households, according to the 2011 Census. The number of people employed in Copperton was reported to be 14, with only 3 unemployed, in 2011.

Land Use & Economic Activity: Copperton was formerly a copper and zinc mining centre which, at its peak between 1970 and 2000, hosted about 3,000 workers. Much of the mining activity has since disappeared. The former mine at Copperton is currently used by Denel as a missile test site. This activity utilizes the few mining buildings that remain. As a result of the closure of the mine, the Copperton area has lost most of its economic activity and population.

Grootdoring:
A small settlement with a railway siding, situated between Corridor 1 and Corridor 2. This settlement lies in Pixley ka Seme District Municipality. Grootdoring has a railway siding along the main track that passes through the region. Population is estimated to be less than 50 people.

Plooysburg:
A small settlement about half-way between Ritchie and Douglas. This settlement is located about 5km north of Corridor 3. The community serves the surrounding agricultural areas along the Riet River. There are an estimated 20+ households plus services including a church, retail store, and police station. Plooysburg is the closest settlement to Mokala National Park, located just to the south and east.

Ritchie:
A farm and market town situated on the north bank of the Riet River in Frances Baard District Municipality, in the Northern Cape. The town of Ritchie, along with the adjoining township of Motswedimosa and the railway node at Modderrivier, together form a small urban agglomeration and economic hub. This agglomeration is situated around the confluence of the Riet River and Modderriver, a rich agricultural node with extensive irrigation within an otherwise arid region. The area is located about 8 kilometers south of Corridors 2 and 3, and about 20km north of Corridor 1. Thus, the area is situated between the proposed power line corridors.

Demographic Base: Ritchie had a population of 7,610 in 2011, a sharp increase from 2001, when the town's population totaled 5,706. Ritchie had about 1,880 households in 2011. The adjacent township of Motswedimosa (located north of Ritchie's centre) had a population of 7,240 in 2011, up from 5,509 in 2001. Modderrivier, about three kilometers to the east, has an estimated population of about 250 people, based on housing settlement. Thus, the overall area has a total population of about 15,100, up by about 31.7% since 2001.

In 2011, Ritchie had an employment base of 1,748, plus another 821 unemployed, yielding a 32% unemployment rate. Given the substantial increase in the area's population base since 2001 (both in formal and informal settlement areas), it can be surmised that economic opportunities continue to grow and support people locally.

Land Use & Economic Activity: Ritchie is a formal agricultural market town with commercial, civic, medical, residential and other uses. There is extensive farmed land in Holpan along the R705, to the southeast of Ritchie and between Riet River and the N12. Other uses include a railway line running along the N12. Housing prices are averaging around R1.0 million in Ritchie, based on a review of current listings. Commercial properties are listed at more than R7.2 million on average.

Motswedimosa:
Includes formal and informal township settlements, built to a somewhat higher intensity than the formal town of Ritchie. Modderrivier is a rail transport node that also serves as a distribution centre, with warehousing and storage uses oriented to the surrounding agricultural industry. Land surrounding Modderrivier to the south and east appears to be intensively farmed, based on satellite images of the area.

Jacobsdal:
A small farming community situated in Letsemeng Local Municipality (in Xariep District Municipality). The town is located about four kilometers north of Corridor Alternative 1 and 25km south of Corridor Alternatives 2 and 3, thus between the northern and southern routes of the proposed power line. The town's origin dates back to 1859 when Christoffel Jacobs laid out its foundation on Kalkfontein farm. Today, the area around Jacobsdal is home to 6,500 people.

Demographic Base: The population in Jacobsdal was 3,505 in 2011, whilst the number of households was about 1,000. Ratanang, located nearby, had a population of 4,233 and 1,110 households. The two areas together thus provide a population base of about 7,740.

According to Census data, Jacobsdal had 766 people employed, versus 289 unemployed, yielding an unemployment rate of 27.4%. Ratanang had 874 people employed and 268 unemployed, for an unemployment rate of 23.5%.

Land Use & Economic Activity: Irrigation-fed agriculture helps drive the area's economy, with extensive water canals supporting farming of Lucerne, potatoes, wheat, cotton, ground nuts, olives, maize, and table & wine grapes. Jacobsdal has some downstream economic activity building on this agricultural base, including two wine cellars (Landzicht and Wilreza), plus dairies and other processing facilities.

OTHER TOWNS AND SETTLEMENTS

Among the other settlements located near the Power Line Corridor are:
Groveput,
Higgs Hope,
Spytfontein,
Ondraaisvlei, and
Oraspan.

A number of farmsteads with limited settlement are located within the power line alternative corridors, comprising:
Witkoppies,
Emmaus,
Hedley Plains,
Eureka,
Die Dam, and
Jagt Drift.

Places like Graspan are small farming settlements with perhaps 20 houses at most. Several, like Diemansputs, are located between corridor alternatives. There are also several larger cities located within a short drive of the corridor, including Boshof and Kimberley.

Another substantial town located within a short drive of the Power Line Corridor is Prieska. This town of 14,250 people is located off the N10 national road, about 20 to 25km northwest of Corridor Alternatives 3 and 2, respectively. Prieska is situated on the banks of the Orange River and mainly serves as a market place for the surrounding farming communities.

The following locality map illustrates the towns and settlements discussed above:

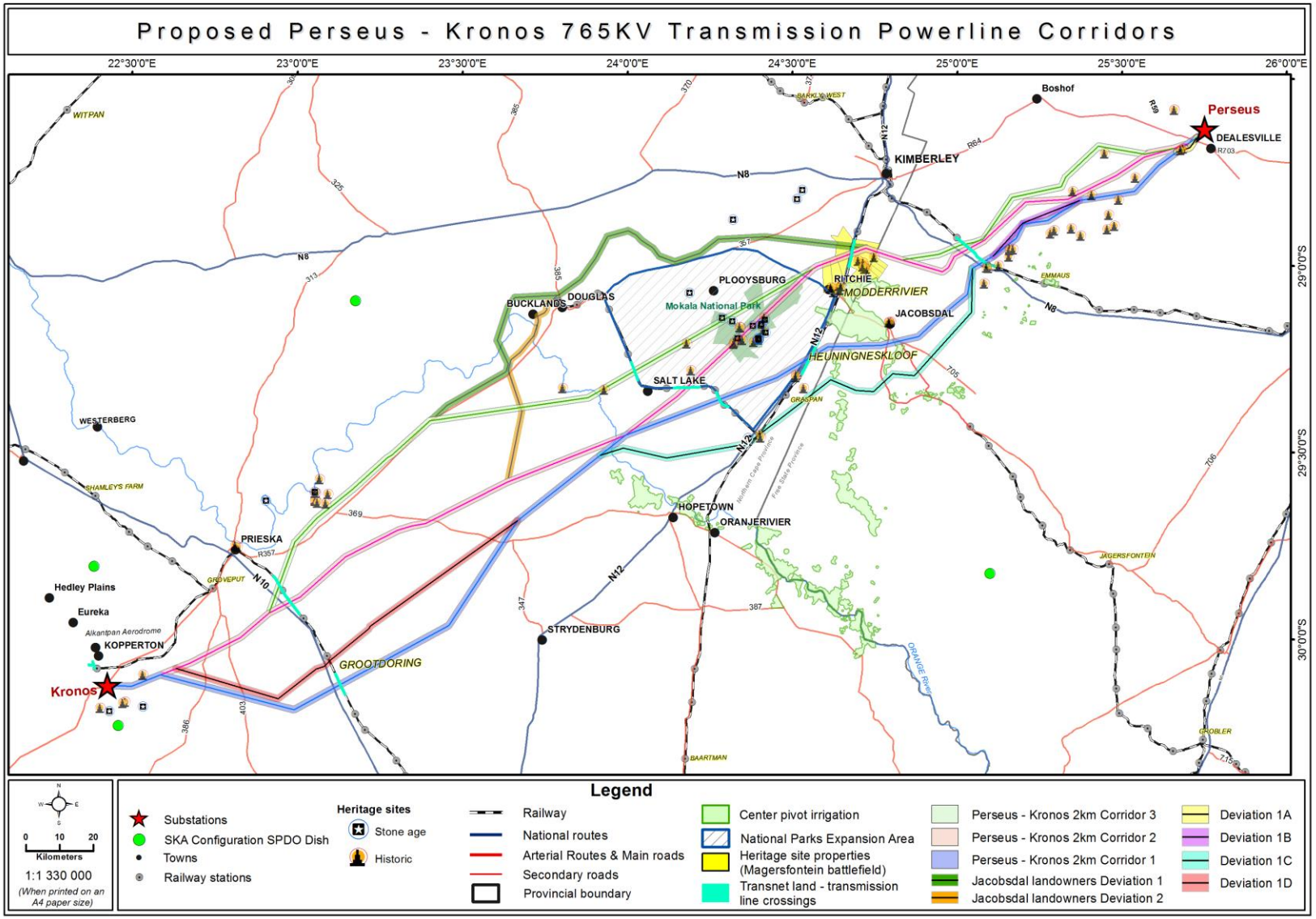


Figure 43: Towns and Settlements within Study Area

9.9.2 Potential Socio-economic Impacts and Mitigations

Scoring Without Mitigation = **(NM)** Scoring With Mitigation = **(WM)**

Table 49: Analysis of the Significance of Potential Socio-economic Impacts – **Agriculture Sector** (Kronos to Perseus – for all three route corridors) (ADEC, 2013)

Environmental Parameter	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without Mitigation	With Mitigation
Loss of productive agricultural land	• Land equivalent to the "footprint" of towers taken out of production	2 1	3 1	2 2	4 4	4 3	44 24	Low	Low
Loss of agricultural production	• Productive capacity reduced by area equivalent to the "footprint" of pylon towers	2 0	3 1	2 2	4 4	3 1	33 7	Low	Low
Loss of agricultural value / income	• Value and income reduced where productive capacity is reduced	1 1	3 1	2 2	4 4	3 1	30 8	Low	Low
Loss of Employment	• Jobs lost where production and value lower (and returns insufficient)	0 0	1 1	2 2	4 4	1 1	7 7	Minor	Minor
Loss of household income	• Income lost where jobs are lost	0 0	1 1	2 2	4 4	1 1	7 7	Minor	Minor

Table 50: Analysis of the Significance of Potential Socio-economic Impacts – **Tourism and Development Sector** (Kronos to Perseus) (ADEC, 2013)

Alternative Corridors	Environmental Parameter	Nature of Impact	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
									Without Mitigation	With Mitigation
Corridor 1	Reduction in competitiveness or marketability of tourism attractions	Visibility of power lines in areas otherwise marketable for physical isolation or environmental character	1 1	3 0	1 1	4 4	3 3	27 18	Low	Low
Corridor 2 & 3			4 4	3 3	1 1	4 4	4 4	48 48	Moderate	Moderate
Corridor 1	Loss of attendance and revenue for tourism attractions	Reduced marketability or competitiveness of attractions	0 0	1 0	0 0	4 4	1 1	5 4	Low	Low
Corridor 2 & 3			3 3	3 3	1 1	4 4	3 3	33 33	Moderate	Moderate
Corridor 1	Loss of revenue for tourism-related businesses (e.g., in towns)	Reduced attendance at visitor attractions in impact areas	0 0	1 0	0 0	4 4	1 1	5 4	Low	Low
Corridor 2 & 3			3 3	3 3	3 3	4 4	3 3	39 39	Moderate	Moderate
Corridor 1	Loss of tourism-related Employment	Jobs lost at impacted tourism attractions or tourism-related businesses	0 0	1 0	0 0	4 4	1 1	5 4	Low	Low
Corridor 2 & 3			3 3	3 3	3 3	4 4	3 3	39 39	Moderate	Moderate
Corridor 1	Loss of tourism-related HH income	Household income lost where tourism jobs are lost	0 0	1 0	0 0	4 4	1 1	5 4	Low	Low
Corridor 2 & 3			3 3	3 1	3 3	4 4	3 3	39 33	Moderate	Low
Corridor 1	Loss of property value	Proximity of power lines to residential areas	1 0	1 0	2 0	4 4	3 1	24 4	Low	Low
Corridor 2 & 3			0 0	0 0	0 0	4 4	1 1	4 4	Low	Low

Table 51: Mitigation Measures (Socio-Economic - **Agriculture**)

Impact	Mitigation Measures

Disruption of Irrigation Systems:
The construction of power lines will disrupt the operation of centre pivots for individual farms and large scale water irrigation schemes, leading to total incapacitation of irrigation farming operations. Also, farmers will not be able to carry out aerial spraying vital for checking crop pests and diseases.
 	
The construction of power lines will lead to the demise of game farming/hunting industry (see details in Tourism Impact Report – Mitigation Measures). Game hunting is a pillar of mixed-use farming enterprises in the area, so its failure or success bears directly on the performance of irrigation and livestock farming.
	• Power lines must be constructed away from current farming areas. This would require changing the path of proposed power line corridor.
	• Aerial spraying would require the power lines to be as far away as possible from farms.
	• Two deviations are recommended, as below: -
	  ○ <u>Deviation 1</u> (preferred). Push power line to the south of Jacobsdal, following existing Eskom corridor (i.e. close to Oppermans, roughly halfway between Jacobsdal and Kalkfontein.
	  ○ <u>Deviation 2</u> (optional). Construct power lines to south of Kimberly, out of the game farming areas (detailed in Tourism and Urban Development Report).
	
	• Recommended principle mitigation measure is for Eskom to use existing "brownfield" corridors, with no new socio-economic impacts.

Loss of Productive Agricultural Land: The construction of the power line route would require use of some land to accommodate the "footprint" of towers (pylons). Whilst the footprint is small on an individual basis, the total number of pylons can result in an overall reduction in agricultural land in the broad area over which the corridors extend. All three alternative power line corridors pass through agricultural land that would be removed from production to accommodate towers. *<u>Caveat</u>: Stakeholders maintain that Eskom only compensates for part of the structure which goes into the ground, and not the structure's footprint.*	• The only way to avoid a reduction in productive agricultural land is to reduce the volume of pylons and/or minimize pathways over productive farmland. In some cases, a few hundred metres in another direction can make a significant difference in the ability of a farmer to ensure efficiencies in production. • As a mitigation measure, farmers should be compensated at fair market value (FMV) for productive farmland used to accommodate pylons and other infrastructure. The value of the farmland would be determined based on farm income generated on an average annual basis. • Indicative production crop values per hectare are provided in this Report. (i.e. R40,000 to R50,000 per hectare).

Impact	Mitigation Measures
Loss of Investment Capital and Assets: The construction of power lines on farm land will immobilize operation of centre pivots and water irrigation systems, leading to loss heavy capital investment. The construction of power lines near farms will prevent aerial spraying operations for pest and disease control, leading to loss of productivity, output and employment.	• The path of the proposed power lines must avoid existing farms. • If the power lines transgress existing farms, then farmers must be compensated for lost investment, currently estimated at R200,000 to R300,000 per hectare, plus operating losses. The compensation for larger water irrigation schemes would be much higher that the investment cost of centre pivots • The path of the proposed power lines must be as far away as possible from currently farmed land. • Compensation would be hard to determine as there is no alternative to aerial spraying at the moment.
Loss of Productive Capacity: When farmland is taken out of production, there is a reduction in production capacity and output. The reduction in output results not only from the loss of land but also from a reduction in efficiencies (e.g., farm equipment must maneuver around pylon structures). For the purposes of this impact analysis, productive capacity is tied closely to a reduction in land available for agriculture. *Caveat: Stakeholders maintain that Eskom does not compensate for loss of productivity, production or value. Eskom may have to re-consider this stance in light of the results of this Socio-economic Impact Study.*	• Loss in productive capacity is an indication of income and value. A reduction in farm income would result in a change in value. As such, mitigation measures are warranted as above (and below) based on farm income and value.
Loss of Agricultural Value: As noted above, the loss of productive capacity can result in a loss of farm income, which is used in turn to determine value.	• Farmers would be compensated for the loss in value, based on the income generated by their land. Fair compensation as a mitigation measure is noted above.
Livestock Theft The introduction of power lines will render Eskom service and repair personnel to access farm properties, leading to generation of	• The path of the proposed power lines must avoid existing farms.

Impact	Mitigation Measures
interest and eventual thieving activities (note: animal theft is non-existent at the moment).	
Risk of Death for Eskom Personnel: Eskom personnel tasked to maintain and repair power lines face the risk of dying from exposure to live bullets fired by game hunters.	• The power lines must be constructed as far away as possible from game farms and game hunting areas. This mitigation measure is in the interest of Eskom personnel.
Loss of Employment: If a business (i.e., farm) loses revenue generated by land, there is the possibility that overall operations will become less profitable. Businesses will sometimes reduce their overhead charges or operating costs in order to stay afloat. Farms, however, are different from many businesses in that they tend to remain much more dependent on family and household members than on outside hiring of staff. A relatively small proportion of agricultural employment is hired from outside the household. As a result, even a sharp downturn in farm revenue will not necessarily translate into a decrease in farm employment. Nevertheless, serious reductions in output and income can still result in tightening of workers' hours.	• Compensation for land used to accommodate towers and other infrastructure does not ameliorate the fact that some farms will have less productive capacity and less need for workers. That being said, the employment impacts were still determined to be minimal. Mitigation in the form of a temporary subsidy is recommended where there is a direct layoff resulting from construction of power infrastructure. Such temporary compensation would be provided directly to claimants, equivalent to 3/5th annual salary and wages, for a period of up to two years.
Loss of Household Income: As noted above, there is a very small possibility of a reduction in employment resulting from the loss of productive capacity. A reduction in employment can also include a loss of hours worked by those who remain employed. Clearly, either a reduction in hours or full-time job loss will result in reduced household income for the worker.	• As noted above, a subsidy could be provided for agricultural workers who are shown to have been laid off or had their hours reduced as a result of the construction of power lines through an agricultural area. This subsidy could help ameliorate the impact on household income generated by the loss of work hours and/or employment. That being said, compensation should only be provided where workers' claims are shown to be related directly to power infrastructure at a specific farm.
Halt of Planned & Proposed Farm Expansion Projects The construction of power lines would bring immediate halt to	• Farmers must be compensated for preparation costs, including investment cost in machinery and equipment. Indicative costs are

Impact	Mitigation Measures
planned and proposed expansion projects spread in the area along and surrounding the path of the proposed power lien corridor.	R10 million for a 21 ha track of land, based on an existing project documented in this Report.
Land Identified for Future Development of Irrigation Farms The corridor of the proposed power lines transgresses identified potential land for earmarked for future development of irrigation farms, including areas with secured water rights.	• Land earmarked for future development of irrigation farms must be marked as "hot spots" to be avoided by the proposed power lines. • Land with existing water rights must also be marked as "hot spots" to be avoided by the proposed power lines.

Table 52: Mitigation Measures (Socio-Economic – **Tourism & Urban Development**)

Impact	Mitigation Measures
Reduced Marketability for Tourism Attractions: The construction of the power lines may impact on the "marketability" of several of the region's tourism attractions. Many of these attractions are oriented towards a market that values physical isolation and/or harsh but beautiful environments. Adventure tourists and film crews are drawn to this area in part *because* of its *lack* of urban infrastructure. Visual pollution caused by power lines can interrupt or reduce the perception of isolation and tranquillity. Other tourists and photographers are drawn to parts of the region by floral seasonal bursts of colour. Power lines and tall pylons situated within flower fields or even on distant hills can ruin the image generated for photographers and other tourists drawn to the region's natural setting.	• The only way to mitigate for the impact of visual pollution on tourism sites is to ensure that power lines and pylons are situated as far away from high-quality view sheds as possible. This will require extensive research and seasonal micro-mapping to ensure the most appropriate routing, even within the basic corridors that have already been identified. Distance is critical especially for the floral view sheds in Namaqualand. • In the case of several large pan sites, there are opportunities to reduce impacts by ensuring that power lines extend only along less-utilised portions of the sites. • Corridors 2 and 3 are likely to have a moderate to high impact on Mokala National Park and its visitor base. As a result, it is highly recommended that ESKOM pursue Corridor 1 around the park to avoid impacting on the park's potential for generating tourism and economic development spin-offs for the region.
Severe Reduction in Game Farms & Game Hunting The construction of the power lines will bring visual pollution to the game hunting industry. The visual impact extends +/- 20 km on either side of the power lines or view shed of up to 40 km across. The plain and flat character of the area is attributed to this implied	• Power lines must be constructed away from current game farms and game hunting areas. This would require changing the path of proposed power line corridor. • • Two deviations are recommended, as below: -

Impact	Mitigation Measures
"exclusive zone" for the proposed power lines.	○ Deviation 1. Relocate power lines to the south of Jacobsdal, following existing Eskom corridor (i.e. close to Oppermans, roughly halfway between Jacobsdal and Kalkfontein. ○ Deviation 2 (preferred). Construct power lines to south of Kimberly, out of the game farming areas. • Recommended principle mitigation measure is for Eskom to use existing "brownfield" corridors, with no new & incremental socio-economic and environmental impacts. Note: Deviation 2 subsumes Deviation 1.
Loss of Game Farms & Wild Animal Stock The construction of power lines will lead to the collapse of the game farms and game hunting enterprises. Direct losses include investment capital in property, equipment, and wild animal (game) stock.	• Game farmers must be compensated for loss of investment and game hunting enterprises as "going concerns", including future revenues streams for the projected lifetime of the businesses. • Compensation must take into account "knock on" effect on the viability of the other mixed-use business lines i.e. irrigation farming and livestock grazing, as appropriate.
Game (wild animal) Poaching The introduction of power lines will require Eskom service and repair personnel to access game farm properties and intrude secluded animal breeding programmes, leading to generation of interest and possible poaching activities (note: animal theft and poaching is non-existent at the moment).	• The path of the proposed power lines must be as far away as possible from existing game farms.
Reduced Attendance & Revenue for Tourism Attractions The impact area does not have a significant number of major commercial tourism attractions although it does have natural areas that generate tourism income for surrounding communities. The reduction in marketability associated with visual pollution could also result in a reduction in attendance to tourism sites.	• A loss in attendance and revenue at tourism sites and parks could be avoided through appropriate positioning as noted above. The view sheds are ultimately very critical to tourism in this region, so ensuring that visual pollution and interruption is minimised in sensitive areas will help mitigate against a loss of attendance and site revenue.

Impact	Mitigation Measures
Loss of Revenue for Tourism-Related Businesses: As noted above, the region offers natural assets (e.g., giant salt pans, unique environments, and Namaqualand's floral kingdoms) that, whilst not themselves major tourist "attractions," then do bring visitors to the region. Those visitors generate revenues in lodging, restaurants, tour operations, transport, supplies and equipment, etc. Thus, a reduction in attendance at isolated attractions can result in a loss of revenue for businesses that may be located kilometres away in the region's towns.	• The primary mitigation approach would be to avoid sensitive view sheds, as noted above. • Where there is still visual pollution or interruption despite the aforementioned mitigation measures, then there may be a need to compensate business operators as claimants who can show a dependence on revenue generated by tourists visiting these natural areas and parks. Compensation would best be assigned based on actual average revenue numbers tracked before and after project implementation.
Loss of Tourist-Related Employment: If a business (i.e., tour operator) loses revenue generated by tourism, there is the possibility that overall operations will become less profitable. Businesses will sometimes reduce their overhead charges or operating costs in order to stay afloat. Tourism businesses are very labour intensive. Thus, a somewhat minor reduction in tourism revenues can still result in the loss of employment.	• Mitigation in the form of a temporary subsidy is recommended where there is a direct layoff of tourism-related workers resulting from construction of power infrastructure. Such temporary compensation would be provided directly to claimants, equivalent to 3/5th annual salary and wages, for a period of up to two years.
Loss of Household Income: As noted above, there is a possibility of a reduction in employment resulting from the loss of tourism. A reduction in employment can also include a loss of hours worked by those who remain employed. Clearly, either a reduction in hours or full-time job loss will result in reduced household income for the worker.	• As noted above, a subsidy could be provided for tourism workers who are shown to have been laid off or had their hours reduced as a result of the construction of power lines through a tourist area or site. This subsidy could help ameliorate the impact on household income generated by the loss of work hours and/or employment. That being said, compensation should only be provided where workers' claims are shown to be related directly to power infrastructure at a specific tourism-related site or business.
Reduction in Property Values: If power lines and infrastructure are developed proximate to residential property, there is a strong possibility of a negative impact on property values. Whist insufficient information is available on the exact interface between the proposed corridors	• Mitigation can include compensation to residential property owners who can show that their property values have or will be impacted by the power infrastructure. Compensation would be made in the form of a negotiated (or economist-determined) percentage of fair market property value, representing the impact.

Impact	Mitigation Measures
and residential properties, the possibility still exists that there may be an impact on the value of a limited number of residential properties. Property values are impacted negatively primarily due to the visual pollution caused by the presence of the towers and lines. Proximity is a key factor, and where the pylons and lines are close to residential properties, the impacts are likely to be greatest.	
Stoppage of Planned & Proposed Farm Expansion Projects The construction of power lines will stop immediate planned and proposed eco-tourism expansion projects spread in the area along and surrounding the path of the proposed power line corridor. The path of the proposed power lines transgresses identified potential land for earmarked for future development of game farms, including areas with existing water rights.	• Game farmers must be compensated for preparation costs already incurred in the form of investment in land and equipment, among others. • Land for future development must be marked as “hot spots” to be avoided by the proposed power lines. • Land with existing water rights must be also marked as “hot spots” to be avoided by the proposed power lines.

9.9.3 Conclusions and Recommendations

Agriculture:
The construction of the proposed 765kV power line between the Kronos and Perseus substations would take an estimated 386 hectares of agricultural land out of cultivation in the region based on data from the 2007 Census of Agriculture. This translates to loss of R17.4 million per annum in crop value. Most of this impact would occur in Boshof. The reduction in production would result in the loss of the equivalent of less than one agricultural job. The loss of one job would be around R36 000 per year in employee earnings. These impacts would vary across the area, owing to variation in the amount of land taken out of production, productivity, value, and other variables across the affected magisterial districts. It is expected that the impacts on field crops would be concentrated primarily in Boshof, whilst impacts on those farming winter cereals would likely be felt in areas of Prieska and Herbert. Boshof would also incur some impacts on horticulture.

However, when these impacts are considered in the local area context, the results are grave as the power lines would affect the very survival of not only irrigation farming but also game hunting and livestock grazing. The impacts on these three land uses will disrupt the mixed-use viability of farming enterprises along and surrounding the path of the proposed power line corridor. For each farm that is taken out of business, the loss in the value of output is estimated at around R8.5 million, plus 8 jobs worth R288 000 in employee earnings per annum.

Tourism:
A high-level review of existing tourism assets within this section of the corridor suggests that Mokala National Park is the primary tourism site located within or near the Power Line Corridor. Other key regional tourism sites are clustered in urbanized areas like Kimberley and Boshof, or at other sites like Florisbad, located further away from direct path of the power line. At the local level, there are about 20 game farms within the proximity of the power line corridor. The majority of these game farms operate as part of mixed-use enterprises alongside irrigation farming and livestock grazing. In terms of functionality, they are distinctively different from Mokala National Park and other regional tourism attractions as they offer exclusive professional game hunting experience for foreign and local niche markets. This assessment also recognizes the possibility for the existence of other lesser-known sites of cultural or natural heritage significance that have not been identified herein but which may hold potential as tourist attractions.

It is recommended that the proposed power lines be re-routed or constructed in existing “brownfield’ corridors (see Figure 43 above).

9.10 RANKING OF THE ALTERNATIVE CORRIDORS

In order to rank the alternative corridors, Table 53 was compiled and the corridors were given a rating on a scale of 1 to 3, with 1 being the most preferred corridor and 3 being the least preferred corridor option.

Table 53: Ranking of the proposed alternative corridors

Order Of Rank	Vegetation	Fauna	Avifauna	Wetland	Agriculture	Visual	Ecotourism	Heritage	Socio-Economic	Technically Preferred
1	Corridor 1 with 1B 1A	Corridor 1 with 1A 1B 1C 1D	Upgrade / recycle existing 400kV line in Kronos-Hydra-Perseus corridor	Corridor 1 with 1B	Corridor 2 Corridor 3	Corridor 1 with 1B 1C 1D	Corridor 1 with 1A 1B 1C 1D	Corridor 1 with 1B 1C 1D Corridor 2 Corridor 3	Corridor 2 Corridor 3 with proposed Deviation 1 and Deviation 2	Corridor 1 with 1A 1B 1C 1D
2	Corridor 1 with 1C 1D Corridor 3	Corridor 3	Corridor 1 with 1A 1B 1C	Corridor 1 with 1D	Corridor 1 with 1A 1B	Corridor 1 with 1A		Corridor 1 with 1A		
3	Corridor 2	Corridor 2	Corridor 1 Corridor 1 with 1D **Corridors 2&3 are fatal flaws**	Corridor 1 with 1A 1C Corridor 2 Corridor 3	Corridor 1 Corridor 1 with 1C 1D	Corridor 2 Corridor 3	Corridor 2 Corridor 3			

INTERESTED & AFFECTED PARTIES PREFERRED CORRIDORS

Mokala NP:
- Prefer Corridor 1 with a Deviation 1C to avoid the future expansion area of Mokala National Park.

Landowners
- Most Landowners prefer the Do-Nothing Alternative;
- Some prefer Corridor 1 that avoids Mokala National Park as well as avoids their farms;
- Other farmers (Jacobsdal area) preferred Corridors 2 and 3 with proposed deviations to avoid their farms.

Magersfontein battle fields
- Corridors 2 and 3 traverse their heritage sites. Hence Corridor 1 would be accepted provided it avoids the battle fields.

Birdlife
- Avoid the pans from east of Kimberly along the N8 towards Perseus Substation.
- Avoid IBA's close to the routes (Benfontein SA033) and (Sandveld &Bloemhof Dam SA039). *Corridor 3 seems to be the closest.*

9.11 SUMMARY OF THE KEY FINDINGS

Below is a summarised conclusion of the key findings regarding the preferred routes (See table 53) based on the nature and extent of impacts on the environmental and social aspects.

Vegetation

Both substations are situated in vegetation groupings of medium sensitivity. The corridors do not differ significantly as to their sensitivity towards the proposed power line development.

The preferred route was determined as Corridor 1 with Deviation 1B based on the lowest percentage sensitivity along the corridor, while the sensitivities traversed by Corridor 1 and Corridor 1 with Deviation 1A are also comparable to the preferred option. Deviation 1D impacts on the highest percentage sensitivity (due to the Gariep Focus Area). However, even with all the deviations to Corridor 1, the percentage sensitivity that could be impacted on is comparable to that of Corridor 3, which is the second preferred option.

Corridor 1 and its proposed deviations will impact on a smaller degree of the Freestate Highveld Grassland protected areas expansion focus area and do not traverse through a portion of the Mokala National Park and its proposed expansion area, as the other corridors. Furthermore, Corridor 1 with deviation 1D, is situated south of the Asbestos Mountain range, while corridors 2 and 3 traverse over the mountain. It is also thought, that Corridor 1 with Deviation 1A, will have a lesser occurrence of the protected trees *Boscia albitrunca* (Witgat / Sheppard's tree) and *Acacia erioloba* (Camel Thorn).

Fauna

The study area is generally of medium value for terrestrial vertebrate biodiversity. Terrestrial vertebrate fauna is unlikely to be substantially negatively affected by this development.

Corridor 1, including any of the Deviations, is the most favourable corridor as it does not traverse a protected area. Corridor 2 and 3 are less favourable, given that they traverse Mokala National Park, however, if Corridor 3 can be moved northward so as to avoid Mokala National Park, then it is equally acceptable to Corridor 1.

Avifauna

Corridor 2 and 3 are fatally flawed as they pass through Mokala National Park and a high risk White-backed Vulture area (Figure 26). Deviations 1A and 1B differ very little from Corridor 1 for avifauna and are assigned the same score as Corridor 1. Deviation 1C is significantly further from the White-backed Vulture areas and is hence the most preferred route. Deviation 1D still passes too close to vulture areas and so is assigned the same score as Corridor 1.

However, the Avifauna Specialist strongly recommends that the option of upgrading or recycling existing 400 kV lines in the Kronos-Hydra-Perseus corridor be fully examined first.

Wetland

From a wetland and riparian ecological perspective, Corridor 1 with deviation 1B is the preferred option due to the fact that it has the least amount of wetlands and drainage lines/riparian areas as well as not crossing any national parks or large mountainous areas. Corridor 1 with deviation 1D is second preferred. Corridor 2 is the least preferred corridor as it contains the most wetlands and transects further over a national park (28km) as well as crossing a mountainous area for 17km. Corridor 3 has the highest number of drainage lines/riparian areas as well as crossing approximately 15km of national park and 17km over a mountainous area and is therefore the not a preferred option.

Agriculture

From an agricultural perspective, the three route corridors including the deviations cross similar soil patterns. There is therefore little to choose between the three corridors as far as soils and agricultural potential is concerned.

The two proposed crossing places for the Gariep River appear to have poor soils which are not cultivated, but at the Riet River, the southern crossing Corridor 1 and Deviations would appear to have the possibility of more irrigated areas in the immediate vicinity than the northern crossing Corridors 2 and 3. Therefore the Corridors 2 and 3 are the most equally preferred. Corridor 1 with Deviations 1C and 1D are the least preferred.

Visual

The three corridors including the deviations have been evaluated against international accepted criteria to determine the impact they will have on the landscape character and the viewers that have been identified in the study area.

Corridor 1, including Deviations 1B, 1C and 1D, is regarded as the most preferred alternative. The impact of Corridor 1 on visual receptors varies between residents, tourists and motorists. Corridor 1's great advantage lies in the less significant visual impact on tourists and residents as compared to the other alternatives.

Deviation 1A would pass through a highly sensitive historical region due to the occurrence of a large number of battle field sites. However, the type of tourist that visits this area is expected to travel considerably through the study area by vehicle. This implies that they will experience a large part of the study area in a relative short time span.

Ecotourism

Corridor 1, including the Deviations, is considered the most preferred alternative from an ecotourism perspective. The deviations have been carefully planned to ensure that the impacts on the ecotourism elements can be avoided as far as possible. Corridor 2 will have too much impact on the Mokala National Park and the ecotourism opportunities which it represents. Corridor 3 will have a visual impact on the Mokala National Park and will have a direct long term impact on the proposed expansion strategy of the Park.

Heritage

Although there are no fatal flaws that would prevent the proposed development from taking place in any of the three corridors and deviations 1B, 1C and 1D, it is a highly sensitive region due to the occurrence of a large number of battle field sites. However, it is perceived that the impact of the proposed development on these sites would largely be visual in nature. This is specifically the case with the newly proposed Deviation 1A, which would have a visual impact on battle field sites at Roodelaagte and Belmont.

Social

The proposed power lines will negatively impact on existing lucrative irrigation farming and game hunting activities along and surrounding the Corridors and the Deviations. The high land values for irrigation farming and game hunting would be reduced to grazing land values, while all investment and infrastructure installed on the farms would become less useful. The immediate consequences are a reduction in existing farming and game hunting enterprises, and a likely stoppage of all planned and proposed farming development in the area. It is therefore recommended that the Corridors 2 and 3, be the preferred routes with either Deviations 1 or 2 (Proposed by the Jacobsdal farmers) to avoid irrigation farming and game hunting areas.

10. ENVIRONMENTAL IMPACT STATEMENT

It is in the view of the Environmental Assessment Practitioner (EAP) that the proposed Perseus-Kronos 756kV transmission power line and the substations upgrades are biophysically acceptable, economically and socially beneficial, particularly in the long run where future electricity demands would increase as well as maximize the purpose and need of the proposed development.

The Do Nothing alternative is considered to be undesirable as it does not meet the purpose and need of the applicant. It is not economically feasible because electricity users such as mining companies, farmers, and domestic users would be unable to avoid electricity interruptions in the long run.

The various specialists had different opinions and preferences for the alternative corridors (see sections 9.10 and 9.11). Initially, before the amendment of this report, most of the various specialists preferred Corridor 1 to be a suitable route alignment for the proposed Perseus-Kronos 765kV power line, mainly due the corridor avoiding Mokala National Park. Furthermore Corridor 1: would impact on a smaller degree of the Freestate Highveld Grassland Protected areas; would avoid traversing over Asbestos Mountain range; would have a lesser occurrence of the protected trees (Sheppard's tree and Camel Thorn); traverses the least amount of wetlands and drainage lines; and would have a less significant visual impact on tourists and residents as compared to the other alternatives corridors.

The main reason for the amendment of this report was to include new deviations to the preferred Corridor 1, to accommodate the technical feasibilities during construction phase. Reasons for the deviations routes are as follows:

- Deviation 1A: The initial Corridor 1 at this particular area was too congested. The new deviation avoids two major line crossings and it is directed to the available bay at Perseus Substation.
- Deviation 1B: The deviation avoids houses, a ridge, a few irrigation center pivots, a major cell tower, an extra strain tower and is further away from the river.
- Deviation 1C: Initially this deviation was named Deviation 1A (prior to amendment of this report). The reasons for the deviation were to avoid the Mokala National Park and the park's future expansion areas. Eskom further added a few smaller deviations to it to avoid major game farms, irrigation center pivots and salt mines/pans.
- Deviation 1D: The deviation avoids a river crossing, pans, soil erosion, bad terrain and reduces the line distance.

It is therefore in the opinion of the EAP, that the recommended route be Corridor 1 with Deviation 1A, 1B, 1C and 1D, to avoid the above mentioned obstacles and environmentally sensitive features. The new deviations also avoid areas of concern by landowners (centre pivots and hunting area). In particular, Deviation 1A was found to be moderately visually impacting on battle field sites at Roodelaagte and Belmont. Hence ground-truthing for final tower positions would be required to consider low visual impacts on the battle fields. Comments from SAHRA would also be required.

The Avifauna's first option would be recycling or upgrading existing 400kV lines (running from Kronos-Hydra-Perseus) However, this suggested exercise is disregarded as a feasible alternative as it is not part of the Cape Corridor Strengthening Phase 5 Grid Plan (see Need and Desirability Section 1.1.1.). Moreover, Phase 5 aims to create an alternative power corridor into the Western Cape should there be problems along the main spine via De Aar as well as to evacuate renewable power generated by solar and wind farms located in the Northern and Western Cape.

Localised sensitivities are to be expected along all the route corridors such as: e.g. occurrence of threatened plant species; occurrence of irrigated areas; and traversing through wetland and riparian areas. This study was broadly scaled and Corridor 1 should be ground-truthed, and be allowed to deviate to accommodate the conservation of such local environmental sensitive areas.

10.1 RECOMMENDATIONS

It is recommended that the proposed transmission line be constructed along **Corridor 1 with Deviation 1A, 1B, 1C and 1D** to avoid obstacles towards technical feasibilities as well as to avoid environmentally sensitive areas.

In this regard it is fundamental that the Environmental Management Programme and all other mitigatory measures in this Environmental Impact Report be instituted during all phases of the proposed project. The following recommendations must form part of the conditions of approval:

- Erect Construction camps and towers some distance from the boundary of ecologically sensitive areas, such as mountainous areas, koppies, wetlands; drainage lines; and agricultural irrigation areas.

- Where Important Bird Areas cannot be avoided, power lines should be marked with anti-collision marking devices according to Eskom Transmission guidelines and particularly at the section emphasized by the Avifauna Specialist.

- Clear all alien species identified by the vegetation specialist in the area within the footprint of the proposed development.

- No natural watercourses, boreholes or dams should be disturbed by the development with a 50m buffer zone (marked during the construction phase) allowed for between the edge of any of the above mentioned features.

- Landowners in close proximity to the proposed power line route must be notified of any construction activities that may lead to disruption of their day to day activities or services such as access routes. The contractors and engineers should ensure that any grievances from the local community are remedied as soon as possible.

- Areas that are not part of the site development plan should be marked as no-go zones.

- Although not expected, the process of negotiating compensation in respect to the loss of any infrastructure or resources along the route must commence prior to construction taking place.

- Unskilled labour should be sourced from local communities to assist in local economic development initiatives.

- Although a Heritage Impact Assessment has already been conducted and no sensitive heritage features were identified, work must cease and SAHRA must be contacted should any heritage and cultural resources be identified during construction and earthmoving activities, this includes grave sites.

The Draft Environmental Management Programme (EMPr) provided in **Appendix L** should be approved as part of the Environmental Authorisation and be strictly adhered to during the construction and operational phase of the proposed 765kV transmission power line and substations upgrade to ensure that activities are environmentally sound.

A suitably qualified independent Environmental Control Officer (ECO) must be appointed to guide the contractor through the construction phase and ensure compliance with the EMPr and the conditions of Environmental Authorisation.

All parties involved in the construction and ongoing maintenance of the power line (including contractors, engineers, and administrators) are, in terms of NEMA's "Duty of Care" and "Remediation of Damage" principals (Section 28), required to prevent any pollution or degradation of the environment, be responsible for preventing impacts occurring, continuing or recurring and for the costs of repair of the environment. Removal of alien invasive plants with specific follow-up control measures, and reclamation and management of soil erosion along the proposed construction route alignment is an ongoing requirement in terms of national legislation.

11. CONCLUSION

Mokgope Consulting was appointed by Eskom to conduct the EIA for the proposed construction of the Perseus-Kronos 765kV transmission power line and substations upgrades. The new power line would ensure a more reliable electricity supply to users in the Northern Cape and Free State Provinces. In addition, more reliable electricity supply is highly likely to confer operating and economic benefits to a variety of industries in the regions.

In the Scoping and EIA phase, three alternative corridors were considered. The preferred route was weighed to be Corridor 1 with Deviation 1C. In July 2015, after the Environmental Impact Report was drafted, Eskom proposed deviations to Corridor 1. The deviations were necessary to avoid the Mokala National Park future expansion areas, major game farms, irrigation center-pivots, salt mines/pans, other ecological features and existing infrastructure. This report was thus amended with the consideration of the new deviations.

In this amended Environmental Impact Report (EIR) phase, Corridor 1 with Deviations 1A, 1B, 1C and 1D, have been determined after considering technical feasibilities, the lowest environmental and social, and financial costs.

I&APs were continuously identified and would be contacted and notified of the project through site notices and written notices (posted and e-mailed). Notice of the project was published on the relevant regional and local newspapers. The Amended Draft EIR will be circulated to stakeholders and registered interested and affected landowners. The Amended Draft EIR would be on Mokgope website. Notification of the availability of the report would be published in local newspapers.

All comments and issues raised by I&APs and stakeholders have been recorded and considered by the EAP when recommending a final decision during the EIA phase. The final built decision by Eskom on the proposed transmission power line and substations upgrade will be made after the Department of Environmental Affairs has granted authorisation and any appeals lodged have been successfully dealt with.

In general, specialist assessments that have been undertaken in the EIA phase have not found any significant detrimental environmental issues that can be caused by the proposed development, apart from the Avifauna's findings that state that Corridor 2 and 3 would be fatal flaws towards avifauna in the study area.

Negotiations will need to take place between Eskom and landowners whose properties would be traversed by the proposed transmission power line.

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APPENDIX A

APPLICATION FORM AND

DECLARATION OF INDEPENDENCE FROM CONSULTANT

APPENDIX B

EAPS, SPECIALISTS CVS AND OR COMPANY PROFILES

APPENDIX C

LOCALITY MAP

APPENDIX D

BACKGROUND INFORMATION DOCUMENT (BID)

APPENDIX E

SITE INSPECTION PHOTOGRAPHS

APPENDIX F

INTERESTED AND AFFECTED PARTY REGISTER

APPENDIX G

SITE NOTICE PHOTOGRAPHS

APPENDIX H

NEWSPAPER ADVERTISEMENTS

APPENDIX I

MINUTES AND ATTENDANCE REGISTERS

APPENDIX J

COMMENTS AND RESPONSE REPORTS

APPENDIX K

TRANSMISSION VEGETATION MANAGEMENT GUIDELINE

APPENDIX L

ENVIRONMENTAL MANAGEMENT PROGRAMME

APPENDIX M

SPECIALIST REPORTS

1. **VEGETATION REPORT**
2. **FAUNA REPORT**
3. **AVIFAUNA REPORT**
4. **WETLAND REPORT**
5. **AGRICULTURE REPORT**
6. **VISUAL REPORT**
7. **HERITAGE REPORT**
8. **ECOTOURISM REPORT**
9. **SOCIO-ECONOMIC REPORTS**