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Proposed Mookodi-Mahikeng 400kV Powerline, North West Province

Terrestrial Ecological Impact Assessment Report

June 2018

Draft

Prepared for: Eskom Holdings SOC Limited

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Title and Approval Page

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Executive Summary

Introduction and Background

The North West Province sources its generation supply from Matimba and Grootvlei power stations, as well as from the Apollo DC converter station. Within the province, the two Customer Load Centres (CLSs) are Rustenburg and Carletonville. The Carletonville CLC consists of Hermes, Pluto, Midas, Watershed substations as well as the newly-built Mookodi substation. However, the existing Watershed substation is currently un-firm and has insufficient capacity to support the forecasted load in the area, which includes Lichtenburg and extends to Mahikeng town. There is also anticipated load growth in the Mafikeng area indicating a need for further enhancement of capacity in the area.

Hence there is a need for further network expansion through establishing a new transmission substation in Mahikeng. There are several projects underway to alleviate the constraint problems and this is referred to as the Watershed Strengthening Scheme. As part of establishing the site for the proposed Mahikeng substation, Mahikeng substation will be designed with an end state of 3x 500MVA 400/132kV transformers and install 2x 500MVA 400/132kV transformers initially. A 1x 160km Pluto – Mahikeng 400kV line will also be established. These two project components are currently undergoing a separate Environmental Impact Assessment (EIA) Process. The EIA Process for this project is for the proposed approximately 180km Mookodi - Mahikeng 400kV Powerline project.

Nemai Consulting (Pty) Ltd was appointed by Eskom Holdings SOC Limited to conduct the EIA for the proposed development Mookodi-Mahikeng 400kV Powerline. A Terrestrial Ecological Assessment was undertaken as part of the EIA Process in order to assess the impacts that the proposed development will have on the receiving environment. The objective of this study was to identify sensitive species and their habitats along the proposed development routes. The current ecological status and conservation priority of vegetation on the sites were assessed. Potential faunal habitats were also investigated in the study area and all mammals, reptiles and amphibians known to occur along the routes or seen were recorded. Red Data species (both fauna and flora) that are known to occur on site were investigated.

Study Area

The proposed project falls within the jurisdiction of the Naledi Local Municipality (LM), Kagisano-Molopo LM, Ratlou LM, and Mahikeng LM in the North West Province. Four alternative routes have been considered for the EIA Process, namely:

- Option 1 (WM1);
- Option 2 (WM13);
- Option 3 (WM4a); and
- Option 4 (WM9a)

The proposed route alternatives for the powerline start in Vryburg at the existing Mookodi substation, and travel in a north-east direction where the line ends near Mahikeng at the proposed Mahikeng substation site.

Regional Vegetation

The proposed Mookodi-Mahikeng 400kV Powerline route alternatives fall within the Savanna biome (SANBI, 2012). However, a very small section of Alternative Route Option 2 (WM13) also falls within the Grassland biome. The Savanna Biome is the largest Biome in South Africa and occupies over one third of the whole area. It is characterized by a grassy ground layer and distinct upper layer of woody plants. The Grassland biome has a high biodiversity, ranked only below the Fynbos biome in terms of biodiversity in South Africa. This Biome is found mainly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. Grasslands are dominated by a single layer of grasses. Trees are absent, except in a few localised habitats and geophytes are often abundant. The study area is classified as falling within the following vegetation types: Ghaap Plateau Vaalbosveld (Savanna biome), Stella Bushveld (Savanna biome), Mafikeng Bushveld (Savanna biome) and very small portions of Western Highveld Sandy Grassland (Grassland biome) and Southern Kalahari Salt Pans (Azonal vegetation).

Terrestrial Threatened Ecosystems

The proposed powerline route alternatives fall within the Mafikeng Bushveld (Vulnerable), with a very small section of Alternative Route Option 2 (WM13) falling within the Western Highveld Sandy Grassland (Critically Endangered).

North West Biodiversity Sector Plan

Critical Biodiversity Areas (CBAs) are areas that are important for conserving biodiversity while Ecological Support Areas (ESAs) are areas that are important to ensure the long term persistence of species or functioning of other important ecosystems. Degradation of CBAs or ESAs could potentially result in the loss of important biodiversity features and/or their supporting ecosystems. The map of CBAs includes five categories: Protected Areas, CBAs, ESAs, Other Natural Areas and Areas with no natural habitat remaining. The proposed Mookodi-Mahikeng 400kV Powerline route alternatives fall within CBA2, ESA1 and ESA2. No CBA1 regions occur along the proposed route alternatives.

Protected Areas

Small sections of the corridor (± 3km in length) of the two route alternatives (*i.e* Option 1 (WM1) and Option 3 (WM4a)) of the proposed Mookodi-Mahikeng 400kV Powerline fall within a Municipal Reserve, namely the Leon Taljaard Nature Reserve. This Nature reserve contains animal species such as White Rhino, Eland, Buffalo, Black and Blue Wildebeest, Waterbuck, Burchell Zebra, Springbok and Impala. The proposed Option 4 will traverse the Makgoro Game Ranch, which has animal species such as Buffalo, Zebra, Impala, Giraffe, Sable, etc.

Methodology

Survey methodology included a comprehensive desktop review, utilising available provincial ecological data, relevant literature, GIS databases, topographical maps and aerial photography. This was then supplemented through a ground-truthing phase, where pertinent areas associated with the various route alternatives were visited during field surveys undertaken during 03 to 06 April 2018. The survey focused on flora (vegetation) and fauna (mammals, reptiles and amphibians). Several Orange Listed floral and Red Data faunal species pertaining to the survey routes were identified during the desktop review. Habitat suitability was assessed through the ground-truthing phase of the surveys.

Results and Discussion - Flora

During the field survey, no threatened plant species were observed along the proposed route alternatives; however, two (2) species of conservation concern (Orange Listed Plants) (listed as *Declining)* were found, namely *Vachellia erioloba (= Acacia erioloba)* (known as Camel Thorn) and *Boophane disticha* (known as Century Plant). These plant species were recorded along the four alternative routes. It is recommended that prior to construction, the *Boophane disticha* plant species recorded must be searched and rescued and then following construction activities, they can be re-established at the site or along the route.

Vachellia (Acacia) erioloba (Camel Thorn), which is listed as a protected tree in terms of the National Forests Act (Act No. 84 of 1998), were recorded in abundance along the four route alternatives. In terms of a part of section 51(1) of the National Forests Act (Act No. 84 of 1998), no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister of Department of Agriculture, Forestry and Fisheries (DAFF).

The major concerns on site are alien invasives, weeds and potential invasives. Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring programme to control and/or eradicate newly emerging invasives. The rehabilitation of disturbed areas should receive high priority and must be included in the EMPr and recommendations regarding the specific plant species used during rehabilitation should be site specific and based on the surrounding vegetation composition.

Results and Discussion - Fauna

Historically, the study area could have provided habitat for a diverse population of larger mammal species, but the agricultural activities and human settlements, associated with hunting activities, have transformed the majority of the habitats and due to these anthropogenic disturbances, it is likely that only the more common and smaller mammal species will be observed, which show more adaptation. However, remnants of natural vegetation still exist and these remnants areas are suitable for survival of the mammals species recorded along the routes. The agricultural fields were largely devoid of mammal species; however Meerkat dens were present on the edges of agricultural fields. Domestic animals such as cattle, sheep, donkeys and horses were noted in abundance along the routes. The riparian vegetation and natural grasslands between agricultural fields are utilised significantly as a movement and linkage corridor within the study area. These areas also provide ideal foraging and breeding habitat for a number of mammal species. Grassland habitats are utilised by a range of faunal species, particularly if there is some form of topographical change within the grassland. Although the grassland along the routes is disturbed as a result of overgrazing and human settlements, it may still supply habitat for small mammals and reptile species. Mammal species such as Gemsbok, Springbok, Blesbok, Sable, Greater Kudu, Blue Wildebeest, Nyala, Common Warthog, Common Eland, Red Hartebeest, Waterbuck, Impala, Common Tsessebe, Burchell's Zebra, African Buffalo, White Rhinoceros and a Camel were either recorded in the Leon Taljaard Nature Reserve, Makgoro Game Ranch or Boereplaas Holiday Resort Resort.

A separate Avifauna Study has been undertaken to assess the impact of the proposed powerline development on avifauna.

The reptile assessment indicated that the rocky habitats, grasslands and riparian vegetation along the proposed route alternatives are of high importance to reptiles. Reptiles are exceptionally hard to detect during field surveys. Riverine habitats are traditionally rich in reptile diversity and concentrations due to the habitat supporting a high number of prey species, such as frogs, birds and small mammals. The majority of reptile species are sensitive to severe habitat alteration and fragmentation. Species are also very often “expelled” into riparian zones due to transformation of lands for anthropogenic disturbances such as human settlements and agricultural purposes. Termite mounds were present in abundance along the proposed development site. Old termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal species. A large number of species of mammals, birds, reptiles and amphibians feed on the emerging alates (winged termites). No termite mounds were destroyed during the brief field survey. All overturned rock material was carefully replaced in its original position.

During the field surveys, no Red Data reptile species were noted. The main potential impact of the proposed powerline development on reptile species is probable to be habitat loss or degradation. Nevertheless, in the long-term, effects on reptile species are probable to be comparatively low as the extent of habitat loss would be low and the majority of the powerline servitude would still be available for use by most reptile species. Habitat destruction should be limited to the absolute minimum throughout the survey area. According to the information obtained from one of the farm owners, species such as Black Mamba (*Dendroaspis polylepis*) are known to occur along the proposed route alternatives, however, according to the distribution range of this species, no such species has been recorded in or around the region.

According to the Frog Atlas of Southern African, the only species of conservation concern which could potentially be found in the study area was the Giant Bullfrog (*Pyxicephalus adspersus*), listed as *Near Threatened*. The Giant Bullfrog has been chosen as a flagship species for the grassland eco-region. Some sections of the proposed route alternatives offer suitable habitat for Giant Bullfrog to occur in the study area. The conservation of this species and of amphibians in general will be met by the protected area network as well as the designation of priority habitats *i.e.,* pans or quaternary catchments, with associated restrictions on land use.

<u>Environmental Impact Assessment</u>

An impact significance rating was assessed and all impacts were found to be significantly reduced through the implementation of mitigation measures. Impacts were noted to be rated between “medium to low” prior to mitigation, and as “low” after mitigation.

<u>Terrestrial Sensitivity</u>

A map of the sensitivity and conservation value of the different parts of the proposed route alternatives was developed showing the distribution of areas in different sensitiviity classes (low, medium and high) relative to the proposed routes. It is possible from this map to identify areas where there are possible conflicts between the alignment of the routes and areas of high sensitivity.

<u>Analysis of Alternatives</u>

Based on the terrestrial ecological sensitivity map and analysis, the four proposed route alternatives were compared to identify the route with the least impacts from a terrestrial ecological point of view. All four proposed route alternatives traverse similar habitat units, however almost 2km of the Option 2 (WM13) corridor traverses the Critically Endangered terrestrial threatened ecosystem, the Western Highveld Sandy Grassland. Option 2 (WM13), however, traverses degraded portions of threatened ecosystem habitats and is the alternative with the shortest length (175km) which would lead to less clearing of CBA regions (about 4884Ha).

Even though Option 3 is the alternative that runs along the N18 for a longer distance (approximately 28km), large sections of the CBA 2 areas will be affected (about 7823 Ha). Almost 3km of this corridor traverses sections of the Leon Taljaard Nature Reserve near Vryburg. However, the position of the final servitude can be amended to avoid the Nature Reserve. Like Option 3, the corridor of Option 1 also traverses sections of the Nature Reserve for about 3km, but more natural areas depicted as CBA 2 will be affected. Option 4 traverses the Makgoro Game Ranch, which is home to mammal species such as Buffalos and also traverses more natural areas depicted as CBA 2. Therefore Option 2 is preferred from a terrestrial ecology point of view.

Conclusion and Recommendations

All four route alternatives incorporate habitat units that would support a variety of both faunal and floral species to a greater or lesser extent and the impacts on biodiversity and habitat conservation can be successfully mitigated with the sincere efforts of the contractor and construction team. Areas exhibiting dense natural vegetation can be avoided/ spanned in order to reduce vegetation loss and also river systems must be spanned and no towers should be placed within the buffer zones dictated by the surface water studies. Powerlines do not result in large-scale clearing and suitable mitigation measures can be implemented to reduce the identified impacts.

It is therefore recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Red Data Listed species and also to develop a comprehensive and site-specific Environmental Management Programme (EMPr) so as to limit the impacts imposed by the proposed development activities at each tower site and tower locations can then be adjusted accordingly. The walk-down survey should preferably be undertaken during the summer season in order to have a higher probability of detecting species of special concern. This is relevant in the areas that have been labelled as ecologically sensitive. In order to conserve the faunal species community structures within the region, habitat destruction should be limited to an absolute minimum as intact habitat would result in higher faunal and floral species diversity. It is therefore critical that operations are limited to the required footprint only. It is recommended that the larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes.

After the conclusion of this Terrestrial Ecological Assessment, it is the opinion of the ecologist that the proposed development be considered favourably provided that the sensitivity map be considered during the planning and construction phases of the proposed development activities to aid in the conservation of ecology within the study area. Once the proposed development has been constructed, the rehabilitation process needs to take place and should ensure that alien plant emergence and erosion do not occur.

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1 INTRODUCTION AND BACKGROUND

The North West Province sources its generation supply from Matimba and Grootvlei power stations, as well as from the Apollo DC converter station. Within the province, the two Customer Load Centres (CLSs) are Rustenburg and Carletonville. The Carletonville CLC consists of Hermes, Pluto, Midas, Watershed substations as well as the newly-built Mookodi substation. However, the existing Watershed substation is currently un-firm and has insufficient capacity to support the forecasted load in the area, which includes Lichtenburg and extends to Mahikeng town. There is also anticipated load growth in the Mahikeng area indicating a need for further enhancement of capacity in the area.

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1.1 Objectives of the survey

In order to achieve the requirements of this study, the following objectives are to be noted:

- To apply relevant literature to determine the diversity and eco-status of the plants, mammals, reptiles and amphibians along the proposed route alternatives;
- To carry out field survey to gain an understanding of the diversity of taxa and eco-status of ecosystems which these species inhabit, as well as the presence of unique habitats that might require further investigation or protection;
- To assess the current conservation status of plant and animal species along the study area;
- To comment on ecological sensitive species/areas;
- To assess the possible impact of the proposed project on these taxa and/or habitats;
- To list the species on site and to recommend necessary actions in case of occurrence of endangered, vulnerable or rare species or any species of conservation importance; and

- To provide management recommendations to mitigate negative and enhance positive impacts along the proposed route alternatives.

1.2 Terms of Reference (ToR) – General

The following general ToR apply to all the EIA Specialist Studies to be undertaken:

1. Address all triggers for the specialist studies contained in the subsequent specific ToR.
2. Address issues raised by IAPs, as contained in the Comments and Response Report, and conduct an assessment of all potentially significant impacts. Additional issues that have not been identified during Scoping should also be highlighted to the Environmental Assessment Practitioner (EAP) for further investigations.
3. Ensure that the requirements of the environmental authorities that have specific jurisdiction over the various disciplines and environmental features are satisfied.
4. Approach to include desktop study and site visits, as deemed necessary, to understand the affected environment and to adequately investigate and evaluate salient issues. Indigenous knowledge (i.e. targeted consultation) should also be regarded as a potential information resource.
5. Assess the impacts (direct, indirect and cumulative) in terms of their significance (using suitable evaluation criteria) and suggest suitable mitigation measures. In accordance with the mitigation hierarchy, negative impacts should be avoided, minimised, rehabilitated (or reinstated) or compensated for (i.e. offsets), whereas positive impacts should be enhanced. A risk-averse and cautious approach should be adopted under conditions of uncertainty.
6. Consider time boundaries, including short to long-term implications of impacts for project life-cycle (i.e. pre-construction, construction, operation and decommissioning).
7. Consider spatial boundaries, including:
    - Broad context of the proposed project (i.e. beyond the boundaries of the specific site);
    - Off-site impacts; and
    - Local, regional, national or global context.
8. The provision of a statement of impact significance for each issue, which specifies whether or not a pre-determined threshold of significance (i.e. changes in effects to the environment which would change a significance rating) has been exceeded, and whether or not the impact presents a potential fatal flaw or not. This statement of significance should be provided for anticipated project impacts both before and after application of impact management actions.
9. Recommend a monitoring programme to implement mitigation measures and measure performance. List indicators to be used during monitoring.

10. Appraisal of alternatives (including the No-Go option) by identifying the Best Practicable Environmental Option (BPEO) with suitable justification.
11. Advice on the need for additional specialists to investigate specific components and the scope and extent of the information required from such studies.
12. Engage with other specialists whose studies may have bearing on your specific investigation.
13. Present findings and participate at public meetings, as necessary.
14. Information provided to the EAP needs to be signed off.
15. Review and sign off on EIA Report prior to submission to Department of Environmental Affairs (DEA) to ensure that specialist information has been interpreted and integrated correctly into the report.
16. Sign a declaration stating independence.
17. The appointed specialists must take into account the policy framework and legislation relevant to their particular studies.
18. All specialist reports must adhere to Appendix 6 of GN No. R 982 of 4 December 2014 (as amended).

1.3 Terms of Reference – Specific to Study

Summary of Key Issues & Triggers identified during Scoping:

- Potential loss of significant flora and fauna species.
- Impacts to sensitive terrestrial ecological features.
- Management actions for controlling exotic vegetation.

Approach:

- Undertake baseline survey and describe affected environment within the project footprint from a biodiversity perspective.
- Take into consideration the provincial conservation goals and targets.
- Assess the current ecological status and the conservation priority within the project footprint and adjacent area (as deemed necessary). Provide a concise description of the importance of the affected area to biodiversity in terms of pattern and process, ecosystem goods and services, as appropriate.
- Undertake sensitivity study to identify protected and conservation-worthy species. Prepare a biodiversity sensitivity map with the use of GIS, based on the findings of the study.
- Assess impacts to fauna and flora, associated with the project. Consider cause-effect-impact pathways for assessing impacts to biodiversity related to the project.

- Identify potential fatal flaws associated with the project and its alternatives from a biodiversity perspective.
- Assess impacts to surrounding Nature Reserves or Conservancies (Protected Areas) such as Leon Taljaard Nature Reserve, Barberspan Nature Reserve, Molemane Nature Reserve, Mafikeng Game Reserve and Botsalano Game Reserve.
- Comply with specific requirements and guidelines of DEA and NW READ.
- Consider the NW Biodiversity Sector Plan (2015) and other relevant policies, strategies, plans and programmes.

NOTE: See a separate avifaunal report conducted by Mathew Ross.

1.4 Declaration

I, Avhafarei Phamphe, declare that I –

- act as an independent specialist consultant in the fields of Biodiversity (Fauna and Flora) for the Biodiversity Impact Assessment Report for the Mookodi Integration Project;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

Avhafarei Phamphe
Flora and Fauna Specialist
Nemai Consulting

2 RELEVANT LEGISLATION AND GUIDELINES

The following legislation are relevant to this project:

- The Constitution, 1996 (Act No. 108 of 1996) – Section 24;

- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- National Forests Act, 1998 (Act No. 84 of 1998);
- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004);
- Eskom Standard Vegetation Management and Maintenance within Eskom Land, Servitudes and Rights of Way (240-70172585) and
- North West Biodiversity Sector Plan (2015).

3 STUDY AREA

The proposed project is situated within the Naledi Local Municipality (LM), Kagisano-Molopo LM, Ratlou LM, and Mahikeng LM in the North West Province (**Figures 1** and **2**). The proposed alternative routes for the line start in Vryburg at the existing Mookodi substation and travel in a north-east direction where the line ends near Mahikeng at the proposed Mahikeng substation site (**Figures 3** and **4**).

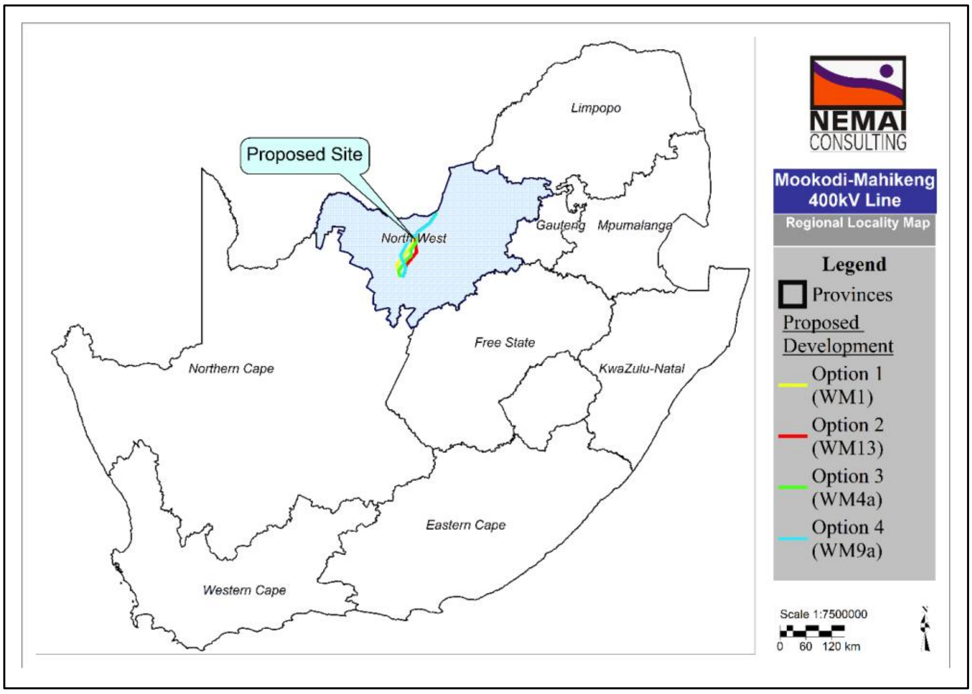

Figure 1. Regional locality map

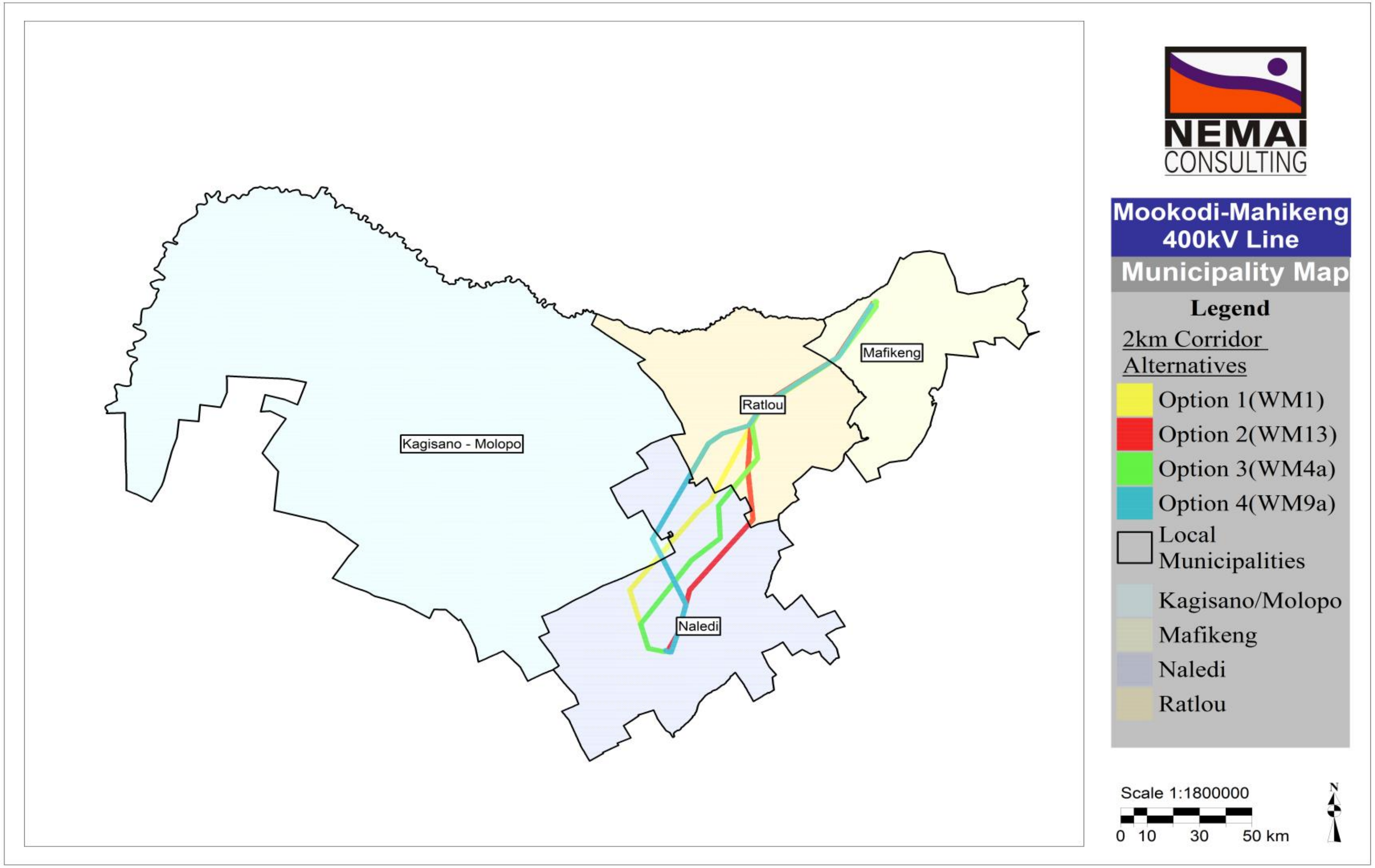

Figure 2. Municipality map

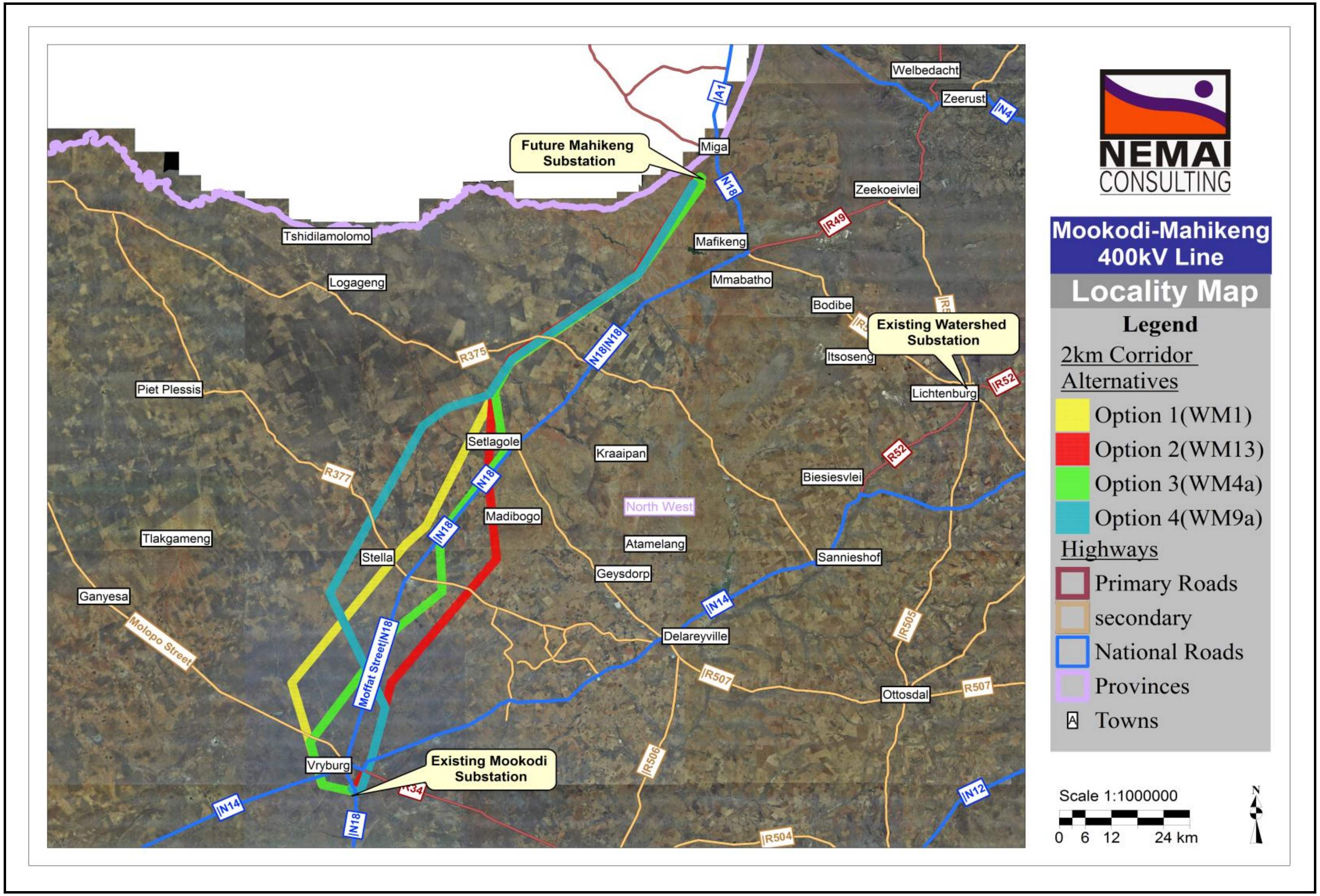

Figure 3. Locality map of the study area

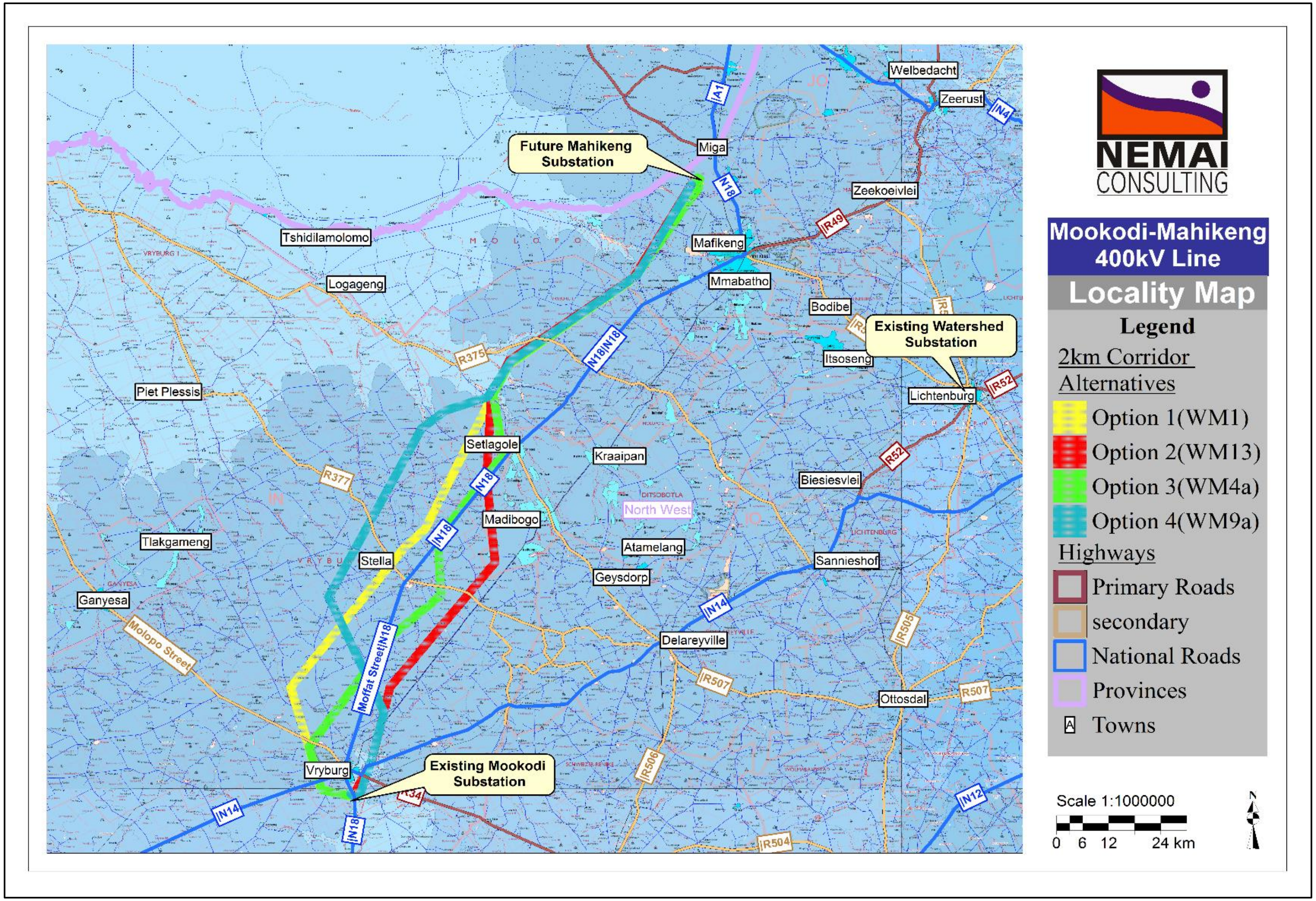

Figure 4. 1 in 250 000 Topographical map of the study area

3.1 Route Alternatives

3.1.1 Option 1 (WM1)

Route Alternative Option 1 (WM1) is approximately 186km in length, and travels in a northwest direction from the starting point at Mookodi substation in Vryburg, where it then travels in a northeast direction passing on the western side of Stella, and runs parallel to the western side of the N18. This route involves major road crossings of the N14, R378 (also known as Molopo Street), R377, R376 and R375. All route alternatives then join and overlap the same footprint between the R376 and R375 road crossing where they run in a northeast direction to end in Mahikeng, at the proposed future substation site. Refer to **Figure 5**.

3.1.2 Option 2 (WM13)

Route Alternative Option 2 (WM13) is approximately 176km in length, and travels in a northeast direction from the starting point at Mookodi substation in Vryburg, passing on the eastern side of Stella. This route runs on the eastern side of the N18 where it then crosses the N18 about half way of the route and then runs on the western side of the N18. This route involves major road crossings of the N18, R34, N14, R377, R376 and R375. All route alternatives join and overlap the same footprint between the R376 and R375 road crossing where they run in a northeast direction to end in Mahikeng at the future substation site. Refer to **Figure 6**.

3.1.3 Option 3 (WM4a)

Route Alternative Option 3 (WM4a) is approximately 187km in length, and travels in a northwest direction from the starting point at Mookodi substation in Vryburg, where it then heads in a northeast direction passing on the eastern side of Stella. This route runs parallel for a small section to the western side of the N18, where it then crosses the N18 and runs on the eastern side of the N18, where it then crosses the N18 again to run back on the western side of the N18. This route involves major road crossings of the N14, R378, N18, R377, R376 and R375. All route alternatives join and overlap the same footprint between the R376 and R375 road crossing where they run in a northeast direction to end in Mahikeng at the future substation site. Refer to **Figure 7**.

3.1.4 Option 4 (WM9a)

Route Alternative Option 4 (WM9a) is approximately 185km in length, and travels in a northeast direction from the starting point at Mookodi substation in Vryburg. This route then travels in a northwest direction where it crosses the N18. This route then runs parallel to the N18 passing on the western side of Stella. This route involves major road crossings of the N18, R34, N14, R377, R376 and R375. All route alternatives join and overlap the same footprint between the R376 and R375 road crossing where they run in a northeast direction to end in Mahikeng at the future substation site. Refer to **Figure 8**.

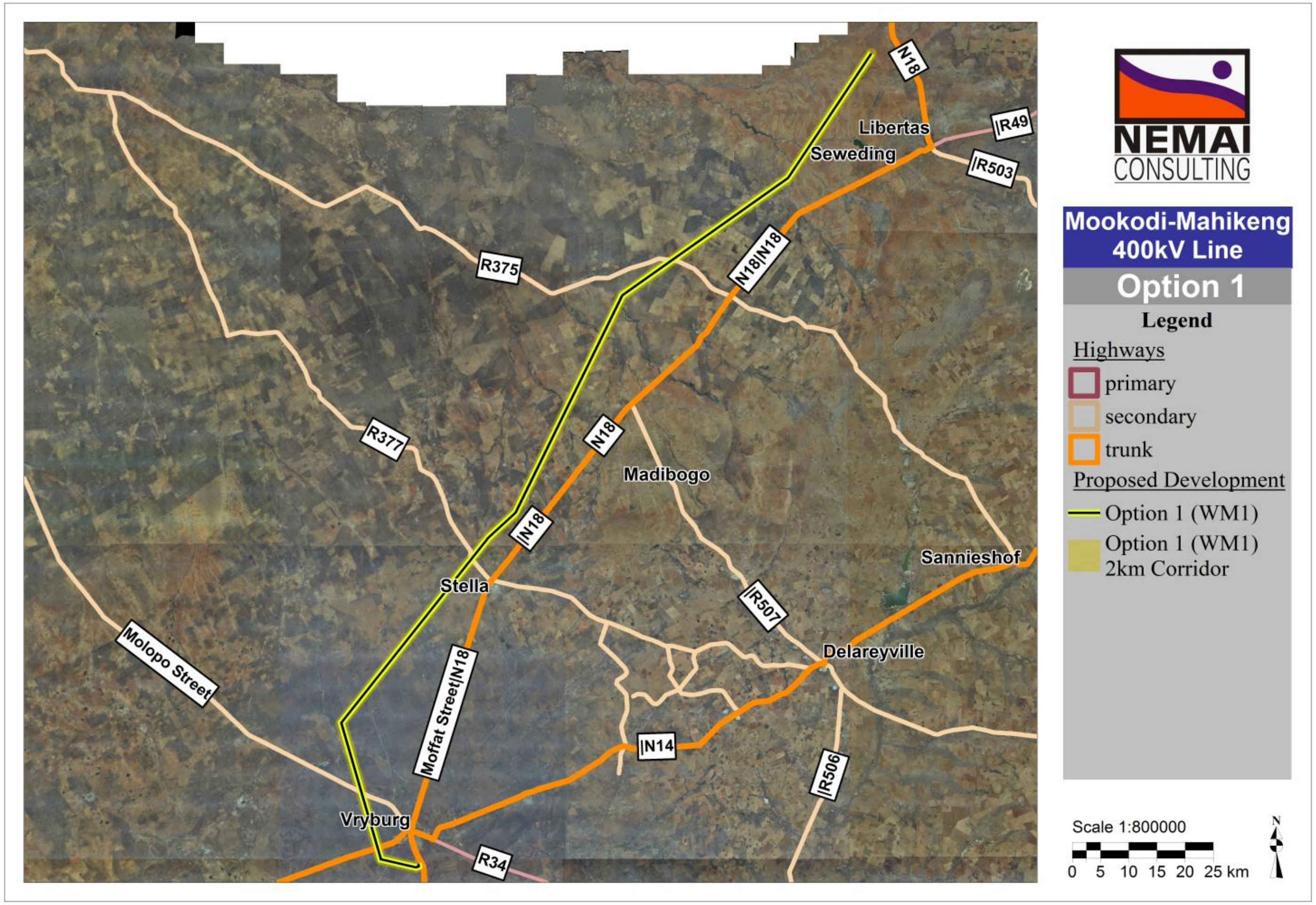

Figure 5. Route Alternative Option 1 (WM1)

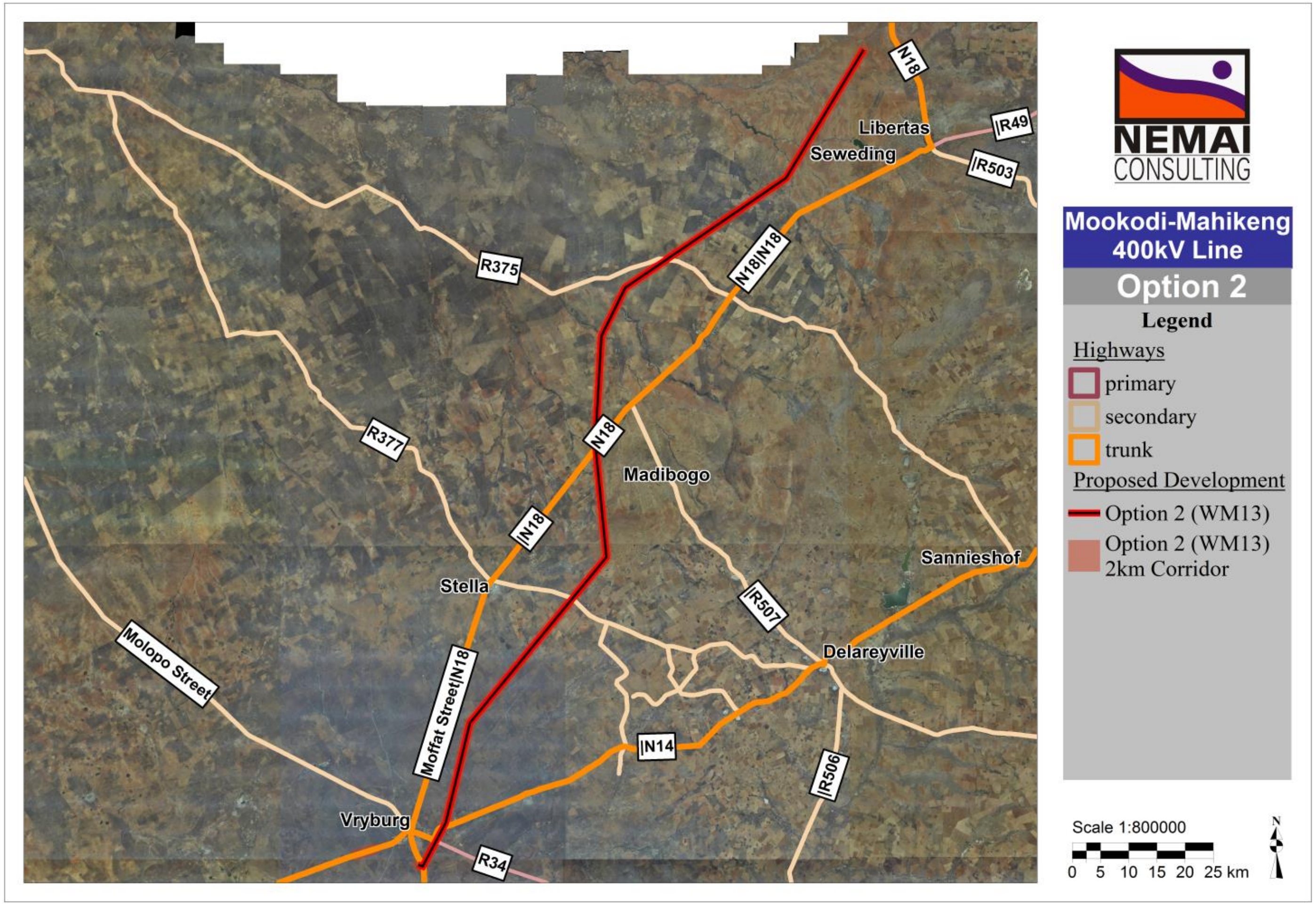

Figure 6. Route Alternative Option 2 (WM13)

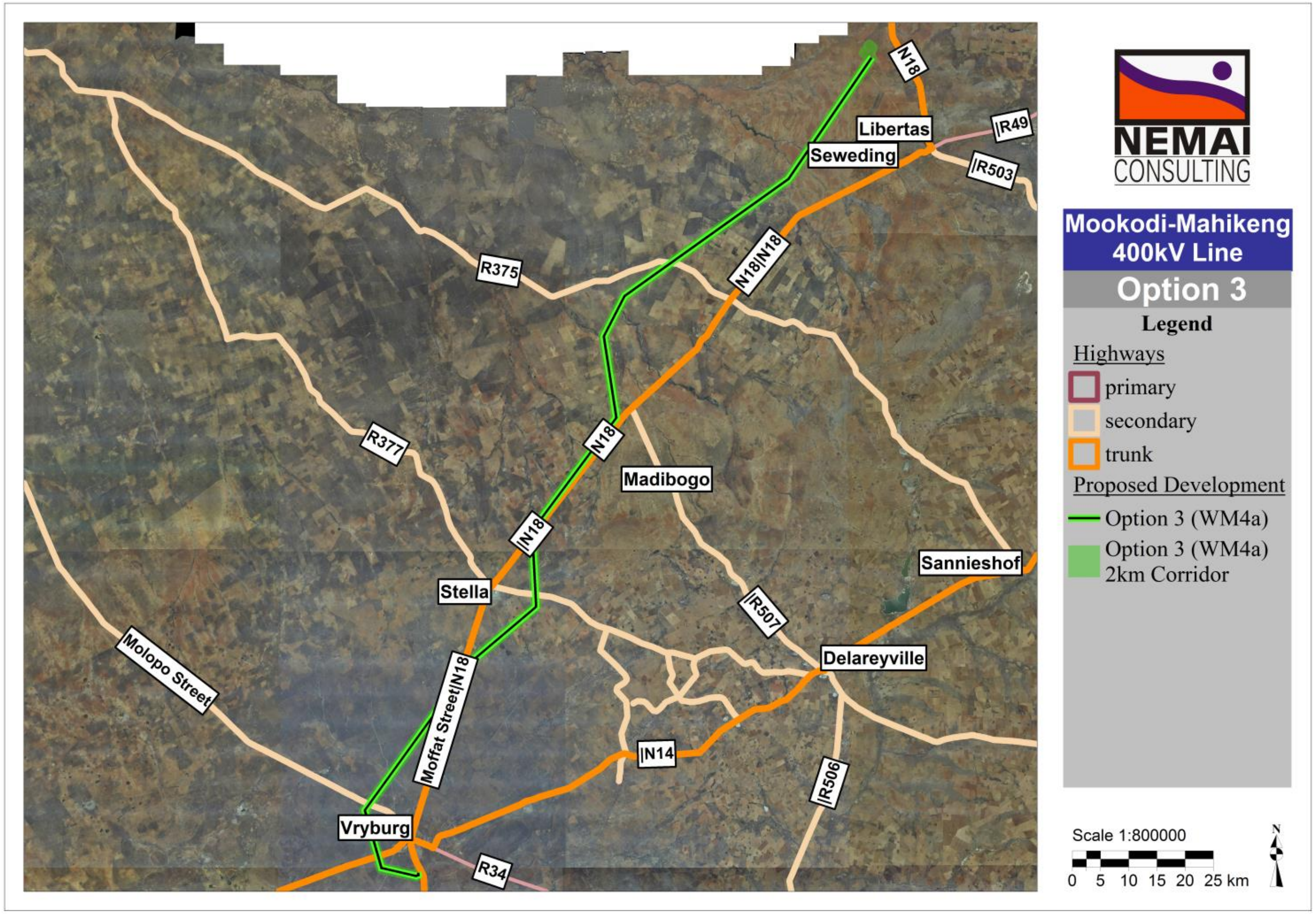

Figure 7. Route Alternative Option 3 (WM4a)

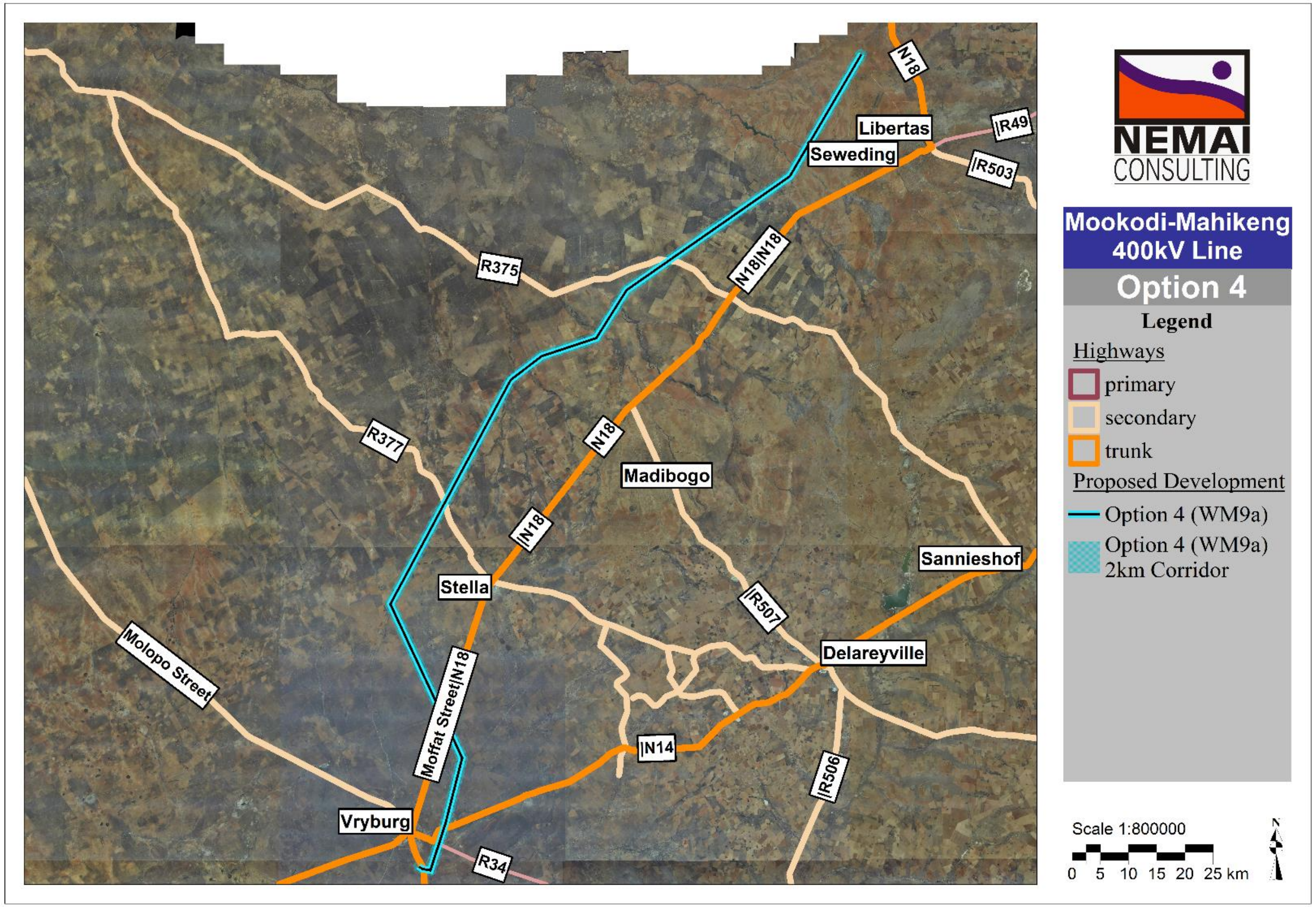

Figure 8. Route Alternative Option 4 (WM9a)

4 LIMITATIONS AND GAPS

The constraints or limitations to the survey included:

- Given the magnitude of the project and the various extent of ervens and portions of farms in the area, some farms/areas were not easily accessible. However, detailed walk down surveys once the tower locations are final will be required to reduce impacts identified in this report;
- Late wet season surveys were undertaken from 3-6 April 2018, which fall within an optimal time of the season to find sensitive plant and animal species of high conservation priority. Weather conditions during the surveys were favourable for recording both fauna and flora.
- A separate Avifauna study was compiled by Mathew Ross for this EIA Process.
- Fauna species directly or indirectly observed during the site visits were augmented with those that are likely to occur in the area based on their distribution and habitat preferences; and
- Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and Nemai Consulting can thus not accept responsibility for conclusions and mitigation measures made in good faith based on information gathered or databases consulted at the time of the investigation. Detailed walk-down surveys once the tower locations are finalised will be required in order to reduce impacts identified in this report.

5 REGIONAL VEGETATION

The proposed Mookodi-Mahikeng 400kV Powerline route alternatives fall within the Savanna biome and Azonal Vegetation (SANBI, 2012). However, a very small section of Alternative Route Option 2 (WM13) also falls within the Grassland biome (**Figure 9**). The Savanna Biome is the largest Biome in South Africa and occupies over one third of the whole area. It is characterized by a grassy ground layer and distinct upper layer of woody plants. The Grassland biome has a high biodiversity, ranked only below the Fynbos biome in terms of biodiversity in South Africa (Driver *et al*. 2004). This Biome is found mainly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. Grasslands are dominated by a single layer of grasses. Trees are absent, except in a few localised habitats and geophytes are often abundant (Low and Rebelo, 1996). SANBI (2012) classified the study area as falling within the following vegetation types: Ghaap Plateau Vaalbosveld (Savanna biome), Stella Bushveld (Savanna biome), Mafikeng Bushveld (Savanna biome) and very small portions of Western Highveld Sandy Grassland (Grassland biome) and Southern Kalahari Salt Pans (Azonal vegetation) (**Figure 10**).

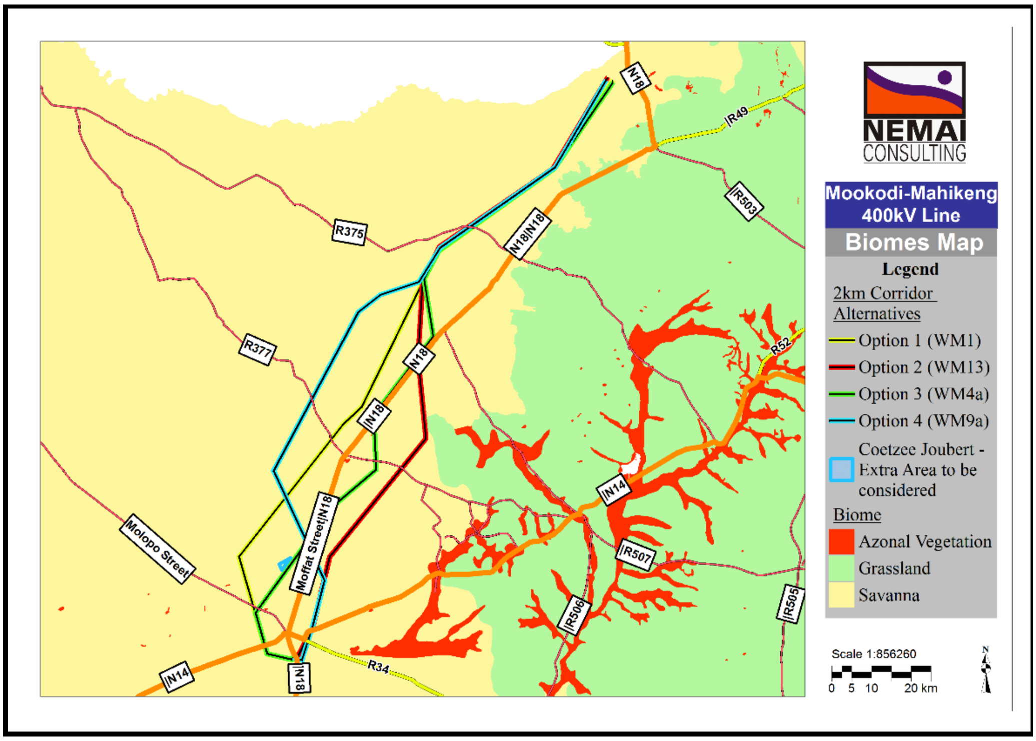

Figure 9. Biomes in relation to the project area

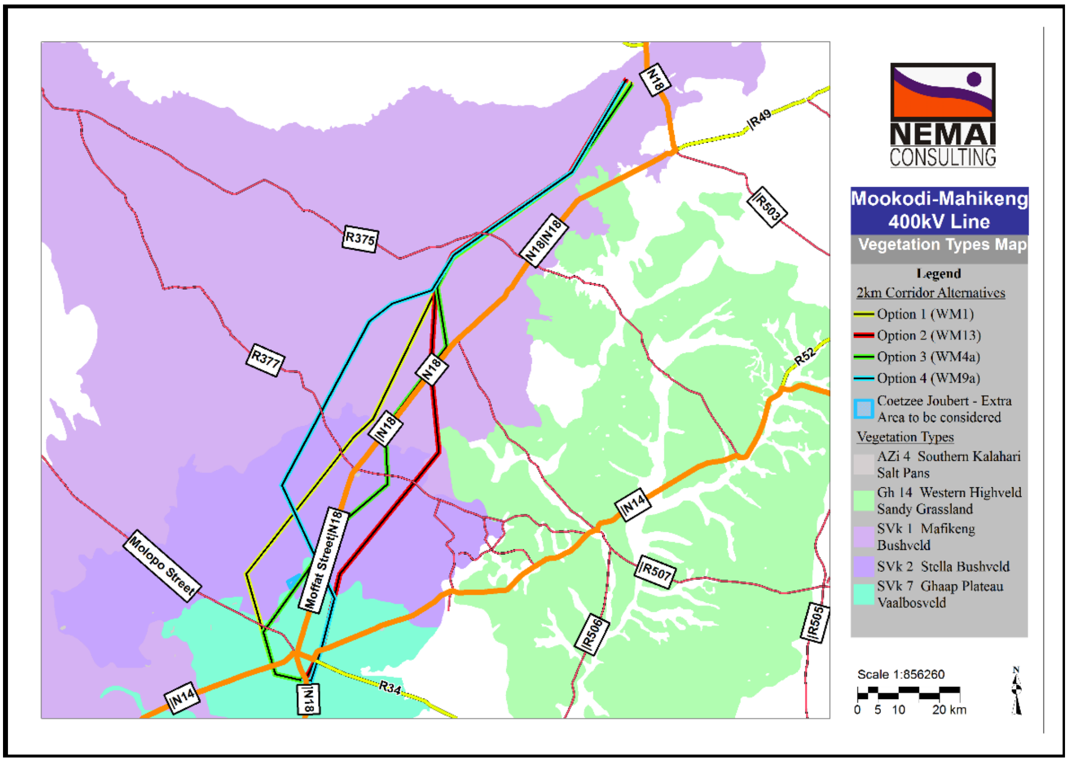

Figure 10. Vegetation types in relation to the project area

The description of the vegetation types follows below:

5.1 Ghaap Plateau Vaalbosveld

This vegetation type is found in Northern Cape and North-West Provinces. It occurs in flat plateau from around Campbell in the south, east of Danielskuil through Reivilo to around Vryburg in the north. It is listed as *Least threatened*, with a national target of 16%. None of this vegetation type is conserved in statutory conservation areas. Only about 1% is already transformed (Mucina and Rutherford, 2006).

5.2 Stella Bushveld

This vegetation type is found in North-West Province. It occurs in North of Vryburg around Stella westwards to Louwna and eastwards to about 20 km west of Delareyville. It is listed as *Vulnerable*, with a national conservation target of 16%. None of this vegetation type is conserved in statutory conservation areas. Some 21% is transformed, almost all by cultivation (Mucina and Rutherford, 2006).

5.3 Mafikeng Bushveld

This vegetation type is found in North-West Province. It occurs West of Mafikeng and south of the Botswana border westwards to around Vergeleë, southwards to Piet Plessis and Setlagole. It is listed as *Vulnerable*, with a national conservation target of 16%. None of this vegetation type is conserved in statutory conservation areas but very small area conserved in the Mmabatho Recreation Area. About 25% is already transformed, mainly for cultivation and urban development (Mucina and Rutherford, 2006).

5.4 Western Highveld Sandy Grassland

This vegetation type is found in North-West Province. It is found in Mafikeng to Schweizer-Reneke in the south and from Broedersput and Kameel in the west to Lichtenburg and Ottosdal in the east. It is listed as *Endangered*, with a national conservation target of 24%. Only a very small portion is statutorily conserved (Barberspan Nature Reserve). More than 60% has been ploughed. Non-arable parts are on shallow aeolian soils which become easily over utilised through grazing. About 95% of this land is suitable for cultivation, but the low rainfall makes it a high-risk area for agriculture. Therefore the natural vegetation is often restricted to non-arable bush clumps, shallow soils, aeolian sands and pans (Mucina and Rutherford, 2006).

5.5 Southern Kalahari Salt Pans

This vegetation type is found in Northern Cape and North-West Provinces and neighbouring Kalahari regions of Botswana and Namibia. It is found in a system of endorheic, closed depressions (pans) in the southern. The largest concentrations of such pans in South Africa are found near Groot-Mier in western Gordonia. It is listed as *Least threatened*, with a national conservation target of 24%. About 8% is statutorily conserved in the Kgalagadi Transfrontier Park. The vegetation of the pans is subject to natural degradation/regeneration cycles controlled by concentration of grazing animals (antelopes in particular) (Mucina and Rutherford, 2006).

6 TERRESTRIAL THREATENED ECOSYSTEMS

The South African National Biodiversity Institute (SANBI), in conjunction with the Department of Environmental Affairs (DEA), released a draft report in 2009 entitled “Threatened Ecosystems in South Africa: Descriptions and Maps”, to provide background information on the above List of Threatened Ecosystems (SANBI, 2009). The purpose of this report was to present a detailed description of each of South Africa’s ecosystems and to determine their status using a credible and practical set of criteria. The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat;
- Ecosystem degradation and loss of integrity;
- Limited extent and imminent threat;
- Threatened plant species associations;
- Threatened animal species associations; and
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan.

In terms of section 52(1) (a), of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011 (Government Notice 1002) (Driver et al. 2004). The list classified all threatened or protected ecosystems in South Africa in terms of four categories; Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Protected. The purpose of categorising these ecosystems is to prioritise conservation areas in order to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that Threatened Ecosystems make up 9.5% of South Africa, with critically endangered and endangered ecosystems accounting for 2.7%, and vulnerable ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive conservation and planning tools, such as Biodiversity Sector Plans, municipal Strategic Environmental Assessments (SEAs) and Environmental Management Frameworks (EMFs), EIAs and other environmental applications (Mucina *et al*. 2006).

The proposed Mookodi-Mahikeng 400kV powerline route alternatives fall within the Mafikeng Bushveld (Vulnerable), with a very small section of Alternative Route Option 2 (WM13) falling within the Western Highveld Sandy Grassland (Critically Endangered) (**Figure 11**).

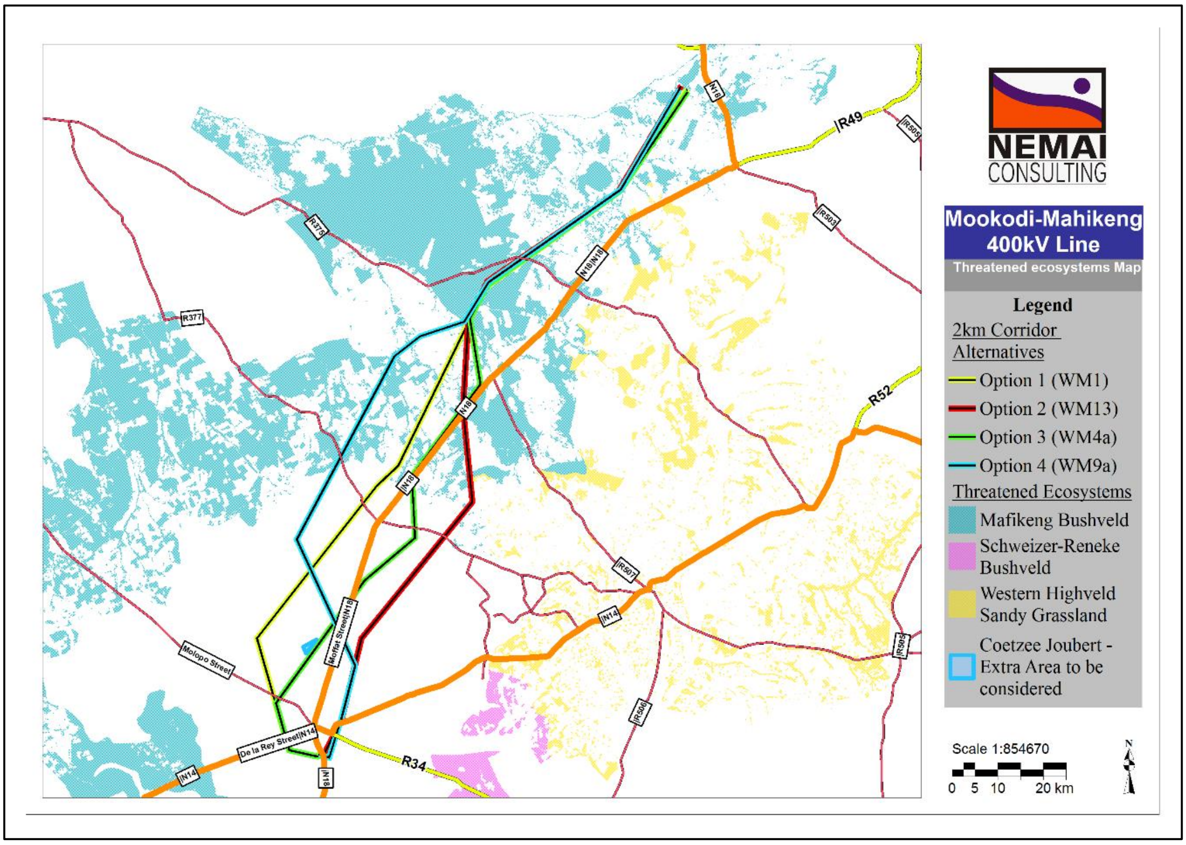

Figure 11. Terrestrial threatened ecosystems in relation to the project area

7 NORTH WEST BIODIVERSITY SECTOR PLAN

The North West Province's biodiversity provides an important basis for economic growth and development, in ways such as providing rangelands that support commercial and subsistence farming, horticulture and agriculture industry based on indigenous species, tourism industry, aspects of film industry, commercial and non-commercial medicinal applications of indigenous resources, and provision of clean water.

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (Anon, 2008). The primary purpose of CBA's is to inform land-use planning and the land-use guidelines attached to CBA's aim to promote sustainable development by avoiding loss or degradation of important natural habitat and landscapes in these areas and the landscape as a whole. CBA's can also be used to inform protected area expansion and development plans. The use of CBA's here follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008):

- CBAs are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.
- Ecological support areas (ESAs) are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

The map of CBAs includes five categories: Protected Areas, CBAs, ESAs, Other Natural Areas and Areas with no natural habitat remaining. The proposed Mookodi-Mahikeng 400kV Powerline route alternatives fall within CBA2, ESA1 and ESA2 (**Figure 12**).

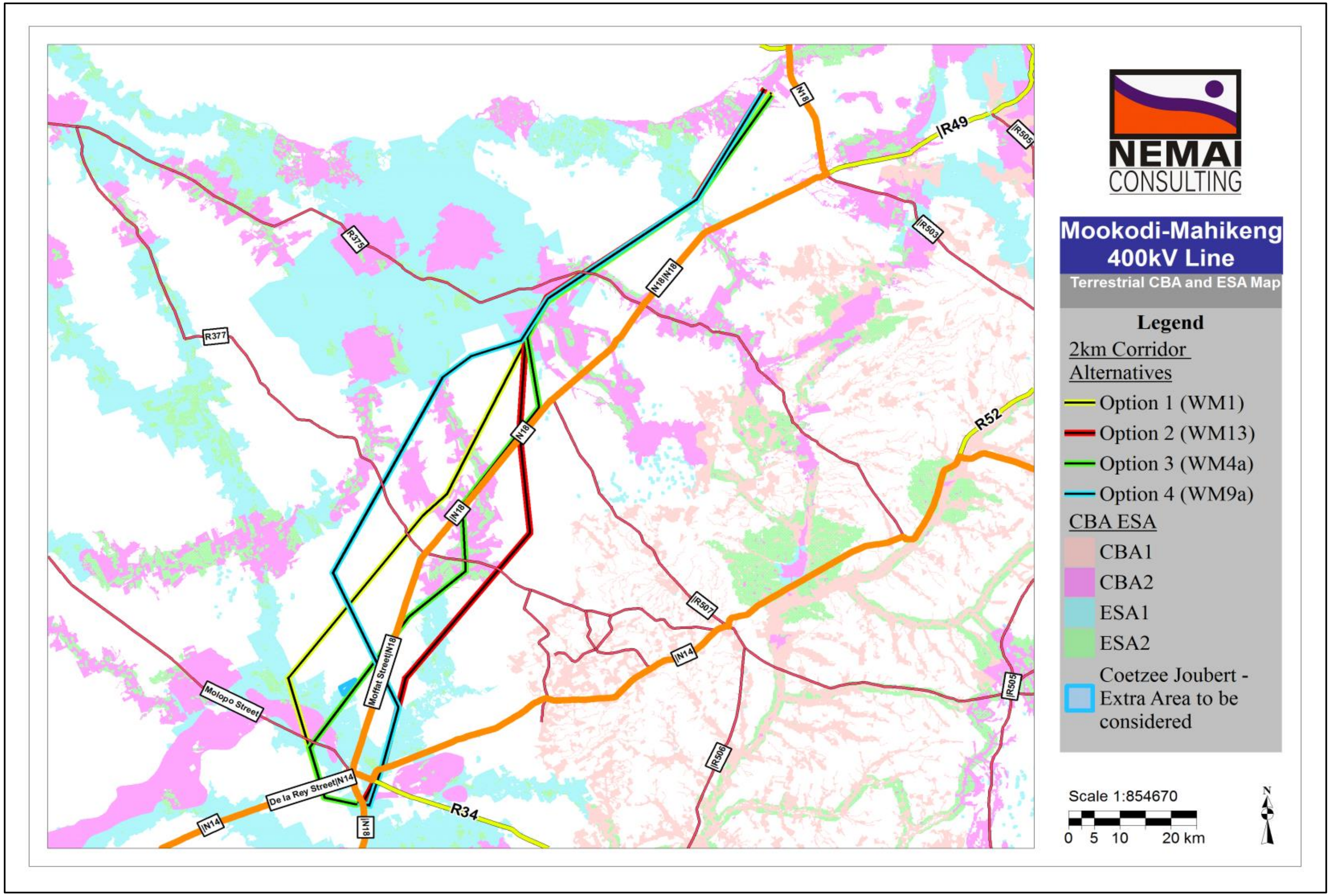

Figure 12. CBA and ESA in relation to the proposed route alternatives

8 PROTECTED AREAS

The aim of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003) is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural seascapes.

Small sections of the corridor (± 3km in length) of the two route alternatives (i.e Option 1 (WM1) and Option 3 (WM4a)) of the proposed Mookodi-Mahikeng 400kV Powerline fall within a Municipal Reserve, namely the Leon Taljaard Nature Reserve (**Figures 13** and **14**). This Nature reserve contains animal species such as White Rhino, Eland, Buffalo, Black and Blue Wildebeest, Waterbuck, Burchell Zebra, Springbok and Impala (**Figure 15**). The proposed Option 4 will traverse the Makgoro Game Ranch, which has animal species such as Buffalo (**Figure 16**), Zebra, Impala, Giraffe, Sable, etc.

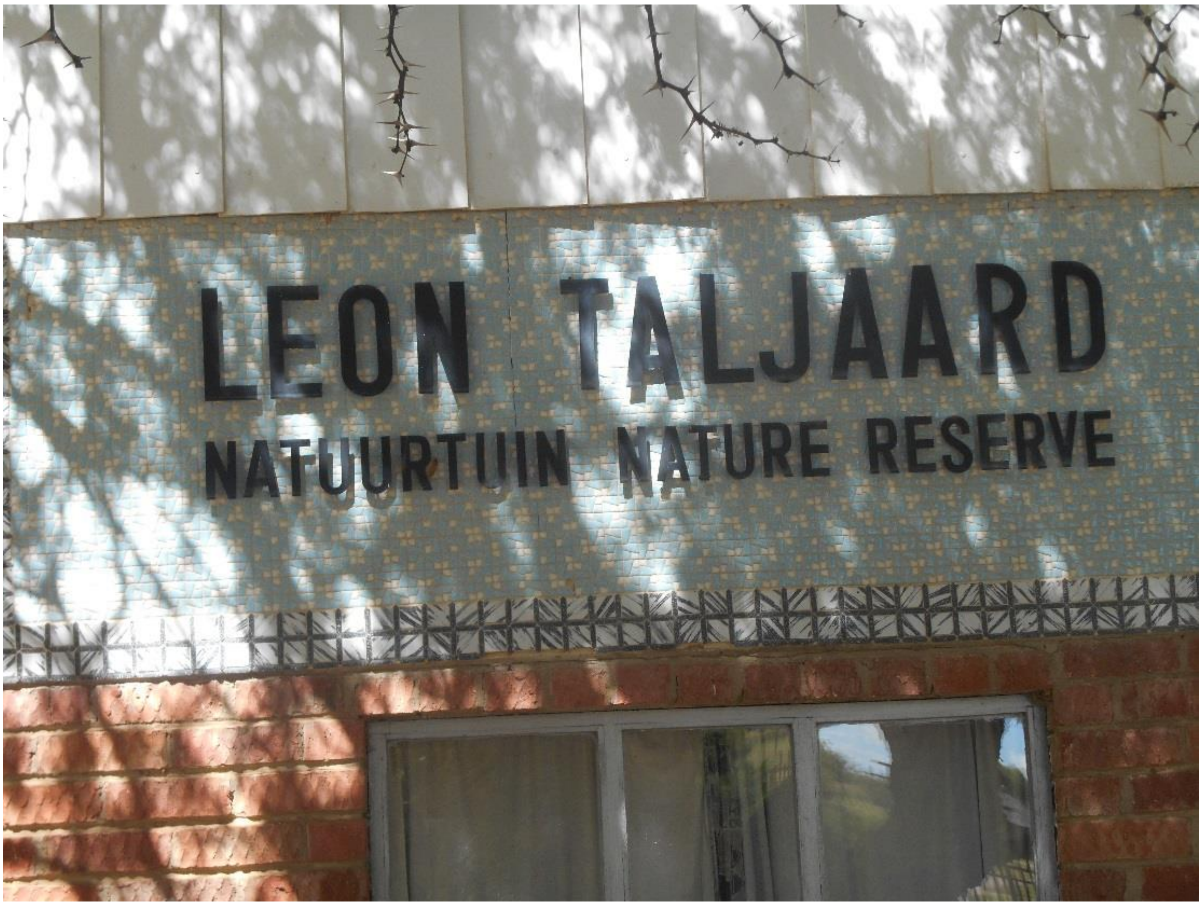

Figure 13. Leon Taljaard Nature Reserve

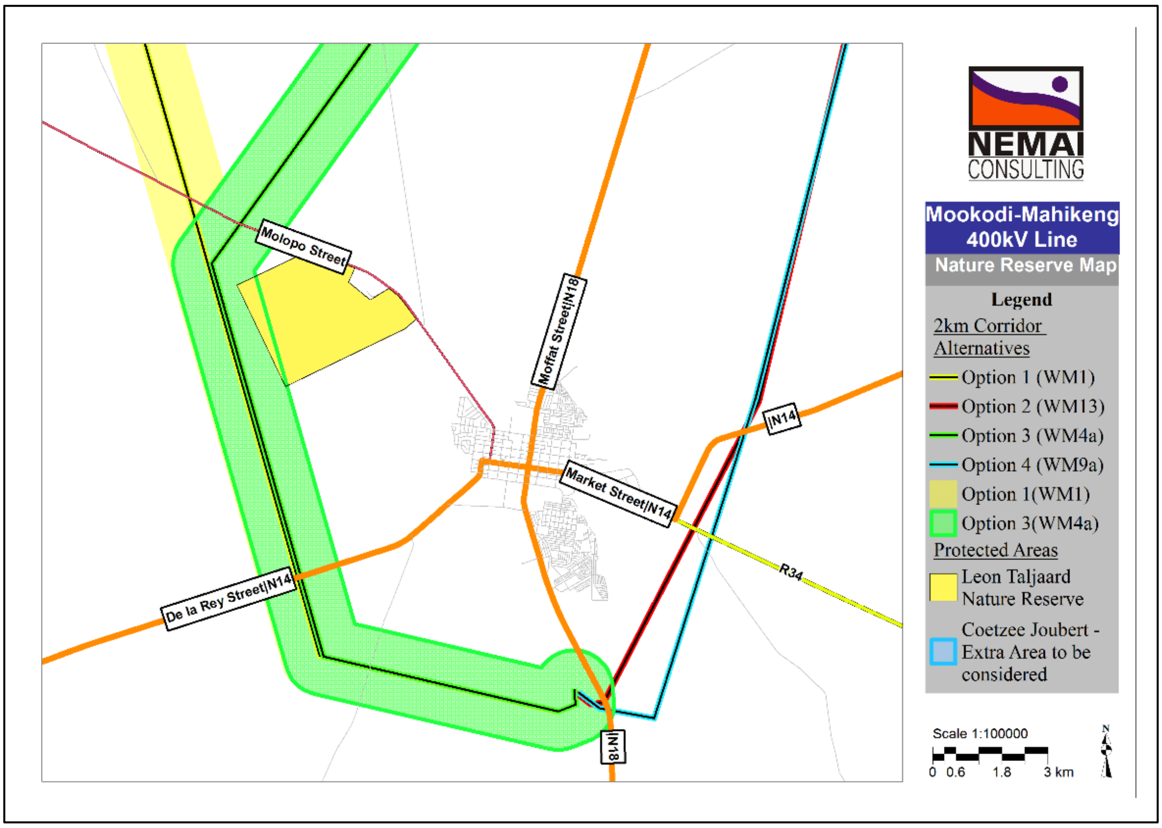

Figure 14. Leon Taljaard Nature Reserve in relation to the project area

Figure 15. Animals seen within the Leon Taljaard Nature Reserve

Figure 16. Buffalos seen within the Makgoro Game Ranch (Route Option 4)

9 METHODOLOGY

9.1 Flora

The flora assessment consisted of two complementary approaches:

- A desktop analysis, which included a literature review, local knowledge, topographical maps, and Google Earth imagery; and
- Site visits were conducted from 03 to 06 April 2018.

Satellite imagery of the area (Google Earth) was studied in order to acquire a three dimensional impression of the topography and land use and also to identify potential “hot-spots” or specialized habitats such as natural habitats, wetlands and rivers on or near the study area.

The Pretoria Computerised Information System (PRECIS) list of Red Data plants recorded in the 2724BB, 2724BA, 2624DD, 2624DC, 2625CA, 2624DB, 2624DA, 2625AC, 2624BD, 2624BC, 2625AA, 2624BB, 2625AB, 2525CD and 2525DC quarter degree grid squares were consulted to verify the record of occurrence of the plant species seen in the vicinity of the study area. The site sampled is also only a very small portion of the whole grid and so habitats suitable for certain species in the PRECIS list may not be present at the areas sampled. The vegetation map published in SANBI (2012) was consulted to identify vegetation units that are found in the study area. The desktop component of the study of the habitats of the Red-Data-listed plants was conducted before the site visits.

The habitats along the study area were inspected in a random zigzag fashion, paying particular attention to areas that at first sight appeared to be sensitive. All general observations were noted such as grasses, herbs (forbs), shrubs and trees. The habitats suitable for Red Data listed species known to occur in the quarter degree grid square were examined intensively for the presence of such species. Attention was also paid to the occurrence of medicinal, alien and declared weed species. Field guides such as van Wyk *et al.* (1997), Pooley (1998), van Oudshoorn (1999) and Manning (2009) were utilised during the field work.

Exotic and invasive plant species were categorised according to the framework laid out by The Conservation of Agricultural Resources Act (CARA) (Act No. 43 of 1983). CARA defines weeds as alien plants, with no known useful economic purpose that should be eradicated. Invader plants, also considered by the Act, can also be of alien origin but may serve useful purposes as ornamental plants, as sources of timber, or other benefits such as medicinal uses (Henderson, 2001). These plants need to be managed and prevented from spreading.

Invasive species are controlled by the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) - Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014. The AIS Regulations list four (4) different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa.

Invasive plant species are divided into four categories, namely:

- Category 1a: Invasive species which must be combatted and eradicated. Any form of trade or planting is strictly prohibited.
- Category 1b: Invasive species which must be controlled and wherever possible, removed and destroyed. Any form or trade or planting is strictly prohibited.
- Category 2: Invasive species, or species deemed to be potentially invasive, in which a permit is required to carry out a restricted activity. Category 2 species include commercially important species such as pine, wattle and gum trees.
- Category 3: Invasive species which may remain in prescribed areas or provinces. Further planting, propagation or trade, is however prohibited.

According to van Oudtshoorn (1999), a grass species reacts to grazing in one of two ways: it can either become more or less abundant. **Table 1** describes the classification of grasses.

Table 1. Classification of grasses (van Oudtshoorn, 1999)

Class	Description	Examples
Decreasers	Grasses that are abundant in good veld, but that decrease in number when the veld is overgrazed or undergrazed.	*Themeda triandra, Digitaria eriantha*
Increaser 1	Grasses that are abundant in underutilised veld. These grasses are usually unpalatable, robust climax species that grow without any defoliation	*Hyperthelia dissoluta, Trachypogon spicatus*
Increaser 2	Grasses that are abundant in overgrazed veld. These grasses increase due to the disturbing effect of overgrazing and include mostly pioneer and subclimax species	*Aristida adscensionis, Eragrostis rigidor*
Increaser 3	Grasses that are commonly found in overgrazed veld. These are usually unpalatable, dense climax grasses	*Sporobolus africanus, Elionurus muticus*
Invaders	All plants that are not indigenous to an area. These plants are mostly pioneer plants and are difficult to eradicate	*Arundo donax*

9.2 Mammals

Mammal site visit was conducted in April 2018, and during these visits, the observed and presence of mammals associated with the recognized habitat types of the study routes were recorded during the day. Animal Demography Unit virtual museum was consulted before the site visits for a list of species that could potentially be found along the proposed route alternatives and these species were thoroughly investigated within their suitable habitats. No night surveys were undertaken. Adjoining properties were also scanned for important faunal habitats. During the site visits, mammals were identified by spoor, burrow and visual sightings through random transect walks. Locals were also interviewed to provide species lists on their properties.

9.3 Reptiles

The reptile assessment was conducted during the day. During the field visits, the observed and derived presence of reptiles associated with the recognised habitat types of the study site were recorded. This was done with due regard to the known distributions of Southern African reptiles. Reptiles were identified by sightings during random transect walks. Possible burrows or other reptile retreats were inspected for any inhabitants. Locals were also interviewed to provide species lists on their properties.

9.4 Amphibians

According to Carruthers (2001), amphibians are extremely sensitive to habitat transformation and degradation. The identification technique which was used for this study was frog's call. According to Carruthers (2001), a frog's call is a reliable means of identifying species. Frog calls were compared with pre-recorded calls from du Preez and Carruthers (2009)'s CD and identified from this comparison. According to Waddle (2006), physical searching should take place during both day and night, while acoustic surveying took place primarily at night between the hours of 18:00 and 21:00. Samplings were conducted on the moist to semi-aquatic areas. During this surveys; fieldwork was augmented with species lists compiled from personal records; data from the South African Frog Atlas Project (SAFAP) (1999-2003) and published data. Suitable habitats such as ephemeral wetlands where amphibian species of conservation such as Bullfrogs occur were also investigated.

10 RESULTS AND DISCUSSION

10.1 Flora

10.1.1 Desktop study results

The proposed development is located within the following quarter degree squares in terms of the 1:20 000 grid of South Africa 2724BB, 2724BA, 2624DD, 2624DC, 2625CA, 2624DB, 2624DA, 2625AC, 2624BD, 2624BC, 2625AA, 2624BB, 2625AB, 2525CD and 2525DC. SANBI uses this grid system as a point of reference to determine any Red Data plant species or any species of conservation importance occurring in South Africa. This can be used to determine the list of species which could potentially occur within an area. **Table 2** indicates the plants that are known to occur on or around the project area recorded in 2627DD quarter degree square. The definitions of the conservation status are provided in **Table 3.** Due to the fact that threatened species have historically been noted in the area, it is imperative that, before the construction activities take place, detailed searches for these rare/threatened and protected species are made during the appropriate time of year when plants are likely to be more noticeable.

Table 2. Red Data Plant species which could potentially occur in the study area (SANBI data)

Family	Genus	Species	Red List category
Mesembryanthemaceae	*Lithops*	*lesliei*	NT
Asteraceae	*Rennera*	*stellata*	VU
Apocynaceae	*Brachystelma*	*canum*	CR
Anacardiaceae	*Searsia*	*maricoana*	VU
Hyacinthaceae	*Drimia*	*sanguinea*	NT
Fabaceae	*Acacia*	*erioloba*	Declining

Note*: CR=Critically Endangered; VU=Vulnerable; NT=Near Threatened*

Table 3. Definitions of Red Data status (Raimondo *et al*. 1999)

Symbol	Status	Description
CR	Critically Endangered	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the five International Union for Conservation of Nature (IUCN) criteria for Critically Endangered and it is therefore facing an extremely high risk of extinction in the wild.
VU	Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the five IUCN criteria for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.
NT	Near Threatened	A taxon is Near Threatened when available evidence indicates that it is close to meeting any of the five IUCN criteria for Vulnerable and it is therefore likely to qualify for a threatened category in the near future.

Symbol	Status	Description
	Declining	A taxon is Declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

10.1.2 Plant species recorded in the proposed development site

The four proposed route alternatives traversed through untransformed grasslands (**Figure 17**), agricultural areas such as maize fields (**Figure 18)**, roads (**Figure 19**), human settlements (**Figure 20**), town areas, and also through existing infrastructures (including roads, fences and powerlines). The species recorded during the site visits confirmed the study area's location within the Savanna Biome of South Africa. All of the species recorded in the study area are listed in **Table 4** and the species of conservation importance recorded are indicated in **bold**.

Figure 17. Untransformed grasslands

Figure 18. Maize fields

Figure 19. Roads

Figure 20. Human settlements

Table 4. Plant species recorded along both proposed route alternatives

Scientific Name	Common Name	Ecological status	Form	Option 1	Option 2	Option 3	Option 4
Vachellia erioloba (= Acacia erioloba)	**Camel thorn**	**Declining/Protected**	**Tree**	✓	✓	✓	✓
Acacia (Vachellia) hebeclada subsp. *hebeclada*	Candle thorn		Tree	✓	✓	✓	✓
Acacia karroo (*Vachellia karroo*)	Sweet thorn		Tree	✓	✓	✓	✓
Acacia mearnsii	Black Wattle	Invader 2	Tree	✓	✓	✓	✓
Acacia (*Senegalia*) *hereroensis*	Arid Hook-thorn		Tree	✓	✓	✓	✓
Acacia (Vachellia) tortilis subsp. *heteracantha*	Umbrella thorn		Tree	✓	✓	✓	✓
Agave americana	Spreading century plant	Invader 2	Succulent	✓	✓	✓	✓
Agave sisalana	Sisal	Invader 2	Succulent	✓	✓	✓	✓
Albuca setosa	Soldier-in-the-box		Herb	✓	✓	✓	✓
Aloe transvaalensis	Spotted Aloe	Medicinal	Succulent	✓	✓	✓	✓
Alternanthera pungens	Khakhiweed	Weed	Herb	✓	✓	✓	✓
Ammocharis coranica	Karoo Lily		Herb	✓	✓	✓	✓
Argemone ochroleuca	White-Flowered Poppy	Category 1b	Herb	✓	✓	✓	✓
Aristida congesta subsp. *congesta*	Buffalo Grass		Grass	✓	✓	✓	✓
Aristida junciformis	Ngongoni three-awn		Grass	✓	✓	✓	✓
Aristida meridionalis	Gemsbokgras		Grass	✓	✓	✓	✓
Artemisia afra	Wild wormwood		Herb	✓		✓	✓
Arundo donax	Spanish Reed	Category 1b	Reed	✓	✓	✓	✓
Asparagus laricinus	Bergkatbos		Herb	✓	✓	✓	✓
Barleria macrostegia			Herb	✓	✓	✓	✓
Boophane disticha	**Century plant**	**Declining**	**Herb**	✓	✓	✓	✓
Berkheya setifera	Buffalo-tongue		Herb	✓	✓		✓

Scientific Name	Common Name	Ecological status	Form	Option 1	Option 2	Option 3	Option 4
Berkheya rigida	Disseldoring		Herb	✓		✓	
Bidens pilosa	Common Black-jack	Weed	Herb	✓	✓	✓	✓
Bulbine narcissifolia	Strap-leaved Bulbine	Medicinal	Herb	✓	✓	✓	✓
Canna indica	Indian shot	Category 1b	Herb	✓	✓	✓	✓
Casuarina equisetifolia	Horsetail tree	Invader 2	Tree	✓	✓	✓	✓
Cenchrus ciliaris	Foxtail buffalo grass		Grass	✓	✓	✓	✓
Cereus jamacaru	Queen of the night	Category 1b	Succulent	✓	✓	✓	
Cirsium vulgare	Scotch Thistle	Category 1b	Herb	✓	✓	✓	✓
Chenopodium album	Common lambsquarters	Weed	Herb	✓	✓	✓	✓
Commelina africana	Yellow commelina	Medicinal	Herb	✓	✓	✓	✓
Combretum erythrophyllum	River bushwillow		Tree	✓	✓	✓	✓
Crinum graminicola	Grass Crinum		Herb	✓	✓	✓	✓
Cymbopogon excavatus	Broad-Leaved Turpentine Grass	Increaser 1	Grass	✓	✓	✓	✓
Erigeron (Conyza) bonariensis		Weed	Herb	✓	✓	✓	✓
Cynodon dactylon	Couch Grass	Increaser 2	Grass	✓	✓	✓	✓
Datura stramonium	Jimson weed	Category 1b	Herb	✓	✓	✓	✓
Datura ferox	Long Spined Thorn Apple	Category 1b	Herb	✓	✓	✓	✓
Dichrostachys cinerea	Sicklebush		Shrub				✓
Digitaria eriantha	Common Finger Grass	Decreaser	Grass	✓	✓	✓	✓
Diospyros lyciodes	Blue bush		Tree	✓	✓	✓	✓
Ehretia alba	Puzzle bush		Shrub	✓	✓	✓	✓
Elephantorrhiza elephantina	Elephant's root		Shrub	✓	✓	✓	✓
Eucalyptus camaldulensis	River Red Gum	Invader 2	Tree	✓	✓	✓	✓
Eragrostis superba	Saw-tooth love grass		Grass	✓	✓	✓	✓

Scientific Name	Common Name	Ecological status	Form	Option 1	Option 2	Option 3	Option 4
Eriospermum cooperi var. *cooperi*	White Fluffy-seed		Herb	✓	✓	✓	✓
Flaveria bidentis	Smelter's bush	Category 1b	Herb	✓	✓	✓	✓
Gomphocarpus physocarpus	Balloon milkweed	Medicinal	Shrub	✓	✓	✓	✓
Grewia flava	Brandy bush		Shrub	✓	✓	✓	✓
Helianthus annuus	Common sunflowe		Herb	✓	✓	✓	✓
Hibiscus trionum	Flower-of-an-hour		Herb	✓	✓	✓	✓
Hyparrhenia hirta	Common Thatching Grass	Increaser 1	Grass	✓	✓	✓	✓
Hypochaeris radicata	Hairy wild lettuce	Weed	Herb	✓			✓
Ipomoea oblongata (=*Turbina oblongata*)	Ubhoqo		Herb	✓		✓	
Jatropha zeyheri	Verfbol		Herb	✓	✓	✓	✓
Kalanchoe paniculata	Hasie-oor		Herb	✓	✓	✓	✓
Kalanchoe rotundifolia	Common Kalanchoe	Medicinal	Herb	✓	✓	✓	✓
Lantana camara	Tick-berry	Category 1b	Shrub	✓		✓	
Lippia javanica	Lemon Bush	Medicinal	Herb	✓	✓	✓	✓
Lippia scaberrima	Beukesbossie		Herb	✓	✓	✓	✓
Melia azedarach	Persian Lilac/Syringa	Category 1b	Tree	✓	✓	✓	✓
Melinis repens	Natal Red Top	Increaser 2	Grass	✓	✓	✓	✓
Morus alba	White mulberry	Category 3	Tree	✓	✓	✓	✓
Moraea polystachya	Bloutulp		Herb	✓	✓	✓	✓
Olea europaea subsp. *africana*	Wild Olive		Tree	✓	✓	✓	✓
Opuntia ficus-indica	Sweet prickly pear	Category 1b	Tree	✓	✓	✓	✓
Persicaria lapathifolia	Pale persicaria	Weed	Herb	✓	✓	✓	✓
Plantago major	Broadleaved Ribwort	Weed/Medicinal	Herb			✓	✓
Phragmites australis	Common reed	Decreaser	Reed	✓	✓	✓	✓

Scientific Name	Common Name	Ecological status	Form	Option 1	Option 2	Option 3	Option 4
Pogonarthria squarrosa	Herringbone Grass	Increaser 2	Grass		✓		✓
Pterodiscus speciosus	Sandkambroo		Herb	✓	✓		✓
Prunus persica	Peach tree	Exotic	Tree	✓	✓	✓	✓
Ricinus communis	Caster-oil plant	Category 1b	Shrub			✓	✓
Salvia disermas	Wild Giant sage		Shrub	✓	✓	✓	✓
Scabiosa columbaria	Wild scabious	Medicinal	Herb	✓			✓
Schizocarphus nervosus (= Scilla nervosa)	White scilla		Herb	✓		✓	✓
Schmidtia pappophoroides	Sand Quick Grass		Grass	✓	✓	✓	✓
Searsia lancea	Karee		Tree	✓	✓	✓	✓
Searsia pyroides	Common wild currant		Tree	✓	✓	✓	✓
Senegalia mellifera subsp. *detinens (Acacia mellifera)*	Black thorn		Tree	✓	✓	✓	✓
Senna italica	Port Royal senna		Herb	✓	✓	✓	✓
Sorghum bicolor	Sorghum		Herb	✓	✓	✓	✓
Sporobolus africanus	Ratstail Dropseed	Increaser 3	Grass	✓	✓	✓	✓
Tagetes minuta	Tall Khaki Weed	Weed	Herb	✓	✓	✓	✓
Tarchonanthus camphoratus	Camphor bush		Shrub	✓	✓	✓	✓
Terminalia sericea	Silver terminalia		Tree	✓	✓	✓	✓
Themeda triandra	Red grass		Grass	✓	✓	✓	✓
Trachyandra sp.			Herb	✓	✓	✓	✓
Tragus racemosus	Burweed		Grass	✓	✓	✓	✓
Typha capensis	Bulrush		Aquatic Herb	✓	✓	✓	✓
Eragrostis trichophora	Atherstone's Grass		Grass	✓	✓	✓	✓
Verbena bonariensis	Tall Verbena	Weed	Herb	✓	✓	✓	✓
Verbena brasiliensis	The Brazilian verbena	Category 1b	Herb	✓	✓	✓	✓

Scientific Name	Common Name	Ecological status	Form	Option 1	Option 2	Option 3	Option 4
Verbesina encelioides	Wild Sunflower	Alien weed	Herb	✓	✓	✓	✓
Vernonia fastigiata	Narrow-leaved Vernonia		Herb	✓	✓	✓	✓
Xanthium strumarium	Rough cocklebur	Category 1b	Shrub	✓	✓	✓	✓
Xanthium spinosum	Spiny cocklebur	Category 1b	Herb	✓	✓	✓	✓
Zea mays	Corn or maize		Herb	✓	✓	✓	✓
Ziziphus mucronata	Buffalo thorn		Shrub	✓	✓	✓	✓

10.1.3 Protected Trees

Vachellia (Acacia) erioloba (Camel Thorn) (**Figure 21**), which is a protected tree in terms of the National Forests Act (Act No. 84 of 1998), were recorded in abundance along both route alternatives. In terms of a part of section 51(1) of the National Forests Act (Act No. 84 of 1998), no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister of Department of Agriculture, Forestry and Fisheries (DAFF). The distribution of this species along the four proposed route alternatives is indicated in **Figure 22** below.

Figure 21. *Vachellia (Acacia) erioloba* recorded along the four proposed route alternatives

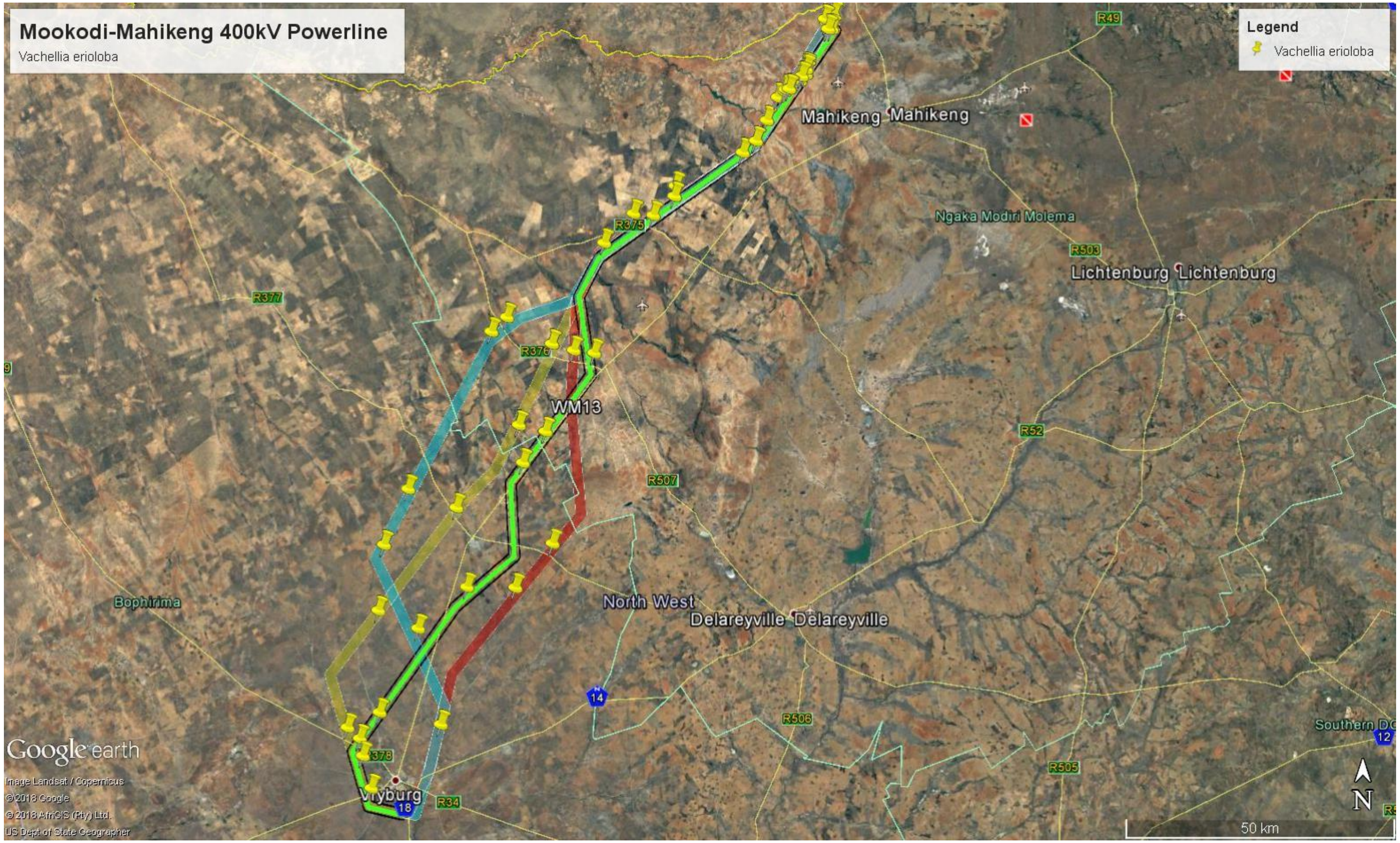

Figure 22. Distribution of *Vachellia (Acacia) erioloba* recorded along the four proposed route alternatives

10.1.4 Alien invasive species recorded on the proposed route alternatives

Alien invader plants are species that are of exotic, non-native or of foreign origin that typically invade undeveloped or disturbed areas. Invaders are a threat to our ecosystem because by nature they grow fast, reproduce quickly and have high dispersal ability (Henderson, 2001). This means that invader plants and seeds spread rapidly and compete for the growing space of our own indigenous plants. If these invader plants out-compete indigenous plants there is a shift in the species composition of the area and the changing our plant communities causes a decline in species richness and biodiversity (Henderson, 2001). Many factors allow alien invasive plants to succeed, particularly the absence of their natural enemies. This makes it difficult to control invasive plants without bringing in natural enemies and eliminating the high competition they have over the indigenous vegetation (Bromilow, 2010). Alien invasive plant species within both alternative sites were observed to occur in clumps, scattered distributions or as single individuals on site. Invader and weed species must be controlled to prevent further infestation and it is recommended that all individuals of invader species (Especially Category 1) must be removed and eradicated (Henderson, 2001). Riparian vegetation, human settlements, overgrazed areas, roads and foot paths and all associated with alien invasive plant species and species which were dominated along these routes were *Flaveria bidentis* (**Figure 23**), *Datura stramonium* (**Figure 24**), *Opuntia ficus-indica* (**Figure 25**) and *Xanthium strumarium* (**Figure 26**) (All Category 1b).

Figure 23. Alien plant *Flaveria bidentis* recorded along both route alternatives

Figure 24. Alien plant *Datura stramonium* recorded along both route alternatives

Figure 25. Alien plant *Opuntia ficus-indica* recorded along both route alternatives

Figure 26. Alien plant *Xanthium strumarium* recorded along both route alternatives

The Environmental Management Programme (EMPr) must ensure that the Applicant/Contractor implements suitable methods during the construction phase to limit the introduction and spread of alien invasive plant species.

10.1.5 Threatened Species and Species of Conservation Concern and Medicinal Plants recorded along the proposed route alternatives

According to the National Environmental Management Biodiversity Act 2004 (Act No. 10 of 2004 as amended), there is a dire need to conserve biodiversity in each province and as such, all natural and/or indigenous resources must be utilised sustainably. Along the proposed route alternatives, there are a number of plants that are used to provide medicinal products (**Table 4**). In some cases there is merit in protecting or translocating them before the proposed development commences. While many of these plants are indigenous or exotic weeds that have medicinal value (and for which no action is necessary with respect to conservation), their economic value means that they are considered to be in need of protection.

According to the South African Red Data list categories done by SANBI (**Figure 27**), **threatened species** are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered, Endangered or Vulnerable is a threatened species whereas **Species of conservation concern** are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the

Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD).

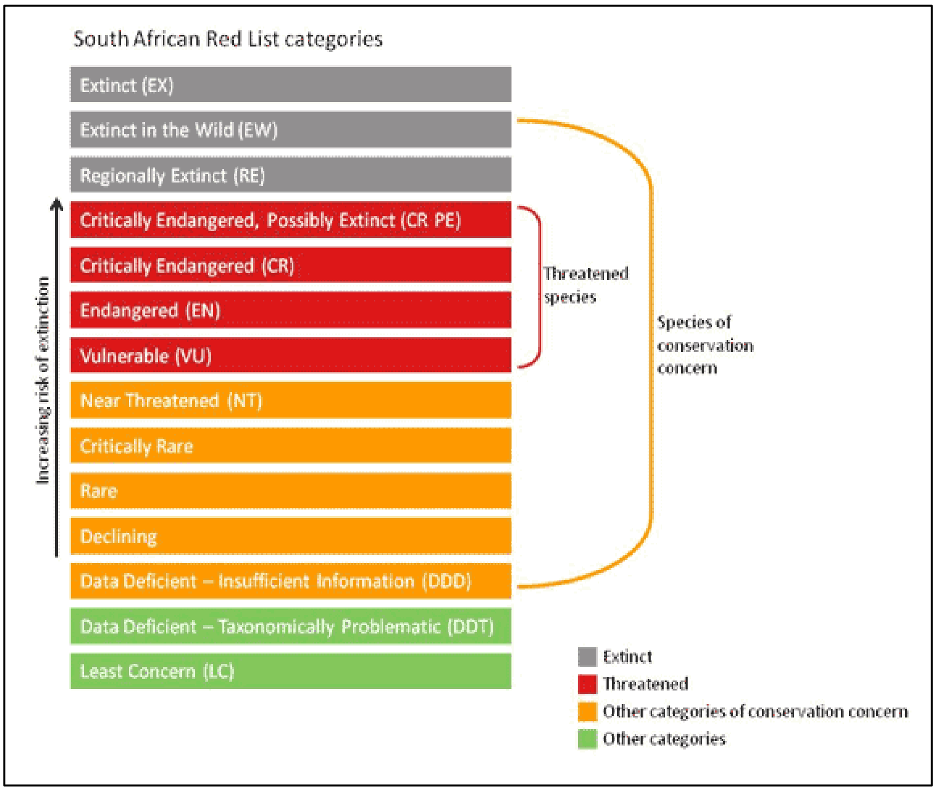

Figure 27. South African Red Data list categories (SANBI)

During the field survey, no threatened plant species were observed along the proposed route alternatives, however only two (2) species of conservation concerns were noted, namely *Vachellia erioloba* (= *Acacia erioloba*) (Camel thorn) and *Boophane disticha* (Century plant). Raimondo *et al.* (2009) has listed these species as *Declining.* These plant species were recorded along both alternative routes.

Vachellia erioloba is widely distributed inland in the western half of the country, from the Northern Cape through to Limpopo Province. It also extends to Namibia, Botswana, Zimbabwe and to central Africa. It is a competitive species that can displace preferred vegetation. The timber is strong and is highly prized for firewood (Coates Palgrave, 2002).

According to Williams *et al.* (2008), *Boophane disticha* (**Figure 28**) is found in the Northern Cape, Eastern Cape, KwaZulu-Natal, Free State, Gauteng, Limpopo, Mpumalanga, and North West provinces, and north up to Uganda, in Albany Thicket, Fynbos, Grassland, Indian Ocean Coastal Belt, Nama Karoo, Savanna and Succulent Karoo habitats, in dry grassland and rocky areas. The distribution of this species along the routes is indicated in **Figure 29**.

Figure 28. *Boophane disticha* recorded along the proposed route alternatives

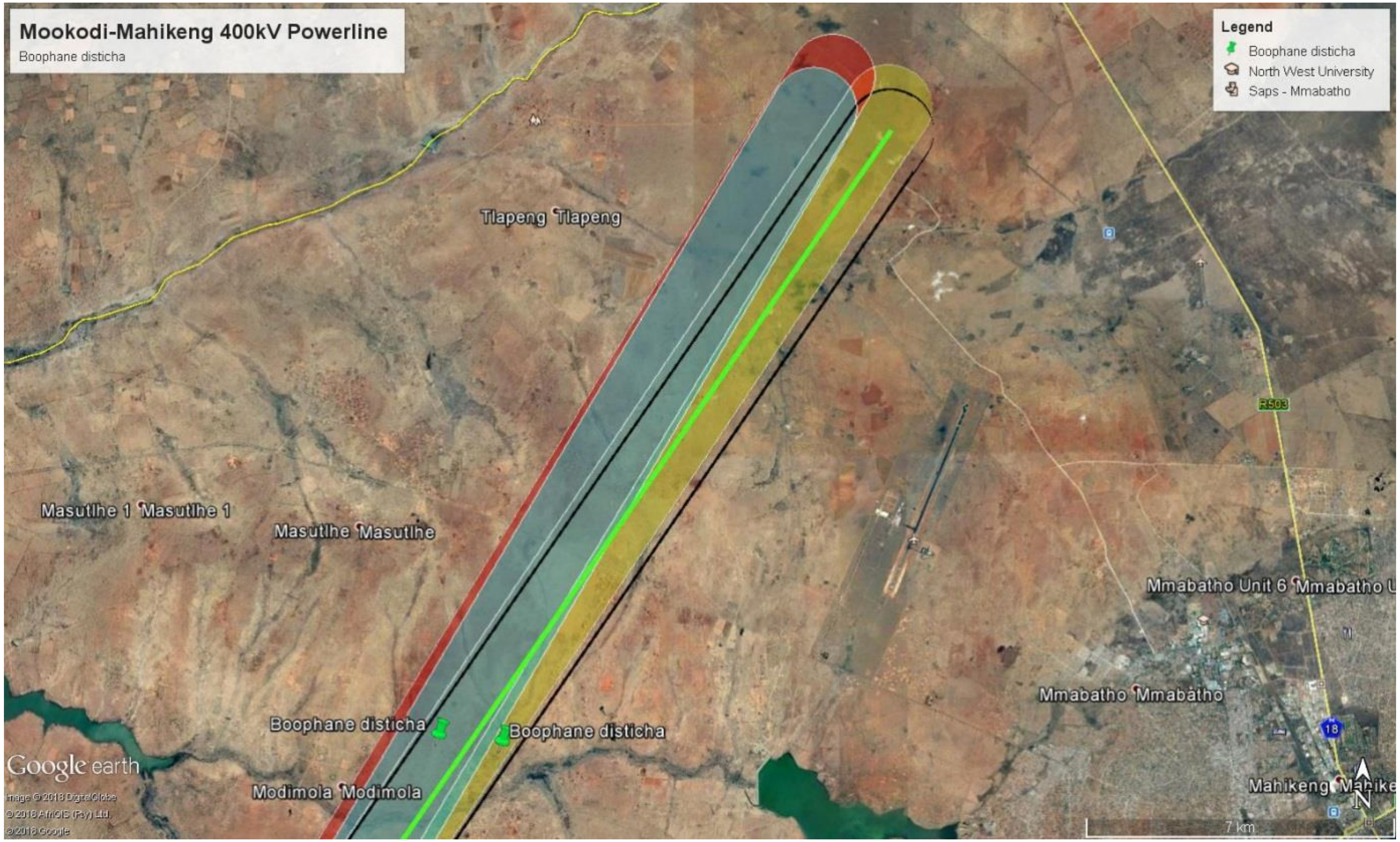

Figure 29. The distribution of *Boophane disticha* along the four proposed route alternatives

It is therefore recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Species of conservation concern and also to develop a comprehensive and site-specific EMPr so as to limit the impacts imposed by the proposed development activities at each tower site. This is relevant in the areas that have been labelled as ecologically sensitive.

10.1.6 Habitat available for species of conservation importance

Data sourced from SANBI indicates there are plant species on the Red Data List that are known to occur in or surrounding the project area. These species and their probability of occurrence are indicated in **Table 5**. The probability of occurrence is based on the suitable habit where the species is likely to occur.

Table 5. Red Listed plant species which are known to occur in the general vicinity of the project area, which could potentially be found along the proposed route alternatives

Genus Species	Red List category	Suitable habitat	Probability of Occurrence
Lithops lesliei	NT	Primarily in arid grasslands, usually in rocky places, growing under the protection of forbs and grasses.	Medium
Pentzia (*Rennera*) *stellata*	VU	Found in seasonally waterlogged calcrete pans	Low
Brachystelma canum	CR	Sandy terminalia veld.	High
Searsia maricoana	VU	Grassland, at the transition from bushveld, in dark soil among igneous rocks.	Low
Drimia sanguinea	NT	Open veld and scrubby woodland in a variety of soil types	Medium
Acacia erioloba	Declining	Savanna, semi-desert and desert areas with deep, sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrop	**FOUND**

10.2 Fauna

The evaluation of faunal presence is based on the presence / absence of mammals, reptiles and amphibians in the study area. The survey determined the current status of threatened animal species occurring, or likely to occur along the proposed route alternatives, describing the available and sensitive habitats. Faunal data was obtained during field survey assessments of the proposed route alternatives, which were carried out utilising vehicles and also on foot. The data was supplemented by previous surveys conducted in similar habitats, literature investigations, and historic data. Different habitats were explored to identify any sensitive or endangered species. Mammal nomenclature is referred to using Stuart and Stuart (1998), Skinner and Chimimba (2005), Friedman and Daly (2004), reptile names by Branch (1988), Branch (2001) and Bates *et al.* (2014) and Amphibian names by Minter *et al.* (2004).

10.2.1 Mammals

10.2.1.1 Desktop survey results

The potential Red Data mammal species that could be found in the study area are those which have been recorded in the grid cells (ADU, 2018) (**Table 6**). The Red List category follows the Friedmann & Daly (2004). Mammal species such as African wild dog, Cheetah and Brown Hyena, which are mostly restricted to protected or conservation areas, were not included in the assessment. According to the latest Red List Assessment (Begg *et al.* 2016), Honey Badger is now listed as Least Concern.

Table 6: Mammal species recorded which could occur in the study area

Genus	Species	Common Name	Red List Category
Hippotragus	*niger*	Sable Antelope	VU
Hippotragus	*equinus*	Roan Antelope	VU
Lycaon	*pictus*	African wild dog	EN
Acinonyx	*jubatus*	Cheetah	VU
Hyaena	*brunnea*	Brown Hyena	NT
Smutsia	*temminckii*	Ground Pangolin	VU
Mellivora	*capensis*	Honey Badger	NT
Rhinolophus	*denti*	Dent's Horseshoe Bat	NT
Miniopterus	*schreibersii*	Schreibers's Long-fingered Bat	NT

Note: EN=Endangered; VU=Vulnerable; NT=Near Threatened

10.2.1.2 Mammals recorded in the study area

Historically, the study area could have provided habitat for a diverse population of larger mammal species, but the agricultural activities on site have transformed the majority of the habitats and due to these anthropogenic disturbances, it is likely that only the more common and smaller mammal species will be observed, which show more adaptation. However, remnants of natural vegetation still exist and these remnants areas are suitable for survival of the mammals species recorded along the routes. The agricultural fields were largely devoid of mammal species; however Meerkat dens were present on the edges of agricultural fields. Domestic animals such as cattle, sheep, donkeys and horses were noted in abundance along both routes (**Figure 30**). Significantly the riparian vegetation and natural grasslands between agricultural fields are utilised as a movement and linkage corridor within the study area. These areas also provide ideal foraging and breeding habitat for a number of mammal species. Grassland habitats are utilised by a range of faunal species, particularly if there is some form of topographical change within the grassland. Although the grassland along the routes is disturbed as a result of overgrazing and human settlements, it may still supply habitat for small mammals and reptile species. **Table 7** lists mammal species recorded during the surveys. The species recorded in the Nature Reserve Game Ranch and Resort (**Figure 31**), or provided by the local land owners are indicated in **BOLD** and includes the three Red Data mammal species.

Figure 30. Donkeys along the four proposed route alternatives

Figure 31. Springbok and Zebra in Boereplaas Holiday Resort traversed by Option 4

Table 7. Mammals recorded on the proposed development site

Scientific name	English name	Conservation Status	Route Alternatives
Sylvicapra grimmia	Grey/Common Duiker	Least concern	All Routes
Cryptomys hottentotus	Common Mole-rat	Least concern	All Routes
Raphicerus campestris	Steenbok	Least concern	All Routes
Canis mesomelas	Black-backed Jackal	Least concern	All Routes
Cynictis penicillata	Yellow mongoose	Least concern	All Routes
Suricata suricatta	Meerkat	Least concern	All Routes
Rattus rattus	House rat	Least concern	All Routes
Xerus inauris	Cape Ground Squirrel	Least concern	All Routes
Gerbilliscus leucogaster	Bushveld Gerbil	Least concern	All Routes
Oryx gazella	**Gemsbok**	**Least concern**	**Options 1 & 3**
Antidorcas marsupialis	**Springbok**	**Least concern**	**Options 1, 2 & 3**
Damaliscus pygargus phillipsi	**Blesbok**	**Least concern**	**Options 1, 3 & 4**
Hippotragus niger	**Sable**	**Vulnerable**	**Options 1, 3 & 4**
Tragelaphus strepsiceros	**Greater Kudu**	**Least concern**	**Options 1 & 3**
Connochaetes taurinus	**Blue wildebeest**	**Least concern**	**Options 1 & 3**
Tragelaphus angasii	**Nyala**	**Least concern**	**Options 1 & 3**
Phacochoerus africanus	**Common Warthog**	**Least concern**	**Options 1 & 3**
Taurotragus oryx	**Common Eland**	**Least concern**	**Options 1 & 3**
Alcelaphus buselaphus caama	**Red Hartebeest**	**Least concern**	**Options 1 & 3**
Kobus ellipsiprymnus	**Waterbuck**	**Least concern**	**Options 1 & 3**
Aepyceros melampus	**Impala**	**Least concern**	**Options 1 & 3**
Damaliscus lunatus	**Common Tsessebe**	**Vulnerable**	**Options 1 & 3**
Equus burchellii	**Burchell's Zebra**	**Least concern**	**Options 1 & 3**
Syncerus caffer	**African Buffalo**	**Least concern**	**Options 1, 3 & 4**
Ceratotherium simum	**White Rhinoceros**	**Near Threatened/ Protected**	**Options 1 & 3**
Camelus	**Camel**		**Option 4**

10.2.1.3 Habitat available for mammal species of conservation importance

Data sourced from Animal Demographic Unit (ADU, 2018) indicates that there are Red Data mammal species which are known to occur in the general vicinity of the study area. **Table 8** below indicates the suitable habitat together with the probability of occurrence for each species that could potentially occur in the study area. The probability of occurrence is based on the presence of suitable habit where the species is likely to occur.

Table 8. Red Data Listed mammal species which could potentially occur along the proposed route alternatives, their suitable habitats and also the probability of occurrence (Friedmann & Daly (2004), Skinner & Chimimba (2005)

Common name	Red list category	Suitable habitat	Probability of occurrence
Roan Antelope	Vulnerable	They mostly inhabit lightly wooded savannah, open areas of medium sized grass, with easy access to surface water.	**FOUND**
Sable Antelope	Vulnerable	Prefers open savannah woodlands or moist vleis, in which they select for medium height, good quality grass cover.	**FOUND**
African Wild Dog	Endangered	Wild Dogs can survive in most habitat types as long as the habitat is large enough, contains sufficient suitable prey and is free from direct threats such as accidental and deliberate persecution.	Low
Cheetah	Vulnerable	Cheetahs occur in the Savanna biome and are habitat generalists which can survive where sufficient food is available and threats are tolerable.	Low
Brown Hyena	Near Threatened	The Brown Hyaena is widespread across southern Africa and is found in the desert areas with annual rainfall less than 100 m, semi-desert, open scrub and open woodland savannah with a maximum rainfall up to about 700 mm. It shows an ability to survive close to urban areas. It requires some type of cover in which to lie up during the day. For this it favours rocky, mountainous areas with bush cover in the bushveld areas of South Africa.	Low
Ground Pangolin	Vulnerable	It is found in various woodland and savannah habitats, preferring arid and mesic savannah and semi-arid environments at lower altitudes, often with thick undergrowth, where average annual rainfall ranges between 250 and 1,400 mm. They also occur in floodplain grassland, rocky slopes and sandveld up to 1,700 m, but are absent from Karroid regions, tropical and coastal forests, Highveld grassland and coastal regions.	Medium
Dent's Horseshoe Bat	Near Threatened	This species is associated with arid savannah habitats where suitable roosting sites occur; typically restricting it to broken country with rocky outcrops or suitable caves	Low
Schreibers's Long-fingered Bat	Near Threatened	It forages in a variety of open and semi-open natural and artificial habitats, including suburban areas. It is a colonial species that roosts mostly in caves and mines (although it can also be found in man-made tunnels, ruins and other buildings), often in large mixed colonies with other cave-dwelling bat species.	Low

10.2.2 Reptiles

10.2.2.1 Desktop survey results

According to South African Reptile Conservation Assessment (ADU, 2018), no reptile species of conservation importance are known to occur in the vicinity of the study area. The most common species within the region, as indicated by the largest number of observations from SARCA (2018) are Leopard Tortoise (*Stigmochelys pardalis*) and Southern Rock Agama (*Agama atra*).

10.2.2.2 Reptiles recorded along the proposed route alternatives

The reptile assessment indicates that the rocky habitats, grasslands and riparian vegetation along the proposed route alternatives are of high importance to reptiles. Reptiles are exceptionally hard to detect during field surveys. Riverine habitats are traditionally rich in reptile diversity and concentrations due to the habitat supporting a high number of prey species, such as frogs, birds and small mammals (Branch, 2001). The majority of reptile species are sensitive to severe habitat alteration and fragmentation. Species are also very often "expelled" into riparian zones due to transformation of lands for anthropogenic disturbances such as human settlements and agricultural purposes. Termite mounds were present in abundance along the proposed development site (**Figure 32**). Old termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal species (Jacobsen, 2005). Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). No termite mounds were destroyed during the brief field survey. All overturned rock material was carefully replaced in its original position. **Table 9** indicates reptile species recorded along the proposed route alternatives site and no Red Data reptile species were noted. The list of species provided by the local land owners are indicated by an Asterix (*****).

During the field surveys, a Leopard Tortoise (*Stigmochelys pardalis*) was sighted in the study area (**Figure 33**). Its habitat varies from montane grassland, fynbos, valley bushveld as well as arid and mesic savanna (Branch, 1988). The main potential impact of the proposed powerline development on reptile species is probable to be habitat loss or degradation. Nevertheless, in the long-term, effects on reptile species are probable to be comparatively low as the extent of habitat loss would be low and the majority of the powerline servitude would still be available for use by most reptile species. Habitat destruction should be limited to the absolute minimum throughout the survey area. According to the information obtained from one of the farm owners, a species such as Black Mamba (*Dendroaspis polylepis*) is known to occur along the proposed route alternatives, however, according to the distribution ranges of this species (Bates *et al.* 2014), no such species has been recorded in or around the region.

Figure 32. Termite mound recorded along both proposed route alternatives

Figure 33. A Leopard Tortoise recorded along the proposed Option 4 route alternative

Table 9. Reptiles recorded along the study area

Genus	Species	Subspecies	Common name
Agama	*aculeata*	*distanti*	Distant's Ground Agama
Trachylepis	*punctatissima*		Montane Speckled Skink (**Figure 34**)
Agama	*atra*		Southern Rock Agama
Bitis	*arietans*		Puff Adder
Lamprophis	*capensis*		Brown House Snake*
Mabuya	*capensis*		Cape skink
Stigmochelys	*pardalis*		Leopard Tortoise
Lygodactylus	*capensis*	*capensis*	Common Dwarf Gecko
Pachydactylus	*capensis*		Cape Gecko
Cordylus	*vittifer*		Common Girdled Lizard
Gerrhosaurus	*flavigularis*		Yellow-throated Plated Lizard
Trachylepis	*capensis*		Cape Skink
Agama	*atra*		Southern Rock Agama
Bitis	*arietans*		Puff Adder

Figure 34. *Trachylepis punctatissima* recorded along both proposed route alternatives

10.2.3 Amphibians

Amphibians are an essential part of South Africa's exceptional biodiversity and are such worthy of both research and conservation effort. This is furthermore made relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but is still poorly understood (Wyman, 1990 & Wake, 1991). This decline seems to have worsened over the past years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data. Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried, 1989) and are worthy of both research and conservation effort.

10.2.3.1 Desktop survey results

Frogs and tadpoles are good species indicator on water quality, because they have permeable, exposed skins that readily absorb toxic substances. Tadpoles are aquatic and greatly exposed to aquatic pollutants (Blaustein, 2003). The presence of amphibians is also generally regarded as an indication of intact ecological functionality and therefore construction activities within these habitat units should be undertaken in an ecologically-sensitive manner.

According to Frog Atlas of Southern Africa (ADU, 2018), the Giant Bullfrog (*Pyxicephalus adspersus*) is the only frog species of conservation concern (considered as Near Threatened by Du Preez and Carruthers (2009) which could potentially be found along the proposed route alternatives. The Giant Bullfrog has been chosen as a flagship species for the grassland eco-region (Cook, 2007).

10.2.3.2 Field work results

The watercourses (**Figure 35**) along the proposed route alternatives hold water on a permanent and temporary basis and are probably important breeding habitat for most of the frog species which occur at the study site. Only Six frog species were recorded along the study area (**Table 10**).

Figure 35. Watercourses along the proposed route alternatives

Table 10. Amphibian species recorded along the proposed route alternatives

Genus	Species	Common name
Amietia	*angolensis*	Common/Angola River Frog
Amietophrynus	*gutturalis*	Guttural Toad
Cacosternum	*boettgeri*	Boettger's Caco
Kassina	*senegalensis*	Bubbling Kassina
Tomopterna	*cryptotis*	Tremolo Sand Frog
Xenopus	*laevis*	Common Platanna

10.2.3.3 Habitat requirements for Red Data amphibian species

The Giant Bullfrog (*Pyxicephelus adspersus*) is known to breed in seasonal shallow grassy pans, vleis and other rain filled depressions in open flat areas of grassland or savanna (Du Preez and Carruthers, 2009) and these habitats units are present along the proposed route alternatives. This species is, however, protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit. The conservation of the Giant Bullfrog and of amphibians in general will be met by the protected area network as well as the designation of priority habitats, *i.e.* pans or quaternary catchments, with associated restrictions on land use.

11 TERRSTRIAL ECOLOGICAL SENSITIVITY ANALYSIS

The ecological function describes the intactness of the structure and function of the vegetation communities which in turn support faunal communities. It also refers to the degree of ecological connectivity between the identified vegetation communities and other systems within the landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

High – Sensitive vegetation communities with either low inherent resistance or resilience towards disturbance factors or vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.

Medium – Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems.

Low – Degraded and highly disturbed vegetation with little ecological function. The sensitivity map (**Figure 36**) was based on the following criteria:

- Threatened Ecosystems (High);
- CBA2 (High);

- Nature Reserve (High);
- Plant species of conservation concern (Medium);
- ESA1 (Medium);
- ESA 2 (Medium).

An ecological field assessment was carried out to determine the most sensitive areas along the routes. All the areas denoted as *high* must be taken into account when the final layout is designed or final route is selected. The natural and near natural areas on site contain plants and animal species of conservation concern and it is advisable that the infrastructure development should be placed in areas which are already disturbed (shown in White colour).

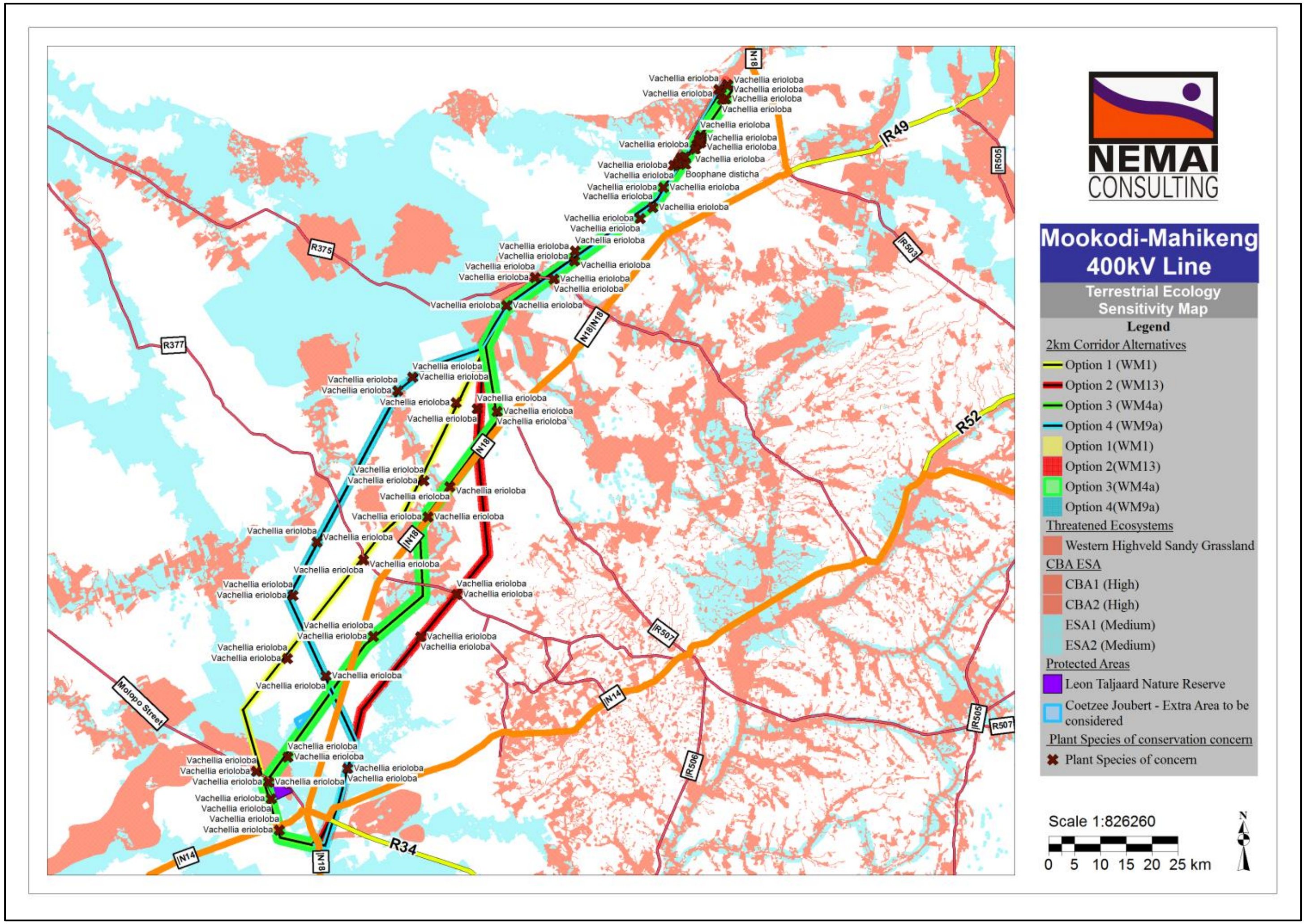

Figure 36. Terrestrial ecological sensitivity map of the four proposed route alternatives

12 ENVIRONMENTAL IMPACT ASSESSMENT

12.1 Methodology

All impacts are analysed in the section to follow (**Table 11**) with regard to their nature, extent, magnitude, duration, probability and significance. The following definitions apply:

Nature (Status)
The project could have a positive, negative or neutral impact on the environment.

Extent
- Local – extend to the site and its immediate surroundings.
- Regional – impact on the region but within the province.
- National – impact on an interprovincial scale.
- International – impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.
- Low – natural and social functions and processes are not affected or minimally affected.
- Medium – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.
- High – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration
- Short term – 0-5 years.
- Medium term – 5-11 years.
- Long term – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- Permanent – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability
- Almost certain – the event is expected to occur in most circumstances.
- Likely – the event will probably occur in most circumstances.
- Moderate – the event should occur at some time.
- Unlikely – the event could occur at some time.
- Rare/Remote – the event may occur only in exceptional circumstances.

Significance

Provides an overall impression of an impact’s importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-

- 0 – Impact will not affect the environment. No mitigation necessary.
- 1 – No impact after mitigation.
- 2 – Residual impact after mitigation.
- 3 – Impact cannot be mitigated.

12.2 Assessment of Environmental Impacts and Suggested Mitigation Measures

Only the environmental issues identified during the appraisal of the receiving environment and potential impacts are assessed (**Table 11**). Mitigation measures are provided to prevent (first priority), reduce or remediate adverse environmental impacts.

The mitigation measures listed in **Table 11** should be supplemented by the Eskom’s standard document which deals specifically with vegetation management in Eskom land including servitudes and rights of way (Appendix A).

Table 11. Proposed impacts and the recommended mitigation measures for the proposed Mookodi-Mahikeng 400kV powerline

FLORA PRE – CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Loss of plant species of conservation concern			• It is recommended that prior to construction, the *Boophane disticha* plant species recorded must be searched and rescued and then following construction activities, they can be re-established at the site or along the route. • A permit from DAFF is required before construction commences in order to disturb, destroy or remove the several *Acacia erioloba* noted along the routes. • It is therefore recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Red Data Listed species and also to develop a comprehensive and site-specific EMPr so as to limit the impacts imposed by the proposed development activities at each tower site. This is relevant in the areas that have been labelled as ecologically sensitive.			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Destruction of indigenous flora during site establishment	• Indigenous plants naturally growing along the proposed development routes, but that would be otherwise destroyed during clearing for development purposes should be incorporated into landscaped areas. • Vegetation clearing should be kept to a minimum, and this should only occur where it is absolutely necessary and the use of a brush-cutter is highly preferable to the use of earth-moving equipment. • Rehabilitate all disturbed areas as soon as the construction is completed along the proposed development route. • Ensure that all personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm and this can be achieved through provision of appropriate awareness to all personnel. • Vehicles and construction workers should under no circumstances be allowed outside the site boundaries to prevent impact on the surrounding vegetation. • Where possible, natural vegetation must not be cleared and encouraged to grow. • Disturbance of vegetation must be limited only to areas of construction. • Prevent contamination of natural grasslands by any pollution. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site. • Any fauna (mammal and reptile) that becomes trapped in the trenches or in any construction or operational related activity may not be harmed and must be placed rescued and relocated by an experienced person. • Proliferation of alien and invasive species is expected within the disturbed areas and they should be eradicated and controlled to prevent further spread. • No trapping or any other method of catching of any animal or bird may be performed on site • No storage of building materials or rubbles are allowed in the sensitive areas. • Avoid translocating stockpiles of topsoil from one place to sensitive areas in order to avoid translocating soil seed banks of alien species. • Areas showing dense natural vegetation can be avoided/ spanned in order to reduce vegetation loss.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss and displacement of animals on site.		• Training of construction workers to recognise threatened animal species will reduce the probability of fauna being harmed unnecessarily. • The contractor must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase. • Vehicles must adhere to a speed limit, 30-40 km/h is recommended for light vehicles and a lower speed for heavy vehicles. • All construction and maintenance vehicles must stick to properly demarcated and prepared roads. Off-road driving should be strictly prohibited. • No fires should be allowed at the site • No dogs or other domestic pets should be allowed at the site.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FLORA AND FAUNA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss of habitat and habitat fragmentation		• The most significant way to mitigate the loss of habitat is to limit the footprint within the natural habitat areas remaining. • No structures should be built outside the area demarcated for the development. • Although it is unavoidable that sections of the powerline will need to traverse areas of potential sensitivity, the powerline construction should be constructed in such cases so as to avoid further impact to these areas. • Where possible, the proposed linear infrastructure (powerline) should be aligned with existing linear infrastructure or routed through already transformed/degraded areas. • All stockpiles, construction vehicles, equipment and machinery should be situated away from the natural vegetation.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss of vegetation due to fuel and chemical spills.		• Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person. • Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. • Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Introduction of alien species.		• During construction, the construction area and immediate surroundings should be monitored regularly for emergent invasive vegetation • Promote awareness of all personnel. • The establishment of pioneer species should be considered with the natural cycle of rehabilitation of disturbed areas, which assists with erosion control, dust and establishment of more permanent species. This can be controlled during construction phase and thereafter more stringent measures should be implemented during the rehabilitation and post rehabilitation. • Larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Destruction of alien vegetation.		• All alien seedlings and saplings must be removed as they become evident for the duration of construction phase • Manual / mechanical removal is preferred to chemical control.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Increased soil erosion		• Topsoil should be stored in such a way that does not compromise its plant-support capacity. • Topsoil from the construction activities should be stored for post-construction rehabilitation work and should not be disturbed more than is absolutely necessary. • Protect topsoil in order to avoid erosion loss on steep slopes. • Protect topsoil from contamination by aggregate, cement, concrete, fuels, litter, oils, domestic and wastes. • An ecologically-sound storm water management plan must be implemented during construction and appropriate water diversion systems put in place.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Loss of habitat of the CBA and ESA		• Where possible, natural vegetation must not be cleared and encouraged to grow. • Disturbance of vegetation must be limited only to areas of construction. • Areas cleared of vegetation must be re-vegetated prior to contractor leaving the site Vehicles and construction workers should under no circumstances be allowed outside the site boundaries to prevent impact on the surrounding vegetation. • All stockpiles, construction vehicles, equipment and machinery should be situated away from the natural vegetation. • Prevent contamination of natural areas by any pollution.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA AND FAUNA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Damage to plant and animal life outside of the proposed route alternatives		• Any fauna (mammal, reptile and amphibian) that becomes trapped in the trenches or in any construction or operational related activity may not be harmed and must be placed rescued and relocated by an experienced person. • Proliferation of alien and invasive species is expected within the disturbed areas and they should be eradicated and controlled to prevent their spread. • No unauthorised vehicles should be allowed to drive through the site during the construction activities. • No trapping or any other method of catching of any animal may be performed on site. • Illegal hunting is prohibited. • No dumping of any form is permitted. • No damage and/or removal/trapping/snaring of indigenous plant or animal material for cooking and other purposes will be allowed. • All areas to be affected by the proposed project will be rehabilitated by indigenous vegetation. • Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by Environmental Control Officer (ECO). • Natural areas which could be deemed as no go should be clearly marked. • River systems must be spanned and no towers should be placed within the buffer zones dictated by the surface water studies.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact		Mitigation				
Disturbance to animals		• Animals residing within the designated area shall not be unnecessarily disturbed. • During construction, refresher training can be conducted to construction workers with regards to littering and poaching. • The Contractor and his/her employees shall not bring any domestic animals onto site. • Toolbox talks should be provided to contractors regarding disturbance to animals. Particular emphasis should be placed on talks regarding snakes.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA OPERATIONAL PHASE						
Potential Impact				Mitigation		
The proposed construction activities may affect biodiversity through the encroachment of exotic vegetation following soil disturbance, in addition the maintenance of the area would disturb naturalised species within the area.				Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring program to control and/or eradicate newly emerging invasives.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION/POST CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Loss of habitat due to construction activities	• All areas to be affected by the proposed project will be rehabilitated after construction and all waste generated by the construction activities will be stored in a temporary demarcated storage area, prior to disposal thereof at a licensed registered landfill site. • As much vegetation growth as possible should be promoted within the proposed route alternatives in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping. In terms of the percentage of coverage required during rehab and also the grass mix to be used for rehab, the EMPr will be consulted for guidance. However, the plant material to be used for rehabilitation should be similar to what is found in the surrounding area.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FAUNA OPERATIONAL PHASE						
Potential Impact		Mitigation				
Disturbance of faunal species		• The disturbance of fauna should be minimized. • Animals residing within the designated area shall not be unnecessarily disturbed.				
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

12.3 Cumulative Impacts

Cumulative impacts can be identified by combining the potential environmental implications of the proposed project with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area. The following cumulative impacts are anticipated:

- Loss of sensitive vegetation types;
- Encroachment of alien vegetation and
- Loss of plant species of conservation concern and protected trees.

Cumulative Impacts						
Potential Impact:	Loss of sensitive vegetation types					
Proposed Mitigation:	• Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person. • Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. • Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use. • Implement suitable erosion control measures.					
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Without Mitigation	-	Local	Medium	Long Term	Likely	2
With Mitigation	-	Local	Low	Long Term	Unlikely	1
Potential Impact:	Encroachment of alien vegetation					
Proposed Mitigation:	Rehabilitation measures must be implemented once construction activities are completed in order to ensure that alien vegetation will be controlled during the construction and operational phases.					
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Without Mitigation	-	Local	Medium	Short	Moderate	2
With Mitigation	-	Local	Low	Short	Unlikely	1
Potential Impact:	Loss of plant species of conservation concern and protected trees.					
Proposed Mitigation:	• It is recommended that prior to construction, the *Boophane disticha* plant species recorded must be searched and rescued and then following construction activities, they can be re-established at the site or along the route. • A permit from DAFF is required before construction commences in order to disturb, destroy or remove the several *Acacia erioloba* noted along the routes. • It is therefore recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Red Data Listed species and also to develop a comprehensive and site-specific EMPr so as to limit the impacts imposed by the proposed development activities at each tower site. This is relevant in the areas that have been labelled as ecologically sensitive.					
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Without Mitigation	-	Local	Medium	Short	Likely	2
With Mitigation	-	Local	Low	Short	Unlikely	1

13 ANALYSIS OF ALTERNATIVES

Based on the terrestrial ecological sensitivity map and analysis, the four proposed route alternatives were compared to identify the route with the least impacts from a terrestrial ecological point of view. All four proposed route alternatives traverse similar habitat units, however almost 2km of the Option 2 (WM13) corridor traverses the Critically Endangered terrestrial threatened ecosystem, the Western Highveld Sandy Grassland. Option 2 (WM13), however, traverses degraded portions of threatened ecosystem habitats and is the alternative with the shortest length (175km) which would lead to less clearing of CBA regions (**Table 12**).

Even though Option 3 is the alternative that runs along the N18 for a longer distance (approximately 28km), large sections of the CBA 2 areas will be affected (**Table 12**). Almost 3km of this corridor traverses sections of the Leon Taljaard Nature Reserve near Vryburg. However, the position of the final servitude can be amended to avoid the Nature Reserve. Like Option 3, the corridor of Option 1 also traverses sections of the Nature Reserve for about 3km, but more natural areas depicted as CBA 2 will be affected. Option 4 traverses the Makgoro Game Ranch, which is home to mammal species such as Buffalos and also traverses more natural areas depicted as CBA 2.

Therefore Option 2 is preferred from a terrestrial ecology point of view.

Table 12. CBA 2 regions which will be affected by the proposed Mookodi-Mahikeng 400kV powerline

Options	CBA 1 (ha)	CBA 2 (ha)
Option 1 (WM1)	0	6343
Option 2 (WM13)	0	4884
Option 3 (WM4a)	0	7823
Option 4 (WM9a)	0	5069

14 CONCLUSION AND RECOMMENDATIONS

The proposed Mookodi-Mahikeng 400kV Powerline route alternatives fall within the Savanna biome. However, a very small section of Alternative Route Option 2 (WM13) also falls within the Grassland biome. The Savanna Biome is the largest Biome in South Africa and occupies over one third of the whole area. It is characterized by a grassy ground layer and distinct upper layer of woody plants. The Grassland biome has a high biodiversity, ranked only below the Fynbos biome in terms of biodiversity in South Africa. This Biome is found mainly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. Grasslands are dominated by a single layer of grasses. Trees are absent, except in a few localised habitats and geophytes are often abundant. The study area is classified as falling within the following vegetation types: Ghaap Plateau Vaalbosveld (Savanna biome), Stella Bushveld (Savanna biome), Mafikeng Bushveld (Savanna biome) and very small portions of Western Highveld Sandy Grassland (Grassland biome) and Southern Kalahari Salt Pans (Azonal vegetation).

During the field survey, no threatened plant species were observed along the four proposed route alternatives; however, two (2) species of conservation concern (Orange Listed Plants) (listed as *Declining)* were found, namely *Vachellia erioloba (= Acacia erioloba)* (known as Camel Thorn) and *Boophane disticha* (known as Century Plant). These plant species were recorded along the four alternative routes. It is recommended that prior to construction, the *Boophane disticha* plant species recorded must be searched and rescued and then following construction activities, they can be re-established at the site or along the route.

Vachellia (Acacia) erioloba (Camel thorn), which is listed as a protected tree in terms of the National Forests Act (Act No. 84 of 1998), were recorded in abundance along the four route alternatives. In terms of a part of section 51(1) of the National Forests Act (Act No. 84 of 1998), no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister of DAFF.

The major concerns on site are alien invasives, weeds and potential invasives. Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring programme to control and/or eradicate newly emerging invasives. The rehabilitation of disturbed areas should receive high priority and must be included in the EMPr and recommendations regarding the specific plant species used during rehabilitation should be site specific and based on the surrounding vegetation composition. Mitigation measures provided will ensure that any available ecological linkages between sensitive areas are not affected negatively. Mitigation measures included within this report are feasible and will be easy to achieve. Several of the mitigation measures included here have been implemented successfully on several different construction sites. The servitudes can also provide a potential positive impact by not allowing further development within these areas. It is critical that operations are limited to the required footprint only.

Historically, the study area could have provided habitat for a diverse population of larger mammal species, but the agricultural activities and human settlements, associated with hunting activities, have transformed the majority of the habitats and due to these anthropogenic disturbances, it is likely that only the more common and smaller mammal species will be observed, which show more adaptation. Mammal species such as Gemsbok, Springbok, Blesbok, Sable, Greater Kudu, Blue Wildebeest, Nyala, Common Warthog, Common Eland, Red Hartebeest, Waterbuck, Impala, Common Tsessebe, Burchell's Zebra, African Buffalo, White Rhinoceros and a Camel were either recorded in the Leon Taljaard Nature Reserve, Makgoro Game Ranch or Boereplaas Holiday Resort Resort.

Some sections of the proposed route alternatives offer suitable habitat for Giant Bullfrog to occur in the study area. The conservation of this species and of amphibians in general will be met by the protected area network as well as the designation of priority habitats *i.e.,* pans or quaternary catchments, with associated restrictions on land use.

All four route alternatives incorporate habitat units that would support a variety of both faunal and floral species biodiversity to a greater or lesser extent and the impacts on biodiversity and habitat conservation can be successfully mitigated with the sincere efforts of the contractor and construction teams. Areas exhibiting dense natural vegetation can be avoided/ spanned in order to reduce vegetation loss and also river systems must be spanned and no towers should be placed within the buffer zones dictated by the surface water studies. Powerlines do not result in large-scale clearing and suitable mitigation measures can be implemented to reduce the identified impacts. Option 2 (WM13) is preferred from a terrestrial ecology point of view.

It is therefore recommended that a walk-down survey of the approved route alternative be undertaken prior to the start of the construction activities in order to survey the area in detail for any Red Data Listed species and also to develop a comprehensive and site-specific Environmental Management Programme (EMPr) so as to limit the impacts imposed by the proposed development activities at each tower site and tower locations can then be adjusted accordingly. The walk-down survey should preferably be undertaken during summer season in order to have a higher probability of detecting species of special concern. This is relevant in the areas that have been labelled as ecologically sensitive. In order to conserve the faunal species community structures within the region, habitat destruction should be limited to an absolute minimum as intact habitat would result in higher faunal and floral species diversity. It is therefore critical that operations are limited to the required footprint only. It is recommended that the larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes.

After the conclusion of this Terrestrial Ecological Assessment, it is the opinion of the ecologist that the proposed development be considered favourably provided that the sensitivity map be considered during the planning and construction phases of the proposed development activities to aid in the conservation of ecology within the study area. Once the proposed development has been constructed, rehabilitation process needs to take place and should ensure that alien plant emergence and erosion do not occur.

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Appendix A: Eskom's standard document which deals specifically with vegetation management in Eskom land including servitudes and rights of way

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4 June 2018

Attention: Kristy Robertson
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RE: SPECIALIST EXTERNAL REVIEW OF THE TERRESTRIAL ECOLOGICAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED MOOKODI-MAHIKENG 400KV POWERLINE, NORTH WEST PROVINCE

The Biodiversity Company was requested to undertake a specialist external review of the terrestrial ecological assessment compiled as part of the environmental authorisation process for the proposed Mookodi-Mahikeng 400kv powerline, undertaken by Mr. Avhafarei Phamphe of Nemai Consulting in May 2018. The terms of reference of the review included the following:

- A CV clearly showing expertise of the peer reviewer;
- Acceptability of the terms of reference;
- Is the methodology clearly explained and acceptable;
- Evaluate the validity of the findings (review data evidence);
- Discuss the suitability of the mitigation measures to address the short comings;
- Identify and short comings and mitigation measures to address the short comings;
- Evaluate the appropriateness of the reference literature;
- Indicate whether a site-inspection was carried out as part of the peer review; and
- Indicate whether the article is well-written ad easy to understand.

The following sections present comment / response on the terms of reference for the completed peer review.

1. A CV clearly showing expertise of the peer reviewer
A CV has been provided, and attached to this report.

2. Acceptability of the terms of reference
The ToR for the study are comprehensive and in fact make allowances for “general” and also “study specific” requirements. Comments were made with reference to the fulfillment of the ToR, with particular reference to the assessment of impacts for various phases of the operation, and also a cumulative impact assessment.

3. Is the methodology clearly explained and acceptable
The methodology is comprehensive and addresses flora, mammals, reptiles and amphibians separately. The date of the site visits is presented. The methodology also makes reference to literature sources, museum records and sampling / search methods. The detail provided therein does provide an indication that literature reviews were conducted for the project, and that preparations were made for the sampling / searching of expected or likely species. Brief descriptions are provided on how sampling / searching was conducted, and where ie burrows, water bodies etc.

4. Evaluate the validity of the findings (review data evidence)

The findings provided are regarded as comprehensive, taking into account the scale of the project and the likely limitations such as access issues.

A comment was made to check and confirm all references as some were not included in the reference list.

A comment was made to review the presence of the South Kalahari Salt Pans vegetation type along the Option 3 alternative.

Details pertaining to vegetation identified for the project are provided, with a table indicating what species were encountered for the various alternatives. A diagram is presented to indicate the localities of *Vachellia (Acacia) erioloba* along the various routes. It has been assumed these localities will be provided to the applicant for consideration in selecting the preferred route. The abovementioned table also makes reference to alien vegetation and threatened plant species identified for the study. The report elaborated further on the alien vegetation encountered (with supporting pictures), which are required to be removed. A section of the report also presents further information (with supporting pictures) with regards to the threatened plant species identified for the project, with the localities of these species presented in aerial images.

A section of the report addresses available habitat types for plant species of conservation importance. A comment was made to include the land cover (2012/ 2013) dataset to provide a broader land cover description for the various alternatives.

Desktop results are provided for the faunal component of the report, with the likelihood of listed species presented where relevant. An indication is made as to whether any of these species were recorded for the alternatives. Information has been provided as to what mammal species were recorded for the various alternatives, with supporting photographs (albeit limited) provided. No indication has been provided as to which herpetofauna species were recorded for the respective alternatives. A comment was made to review the status (Near Threatened) of the Giant Bullfrog discussed in the report, with the status more likely to be Least Concern (to be confirmed).

A terrestrial sensitivity analysis is provided which provides an indication of the extent of CBA / ESA in relation to the various alternatives. A comment was made to quantify this for each alternative in order to provide a comparison of the extent for these CBA / ESAs for each alternative. A comment was made to expand on the requirements to classify an areas as a CBA or ESA in order to confirm if the dataset information is accurate, or could be motivated for re-classification.

With regards to the analysis of route alternatives a comment was made to create a sensitivity map for each of the routes, which therein in also quantifies the extent of CBA / ESAs, delineated habitat types and vegetation types. Thereby a comparison could be made as to which alternative is the least sensitive, and possibly the best suited for the project.

5. Discuss the suitability of the mitigation measures to address the short comings

Impacts were assessed for various phases of the project, considering the faunal and floral impacts separately. The assessment is considered to be comprehensive and the listed mitigation measures satisfactory.

6. Identify and short comings and mitigation measures to address the short comings

The most notable short coming of the assessment is with regards to the scale of the project and the associated limitation of gaining site access. The recommendation to again re-evaluate the impacts and proposed mitigation measures during a walk-down of the selected route is supported.

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7. Evaluate the appropriateness of the reference literature

The methodology makes reference to literature sources. The detail provided therein does provide an indication that literature reviews were conducted for the project, and it appears from this that these are appropriate and suitable for the requirements of this project.

8. Indicate whether a site-inspection was carried out as part of the peer review

No site inspection was conducted for this review.

9. Indicate whether the article is well-written and easy to understand.

The report is well structured and easy to navigate. The structure of the report is regarded as typical (or expected) for the requirements of the project.

I trust this document presents clarity on the findings of the completed review.

Yours Faithfully,

Andrew Husted

The reviewer is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field.

ANDREW HUSTED

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ACADEMIC QUALIFICATION AND TRAINING

- MSc (University of Johannesburg) – Aquatic Health.
- BSc Honours (Rand Afrikaans University) – Aquatic Health
- BSc Natural Science
- Pr Sci Nat (400213/11)
- Certificate of Competence: Mondi Wetland Assessments
- Certificate of Competence: Wetland WET-Management
- SASS 5 Accredited – Department of Water Affairs and Forestry for the River Health Programme
- EcoStatus application for rivers and streams

SKILLS AND EXPERIENCE

- Aquatic ecological state assessments of rivers and dams.
- Instream Flow Requirement or Ecological Water Requirement studies for river systems.
- Ecological wetland assessment studies, including the integrity (health) and functioning of the wetland systems.
- Wetland offset strategy designs.
- Wetland rehabilitation plans.
- Monitoring plans for rivers and other wetland systems.
- Toxicity and metal analysis of water, sediment and biota.
- Fish telemetry assessment that included the translocation of fish as well as the monitoring of fish in order to determine the suitability of the hosting system.
- Faunal surveys which includes mammals, birds, amphibians and reptiles.
- The design, compilation and implementation of Biodiversity and Land Management Plans and strategies.
- Business and operational development
- Familiar with World Bank, Equator Principles and the International Finance Corporation requirements
- Environmental ,Social and Health Impact Assessments (ESIA)
- Environmental Management Programmes (EMP)
- Biodiversity Specialist Assessments
- Biodiversity and Land Management Strategies
- Wetland and Biodiversity Offset Strategies
- Aquatic Ecological Assessments
- Rehabilitation

- Monitoring Programmes

PREVIOUS EMPLOYER

Digby Wells Environmental
October 2013 – December 2014: London Operations Manager
March 2012 – September 2013: Biophysical Department Manager
January 2011 - February 2012: Ecological Unit Manager
June 2010 - December 2010: Aquatic Services Manager
August 2008: Aquatic ecologist

Econ@UJ (University of Johannesburg)

- June 2007 – July 2008: Junior aquatic ecologist
- Researcher
- Technical assistant for fieldwork
- Reporting writing
- Project management

CURRENT EMPLOYMENT

The Biodiversity Company
Position: Director
December 2014 – Present

EXPERIENCE THAT HAS A BEARING ON THE SCOPE OF WORK

<u>Mkomazi Bridge Upgrades / KZN</u>
Baseline wetland and aquatic study - Basic Assessment EIA

<u>Mkhomazana Bridge upgrade / KZN</u>
Baseline wetland and aquatic study - Basic Assessment EIA

<u>Nigel SMP review / Gauteng</u>
Wetland report peer review

<u>P129 Road Upgrade / KZN</u>
Baseline wetland and aquatic study - Basic Assessment EIA

<u>P130 Road Upgrade / KZN</u>
Baseline wetland and aquatic study - Basic Assessment EIA

<u>Sea Ridge Eco Estate / KZN</u>
Baseline wetland and aquatic study - Basic Assessment EIA

<u>Pembani Wetland Delineation / Mpumulanga</u>
Wetland delineation

<u>Mhlalane River Pedestrian Bridge / KZN</u>
Baseline wetland and aquatic study - Basic Assessment EIA

<u>Proposed Rietspruit pipeline / Gauteng</u>
Baseline wetland and aquatic study - Basic Assessment EIA

Nomyeni bridge
Baseline Aquatic Assessment - Basic Assessment EIA

P569 Road Realignment / KZN
Baseline wetland Assessment - Basic Assessment EIA

Proposed Seaview Clay Mine / KZN
Baseline wetland and aquatic study - Basic Assessment EIA

Joburg Water Pipeline Crossings / Gauteng
Baseline wetland and aquatic study - Basic Assessment EIA

Proposed D2069 Pipe Crossing / KZN
Baseline wetland and aquatic study - Basic Assessment EIA

Proposed Mfolozi Bridge / KZN
Baseline wetland and aquatic study - Basic Assessment EIA

Proposed Mlalazi Bridge (P569) / KZN
Wetland Assessment - Basic Assessment EIA

Proposed Nembe Bridge / KZN
Baseline wetland and aquatic study - Basic Assessment EIA

Sand Winning - Musungu Borrow Pit / KZN
Aquatic assessment - Basic Assessment

Proposed Umgeni Bridge
Baseline wetland and aquatic study - Basic Assessment EIA

Proposed Nseleni Bridge Construction / KZN
Baseline wetland and aquatic study - Basic Assessment EIA

Proposed P515 Culvert Upgrade / KZN
Basic Wetland Assessment - Basic Assessment EIA

Pembani Wetland / Mpumalanga
Wetland incident report

Penumbra Biomonitoring / Mpumalanga
Aquatic Biomonitoring

Penumbra Wetland Monitoring / Mpumalanga
Wetland monitoring program

Vanchem Biomonitoring / Mpumalanga
Aquatic Biomonitoring

Vlakvarkfontein Biomonitoring / Mpumalanga
Aquatic Biomonitoring

Boikarabelo Land Management Plan / Limpopo

Biodiversity action Plan, Veld Condition Assessment (Project Manager)

Boikarabelo Biomonitoring /Limpopo
Aquatic Biomonitoring

Kriel Colliery BAP /Mpumalanga
Biodiversity Action Plan

Summerset Ext 10 Housing Development / Gauteng
Wetlands and floodline delineation - Basic Assessment EIA

PUBLICATIONS

Tate RB and Husted, A. 2014. 2nd Review. Aquatic Biomonitoring in the upper reaches of the Boesmanspruit, Carolina, Mpumalanga, South Africa. African Journal of Aquatic Science.

Tate RB and Husted A. 2013. Bioaccumulation of metals in *Tilapia zillii* (Gervai, 1848) from an impoundment on the Badeni River, Cote D'Iviore. African Journal of Aquatic Science.

O'Brien GC, Bulfin JB, Husted A. and Smit NJ. 2012. Comparative behavioural assessment of an established and new Tigerfish (*Hydrocynus vittatus*) population in two manmade lakes in the Limpopo catchment, Southern Africa. African Journal of Aquatic Science.

Tomschi, H, Husted, A, O'Brien, GC, Cloete, Y, Van Dyk C, Pieterse GM, Wepener V, Nel A and Reisinger U. 2009. Environmental study to establish the baseline biological and physical conditions of the Letsibogo Dam near Selebi Phikwe, Botswana. EC Multiple Framework Contract Beneficiaries.8 ACP BT 13 – Mining Sector (EDMS). Specific Contract N° 2008/166788. Beneficiary Country: Botswana. By: HPC HARRESS PICKEL CONSULT AG

Husted A. 2009. Aspects of the biology of the Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*): Feeding biology and metal bioaccumulation in five populations. The University of Johannesburg (Thesis).

Appendix 6B: Avifaunal Impact Assessment

PROPOSED MAHIKENG-MOOKODI 400 kV OVERHEAD POWERLINE DEVELOPMENT, NWP.

AVIFAUNAL IMPACT SURVEYS

Prepared for:

Nemai Consulting

Report author:	Dr Mathew Ross (*Pr Sci Nat*); Dr Tahla Ross
Report Ref:	Mahikeng-Mookodi 400kV Avifauna_201804
Date:	May 2018
Version:	DRAFT

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DECLARATION

PROJECT: PROPOSED MAHIKENG-MOOKODI OVERHEAD 400 kV POWERLINE, NWP: Avifaunal Impact Survey.

This report has been prepared according to the requirements of the Environmental Impact Assessments Regulations (GNR 982) in Government Gazette 38282 of 4 December 2014. We (the undersigned) declare the findings of this report free from influence or prejudice.

Report Authors:

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MJRoss

Date: 18 May 2018

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MSc (Zoology) (RAU)
PhD (Zoology) (RAU)

Field of expertise:

Biomonitoring and wetland evaluations, aquatic ecology, aquatic & terrestrial fauna and flora, avifaunal specialist.

TRoss

Date: 18 May 2018

Dr T Ross

EXECUTIVE SUMMARY

Introduction and Background

ESKOM Transmission has proposed the development of a 400 kV powerline between Mahikeng and Vryburg in the North West Province. Four alignment options were provided as potential routes for consideration.

EnviRoss CC was requested to undertake the avifaunal ecological and impact surveys pertaining to the project. This would allow development-specific mitigation measures to be proposed to abate the ecological impacts associated with the proposed development activities. It also would allow for the determination of a preferred alignment from an avifaunal conservation perspective.

Survey methodology included a comprehensive desktop review, utilising available provincial ecological data, relevant literature, GIS databases, topographical maps and aerial photography. This was then supplemented through a ground-truthing field survey undertaken during April 2018, where pertinent areas associated with the various available habitat units were surveyed for condition and associated potential to support avifaunal biodiversity that has been recorded from the region. Emphasis was placed on ascertaining the potential for the habitat units of supporting Red Data Listed species.

Results and Discussions

The region falls within the savanna biome and includes three different vegetation units, all of which are typified by mixed woodlands and mesic savanna. There is an inclusion of wetland and riparian habitat as well. The survey area was found to suffer varying degrees of ecological transformation and degradation through current and historical land use practices, with agriculture being the main regional land use. Cultivated land is common for irrigated and dryland crops, but cattle farming also forms a major component of the agricultural sector. Much of the woodlands have been cleared and transformed to open grasslands (either cultivated or naturalised), which adds a further component to the habitat availability to avifauna. Large indigenous trees are commonplace throughout the survey area as well. Primary vegetation features have been retained within areas utilised for game farming. Avifaunal diversity was therefore expected to be relatively high.

Red Data Listed (RDL) avifaunal species were noted during the field survey (numerous sightings of Whitebacked vultures (*Gyps africanus*), which is listed as a critically endangered species. Habitat throughout much of the survey area is suitable for supporting this species, and further RDL avifaunal species as well.

The preferred alignment alternative from an avifaunal ecological perspective was noted to be Option 2. The next preferred alternative is Option 3. The impact significance ratings showed that no fatally flawed aspects were noted and that all impacts can be mitigated to lower their significance.

Conclusions & Recommendations:

The following final conclusions were drawn following an avifaunal survey of the areas that would be impacted by the proposed Mahikeng-Mookodi 400 kV overhead powerline:

- Impact ratings are generally regarded as being within a medium category. This is largely due to the construction of a powerline within an area where limited powerline infrastructure exists. No fatally flawed or high impact features were identified during the survey following the implementation of mitigation measures;
- Development at the substation sites will have limited significance to the avifaunal communities within the area as these sites are generally suffering habitat transformation from existing land uses;
- It is felt that the impacts associated with the proposed development activities can be successfully mitigated to within acceptable limits;
- The preferred alignment alternative is Option 2;
- Migratory corridors have been identified and it is recommended that mitigation measures to make the lines more visible to birds be implemented within these areas;
- Ongoing monitoring should be undertaken during the operations phase of the development to identify further problem areas and mitigation measures implemented if found to be necessary;
- Habitat units that are considered to be particularly important to avifaunal conservation such as watercourses, riparian zones and wetlands should be impacted as little as possible;
- As much of the natural vegetation, including larger trees within servitude areas should be allowed to remain as practically possible. Only larger trees that pose a direct risk to the overhead lines should be removed;
- A walk down survey of the chosen alignment option must be undertaken to identify nests and/or important roosting areas to manage these aspects appropriately;
- Indiscriminate habitat destruction must not be allowed to take place within areas outside of the construction footprint areas. Any destruction of habitat that has occurred that is not part of the ultimate footprint of the infrastructure must be rehabilitated.

It should be noted that, in order to conserve the ecological features within the region, a holistic conservation approach should be adopted. This includes keeping general habitat destruction to an absolute minimum. Conserving the habitat units will ultimately conserve the species communities that depend on it for survival. This can only be achieved by the efforts of the contractor during the various processes of the construction phase.

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1. INTRODUCTION & TERMS OF REFERENCE

1.1. Background and Aims & Objectives

ESKOM Transmission has proposed the development of a new 400 kV overhead powerline that stretches between Mahikeng in the north and the Mookodi Substation (in the south), in the North West Province – a linear distance of approximately 166 km. The locality of the various proposed alignment alternatives is presented in Figure 1.

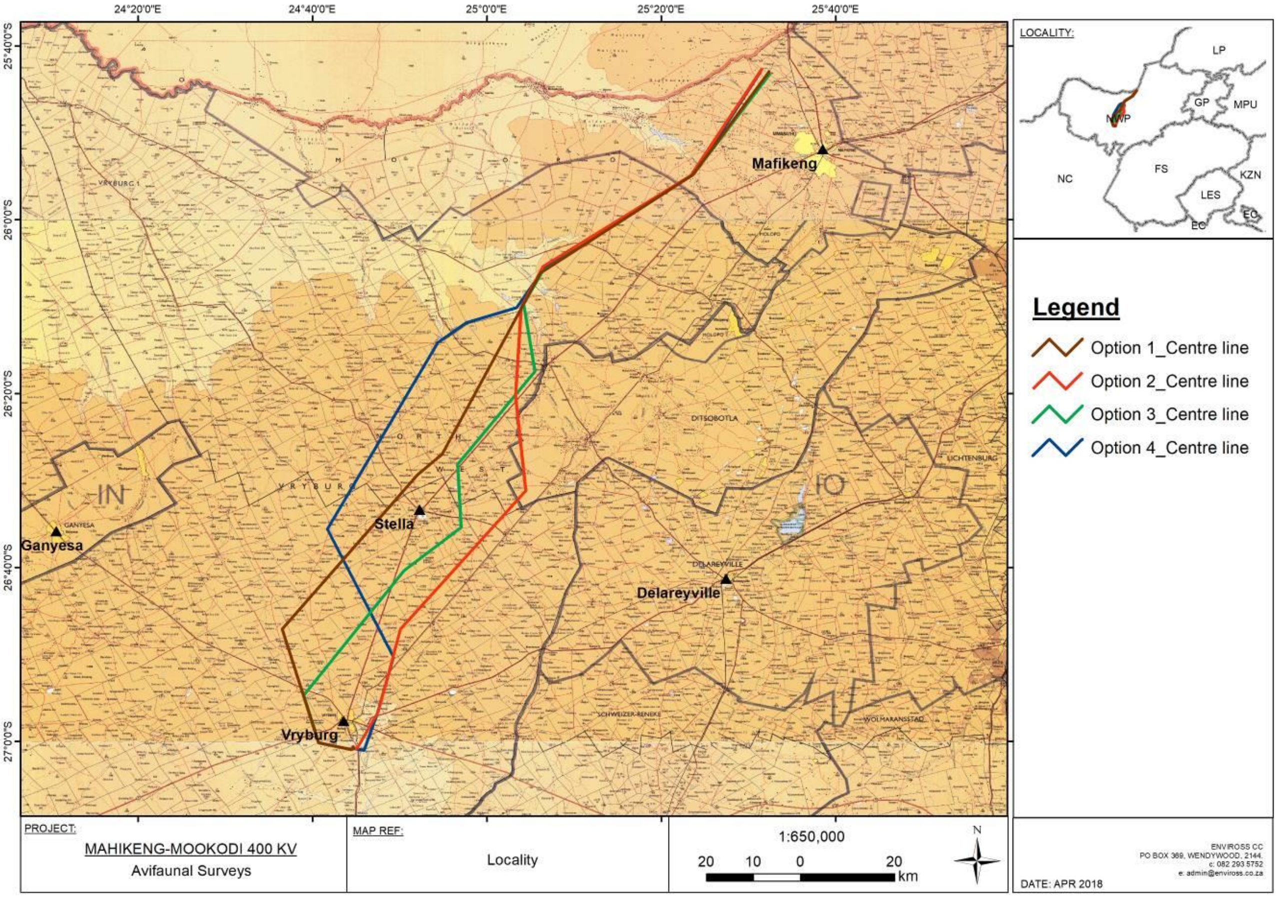

Figure 1: Locality of the proposed development area.

1.2. Scope of Work

EnviRoss CC was requested to undertake an avifaunal ecological and impact survey in order to rate the impact significance to the avifaunal communities emanating from the proposed development activities. Upon completion of the survey, the alignment alternative that poses the least ecological risk can be proposed and mitigation measures to abate the negative ecological impacting features associated with the proposed development activities could be offered.

2. AIMS & OBJECTIVES

The aim of the survey was to ascertain the ecological state of the avifaunal communities within the region associated with the survey area, to evaluate the state of the habitat features and potential dependent avifaunal species that could be impacted by the proposed development activities. Once the habitat features and potential avifaunal species community structures have been ascertained, the significance of the potential impacts emanating from a development of this nature within the areas proposed could be determined. This document presents the findings of a field survey undertaken during April 2018.

3. ASSUMPTIONS & LIMITATIONS

The conclusions to overall perceived impacts have been based on a desktop survey that was reiterated by ground-truthing through a field survey of the proposed development area. Even though every effort was undertaken to identify ecologically sensitive habitats, the presence of RDL and protected species and other pertinent ecological issues relating to the project, the limited time spent on site (limited to a single field survey) necessitated certain assumptions regarding the potential presence or absence of species to be made. These assumptions were largely based on the professional judgement that is supported by similar field experience within similar areas of the specialist.

5. METHODS & MATERIALS

5.1. Desktop survey

Scrutiny of topographical maps, aerial photography and available GIS mapping databases (provincial and national) as well as the latest available literature were used to set the baseline data for the various route alternatives. A large source of data was from the SANBI Biodiversity GIS website (www.bgis.sanbi.org.za) with specific reference to the status of ecosystems and biodiversity within the area, as well as from the Animal Demographic Unit Bird Atlas Project (2) (http://sabap2.adu.org.za).

5.2. Field survey

A field survey was undertaken to assess the site during April 2018, during which various areas pertaining to the proposed development area were assessed. This field survey allowed for the ground-truthing identification of ecologically sensitive habitat, the overall ecological integrity of the vegetation structures, and the areas considered pertinent to avifaunal conservation. The general degree of transformation of the habitat types and units were also assessed during the field survey that allowed for overall general impressions as well as to allow for generalisations regarding habitat sensitivity. This allowed for cross-referencing to those data that were gathered during the desktop survey.

Visual observations were undertaken to identify the avifaunal composition throughout the survey area by making use of binoculars for direct observations and identification of calls for indirect observations and species counts.

6. RESULTS & DISCUSSIONS

6.1. General description of the study area

The proposed development area falls exclusively within the Savanna biome. The alignment route includes three major vegetation types, namely Mafikeng Bushveld, Stella Bushveld and Ghaap Plateau Vaalbosveld. There is also some interaction with Southern Kalahari Salt Pans (an inland wetland unit vegetation type). The region is characterised by an open bushveld complex with tall trees, and a well-developed shrub and grass basal layer. The region is dominated by agriculture, with game farming and cattle being the dominant land use within the northern regions. Commercial cultivation also occurs within the area, also making up a large proportion of the land use within the central areas. Urbanisation only dominates toward the town centres of Mahikeng and Vryburg, to a lesser extent in Stella (south-central area). A diversity of habitat, and large areas of vegetation units that have retained ecological structure, means that avifaunal diversity is expected to be high.

Existing drivers of ecological change include infrastructure development (urbanisation surrounding towns), formal and informal roads, agriculture, existing powerlines and other linear infrastructure. The degree of land impacts vary, with more significant pressures and drivers of ecological change being noted within informal farming areas, where mismanaged grazing by livestock has led to a larger degree of habitat transformation. Crop cultivation is also considered a major driver of ecological change within the region. Various views of the habitat features encountered throughout the survey area are presented in Figure 2.

Various views of the habitat features associated with the proposed Mahikeng Substation site.

Typical habitat features of the northern sections of the survey area that can be described as an open mesic savanna.

Large Camelthorn trees are commonplace throughout the survey area with the greatest densities being noted within the central portions. These trees provide important roosting and breeding sites for many avifaunal species, and are especially suited for nesting sites of larger raptor species.

An existing overhead powerline that is associated with Option 2 for a short distance.

Cultivated cops are common within the survey area.

Open improved grasslands.

Typical habitat features of the soutehrn portions of the survey area.

Figure 2: Various views of the habitat features throughout the survey area.

6.2. Habitat units supporting avifaunal diversity

Within southern Africa, the diversity of bird species in different habitats is strongly dependent on habitat structure, quality of habitat, habitat interconnectivity and rainfall. In general, the least structured and driest habitats have the fewest species, resulting in strong west-east gradient of increasing species richness (Hockey et al, 2006). The relationship between rainfall and species diversity is, however, not as simple as that. Forests, for example, in high rainfall regions of southern Africa support less species diversity than mesic savannas. Endemism in avifaunal distribution is comparably simpler and arid areas incorporate a higher degree of specialist species and therefore endemic species as well. There is therefore a simpler correlation between a rainfall gradient, habitat types and avifaunal species endemism than these climatic features and species diversity (Hockey et al, 2006). The proposed development area occurs within a mesic savanna habitat unit. It includes various vegetation types, so vegetation structure differs slightly from the northern sections to the south. Agriculture has also altered habitat types which has resulted in large expanses of open grasslands within the survey area as well. Cultivation of crops is also a prominent feature, which is a unit known to support many avifaunal species. Sporadic wetland units and riverine and riparian units also have an association with the survey area. The area is dominated, however, by mesic savanna, with varying degrees of vegetation height classes and canopy cover depending on the land use.

The survey area was designated habitat types according to those categories identified by Gibbon (2002) and those species recorded from the region that are known to favour those available habitat types were then focused on for the survey. Red Data Listed and other important migratory species that would potentially suffer undue impacts were emphasised during the survey. It is important to note that many of the avifaunal species are known as habitat generalists and therefore do not show complete habitat type specificity. Other species, however, are confined to only one habitat type. These habitat specialists are species that are generally thought to suffer the greatest impacts as they are unable to adapt to habitat transformations within an area and are very often displaced from a specific area entirely once habitat transformations have taken place.

The habitat types identified for the survey region include the following:

- Grasslands (Gr) – The grassland habitat unit occurs within areas that have been cleared of the tree and shrub components to improve grazing capacity of the area. Grasslands are either cultivated, which results in the dominance of few grassland species, or grasslands that are allowed to maintain a more natural species diversity. Large expanses of grassland areas means that this unit is a prominent feature for consideration throughout the survey area. Grasslands are generally regarded as a highly-productive habitat unit and usually includes a high floral species diversity (except where single species are specifically cultivated). This, in turn, supports a wide diversity of faunal species as well. Grazing of livestock and trampling disturbances occur within these areas, which leads to disturbances of ground-nesting avifaunal species;

- Bushveld and woodlands (BW) – this habitat unit is dominant throughout most of the survey area in various forms and structures. Woodland density is generally medium sparse to sparse. Disturbance impacts have very often dictated the structure of the woodlands, with dominance of bush encroaching species very often dominating within areas utilised for grazing. The degree of habitat transformation is a function of land management within the region. A prominent feature throughout this habitat unit is the relatively high abundance of large Camelthorn (*Vachellia erioloba*), which offers suitable roosting and nesting areas for many larger raptor species;
- Inland water habitats (Wa) – this habitat unit includes the riverine and riparian areas as well as the depression-type wetland features located throughout the survey area, but in greater concentration within the southern portions nearer to Vryburg. Habitat specific species tend to dominate the avifaunal community structures and therefore this is considered an ecologically sensitive habitat type. Another consideration associated with this unit is that many avifaunal species utilise riparian zones for navigational purposes during cyclic migrations. Avifaunal cyclic migrations also occur in association with wetland habitat, with many species migrating to wetland units to forage on a daily basis. The interaction with overhead powerlines with these habitat units therefore warrants significant consideration;
- Farmlands (Fa) – Farmlands (cultivated fields) are common throughout the survey area. It is included here as a habitat unit as many avifaunal species do utilise this unit for foraging purposes (mostly). Farmlands form a habitat type that is usually transformed seasonally and therefore does not form a stable habitat type. They are, however, seasonally attractive to various species such as storks and cranes, or raptors that prey on insects and rodents that feed on crops (ACEE, 2006). Refuge is also very often limited within farmlands due to constant weed control and removal of basal vegetation layers. Many of the habitat generalist species utilise this habitat type predominantly for foraging and hunting purposes. The disturbances of the topsoil layers also very often allow for greater foraging for insectivorous species. The planting of grains increases rodent populations within the fields, which, in turn, increases the hunting potential for raptors and other opportunistic rodent-eating species. The farmland habitat type, however, is not a habitat type that is relied upon by any avifaunal species for survival, but rather utilised by opportunistic species that migrate between agricultural fields. Avifaunal species that undertake these cyclic migrations could affected by collisions with

overhead lines that they intercept (ACEE, 2006). Pesticides and fertilisers (agrochemicals) are well-known hazardous substances to wildlife, which impacts sensitive species within the region.

6.3. General avifaunal impacts

The impacts to avifaunal species and species community structures emanating from the proposed development activities can be categorised under the two main impacts of habitat destruction (loss of habitat during clearing of the servitude, displacement during the construction phase, etc.) and impacts resulting from collisions with the overhead power lines (throughout the operations/lifespan of the infrastructure). This feature is generally limited to larger avifaunal species. There may also be positive impacts to avifaunal species emanating from the proposed development.

Interactions of wildlife, especially birds, with overhead powerlines can be to both the infrastructure (damage to infrastructure due to shorting (earthing) from nest construction, streamers (faecal matter creating an arc between phase wires, etc.) as well as to the biodiversity (ecological impacts). A major cause of unnatural mortality of birds emanates from collisions and electrocutions with overhead lines (van Rooyen, 2004). Electrocution impacts are, however, limited to powerline of less than 132 kV due to the large distance between phase conductors and earth wires that makes it unlikely for birds to come into contact with both simultaneously. Electrocution impacts could still, however, occur, and is more likely to occur as a short circuit due to the build up of faecal matter and/or nesting materials. Species groups most at risk of collision impacts are those with heavier bodies and relatively small wingspan, making them less manoeuvrable and therefore more prone to collisions. Species groups include bustards, storks, cranes, eagles, vultures, ibises, etc. Further groups at risk are fast-flying waterfowl, especially ducks and geese. Another group of birds that are known to migrate at night are flamingos (ACEE, 2001; van Rooyen, 2004). Both the Greater flamingo (*Phoenicopterus ruber*) and Lesser flamingo (*Phoenicopterus minor*) have been recorded from the region. These species tend to migrate between open wetland areas that offer substantive wadeable areas and therefore the likelihood of occurring within the survey area in significant numbers is limited to the southern regions of the survey area.

The avifaunal impacts associated with powerline construction have been identified as the following (van Rooyen, 2004):

1. Site disturbances, habitat destruction and displacement of species. This is important to all species, but is most pertinent to RDL species identified within the area. Initial destruction and then the maintenance of vegetation clearing within servitudes have a greater impact within savanna areas in

comparison to grassland-dominated areas. Grassland areas and areas incorporating a low canopy or sparse canopy cover (low) are generally not stripped of vegetation to accommodate a safe servitude for the overhead line and will re-establish within the servitudes (due to fire risks) following completion of the construction phases. Larger trees and shrubs within savanna areas are felled and removed and are not allowed to re-establish, which leads to habitat transformation. Individuals of larger trees (especially in cases of nationally/provincially protected species) can be accommodated and impacts avoided;

2. Collision of flying birds with overhead wires and electrocution. This is important not only to RDL species, but to all larger and migratory species. *The impact of electrocutions is mostly limited to lines of less than 132 kV due to the short distance between the earth wires and phase wires that can be spanned by larger birds with wider wingspans. This aspect is therefore of limited relevance to the proposed development.* Collisions with overhead powerline and telephone line infrastructure accounts for a considerable proportion of the fatalities of larger avifaunal species. Groups such as korhaans and bustards (both represented within the survey area) seem to be particularly prone to collisions, with mortality rates of up to one individual per year per kilometre of line being reported within Karoo areas (Hockey et al., 2006).

The impacts on the power lines themselves emanating from avifauna within the area have also been identified as important aspects to consider. These include (van Rooyen, 2004):

1. Bird collisions that create interruptions in power supply;
2. Streamers (long streams of bird excreta) emanating from perched birds on pylons can cause short-circuits by affecting the insulators fitted to the line;
3. Nesting birds on pylons that can potentially lead to short-circuits and fires. Some species utilise pieces of wire during nest building, which can short-circuit when the nest collapses (ACEE, 2003).

Research has indicated that 8.1% of recorded line faults have been directly attributed to bird collisions (Bologna et al., 2001). This is the fourth largest reason for recorded line faults behind "unknown reason" (38.2%), storms (28.8%) and grass fires (15.6%). Following further research, the "unknown" category was thought to contain a large proportion of faults related to bird streamers (long streams of bird excreta). Further studies on a 275 kV line have shown that 34% of all line faults were due to bird streamer-related faults (Taylor et al., 1999). This has obvious economic implications, with the estimated cost to the South African economy being in the region of R25 million annually (Bologna et al., 2001). Reducing bird collisions and further impacts emanating from bird interactions with the powerlines is therefore in the better interests of the service provider as line faults are exceedingly costly to rectify.

There are positive interactions between overhead powerlines and avifauna as well (van Rooyen, 2004):

1. Pylons can provide a safe nesting and perching sites away from predators. Some Lesser kestrel colonies have been shown to use overhead lines almost exclusively as perching sites. This species has been recorded from the region and has been considered during the survey. Large colonies are not thought to occur within the area, however. Existing overhead wires and towers were noted to be utilised by a variety of raptors, including Pale Chanting Goshawk, Greater Kestrel and Amur Falcon;
2. Pylons can also provide nesting sites within areas devoid of tall trees. This has enabled certain species to expand their range. Large trees are commonplace throughout the survey area and therefore this is of limited relevance.

6.4. Impacts on avifauna within the survey area

The proposed development activities include the establishment of a 400 kV overhead powerline within an area where limited similar infrastructure exists. Below are some pertinent points that are to be taken into consideration when assessing avifaunal impacts and conservation:

1. The species community structures within the various areas pertaining to the proposed project and what proportions of these communities are at risk to collision impacts and are of conservational significance;
2. The degree of habitat destruction that is considered important to avifaunal conservation (especially RDL species);
3. Areas prone to adverse weather conditions that would increase the risk of collisions (mist, high wind velocities, etc.) (ACEE, 2001);
4. Cultivated grain and pasture crops are often seasonally attractive to many species (e.g. cranes and storks) (ACEE, 2001) and are at risk of collision impacts during routine migrations between roosting and foraging areas;
5. Traversing areas that incorporate topographical features that are known to be used by migratory birds as navigational aids, such as mountains, shorelines and river valleys, that pose a risk of collisions with overhead lines should preferably be avoided (ACEE, 2001; van Rooyen, 2004);
6. Route alternatives would be preferred that are located in close proximity to the existing main transmission system infrastructure. Studies have shown that migratory birds become familiar with the powerline patterns within an area and therefore learn to avoid them (van Rooyen, 2009). This is

of limited relevance to the proposed development, however, with only one alternative following the alignment of a similar overhead line for a short distance;

7. Existing habitat that is considered as being highly degraded due to historical and present transformations is preferred;
8. Habitat units known to be highly productive in supporting breeding, foraging and roosting sites, such as wetlands, should be avoided. Placing powerlines between prominent wetland cluster areas should also be avoided due to the high risk of collision impacts;
9. The degree to which each impact can be realistically mitigated in terms of economic viability and the effectiveness of the mitigation measures needs to be evaluated.

The main migratory routes (if any) needed to be identified as part of the avifaunal impact survey and to determine if the overhead powerlines will pose a threat to migrating birds. The migratory routes followed would typically coincide with river valleys or valley-bottom wetlands, rivers or mountain ridges. This would ultimately lead to an increase in mortalities of various avifaunal species due to collisions with the overhead lines if the line crosses over these habitat types and would therefore require mitigation to lessen the impacts. Migration of avifaunal species between wetland habitat units must also be considered. Some watercourses are associated with the proposed development. Wetland units and wetland clusters are a prominent feature within the southern areas of the proposed alignments and therefore collision impacts emanating from the proposed development activities are of concern.

The impacting features emanating from the proposed development activities would also come from the direct habitat destruction within the footprint of each tower, the clearing of the servitude, especially the removal of larger trees, as well as other infrastructure footprints (servitude roads, etc). This includes the immediate adjacent support areas required for use during the construction phase, such as construction camps, material storage yards, etc.). Species of conservational concern that could be adversely affected by this impact include the ground-dwelling and nesting species such as the bustards, korhaans. It is also applicable to larger raptors that would potentially nest in the larger trees that occur within riparian zones of the watercourses within the area.

6.5. Assessment of avifaunal species diversity

Avifaunal species distribution records from 17 QDS (Quarter degree square) grid areas were utilised to analyse the species data for the survey area. Species details per grid area are presented in Table 1. Species diversity is relatively high throughout the survey area.

Table 1: Avifaunal species details per QDS grid area associated with the survey area.

QDS grid	No. of spp	No. RDL spp	No. spp interacting with PL	No. RDL spp interacting with PL
2525CB	368	24	90	19
2525DA	386	25	90	18
2525CD	367	23	90	17
2525DC	382	23	89	17
2624BB	327	20	82	15
2625AA	342	21	86	16
2625AB	360	23	89	17
2624BC	302	18	79	14
2624BD	316	20	82	15
2625AC	334	21	88	16
2624DA	298	18	80	14
2624DB	310	20	83	15
2625CA	322	23	86	17
2624DC	294	18	80	14
2624DD	299	20	82	16
2724BA	287	20	81	16
2724BB	289	21	82	17
Total survey area	401	26	94	19

There are 401 avifaunal species historically recorded from the survey area, which is a combined distribution list of all of the QDS grid areas. Of these, 16 (3.99%) are regarded as RDL (threatened – CE, EN and VU), and a further 10 (2.49%) are regarded as *Near Threatened* (Orange Listed species). The vast majority (375 [93.52%]) are regarded as least concern (Figure 3).

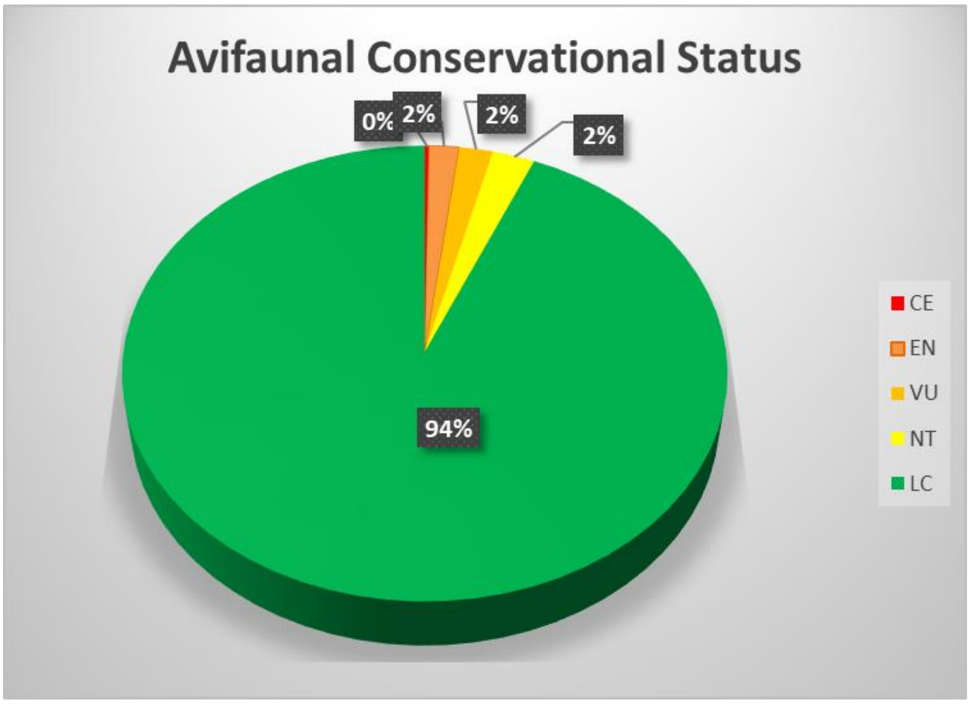

Figure 3: The conservation status of the avifaunal species community within the region.

The diversity of habitat types incorporated into QDS grids from where the complete list is sourced makes for an exaggerated species diversity count and therefore not all of these species would be expected to occur within regions pertaining to the survey area. The habitat units throughout the survey area tend to be relatively homogenous, however, a relatively high proportion of the species diversity recorded is expected to occur within the areas associated with the proposed powerline. The RDL species list recorded from the region is presented in Table 2. The habitat preference for each species are also indicated. Those species that have habitat preferences for the habitat units that are presented within the survey area are thought to be the ones most susceptible to the impacts emanating from the proposed development activities.

Table 2: The RDL and Orange listed avifaunal species recorded from the region pertaining to the entire survey area.

Rob	English Name	*Species*	General Status	RDL Status	Habitats					Expected within the PL region	Expected at SS site
					BW	Gr	Ko	Fa	Wa		
RED DATA LISTED											
123	Whitebacked Vulture	*Gyps africanus*	R-C	CE	1	0	1	0	0	HIGH	LOW
90	Yellowbilled Stork	*Mycteria ibis*	NBM/R-LC	EN	0	0	0	0	1	LOW	LOW
122	Cape Vulture	*Gyps coprotheres*	E-LC	EN	1	1	1	1	0	HIGH	LOW
124	Lappetfaced Vulture	*Torgos tracheliotus*	R-U	EN	1	0	1	0	0	HIGH	LOW
132	Tawny Eagle	*Aquila rapax*	R-LC	EN	1	0	0	0	0	HIGH	LOW
140	Martial Eagle	*Polemaetus bellicosus*	R-U	EN	1	1	1	0	0	HIGH	LOW
165	African Marsh Harrier	*Circus ranivorus*	R-C	EN	0	1	0	1	1	LOW	NONE
168	Black Harrier	*Circus maurus*	E-U	EN	0	1	1	1	0	LOW	NONE
49	White Pelican	*Pelecanus onocrotalus*	R-LC/R	VU	0	0	0	0	1	MED	NONE
50	Pinkbacked Pelican	*Pelecanus rufescens*	R-LC/R	VU	0	0	0	0	1	MED	NONE
77	Whitebacked Night Heron	*Gorsachius leuconotus*	R-R	VU	0	0	0	0	1	LOW	NONE
84	Black Stork	*Ciconia nigra*	R-U/R	VU	0	0	0	1	1	LOW	NONE
118	Secretarybird	*Sagittarius serpentarius*	R-U	VU	1	1	1	1	0	HIGH	LOW
172	Lanner Falcon	*Falco biarmicus*	R-C	VU	1	0	1	1	0	HIGH	LOW
233	Whitebellied Korhaan	*Eupodotis barrowii*	E-U	VU	1	1	0	0	0	MED	NONE
322	Caspian Tern	*Sterna caspia*	R-LC	VU	0	0	0	0	1	LOW	NONE
ORANGE LISTED											
89	Marabou Stork	*Leptoptilos crumeniferus*	R-R/LC	NT	1	0	0	0	1	HIGH	LOW
96	Greater Flamingo	*Phoenicopterus ruber*	R(n)-LA	NT	0	0	0	0	1	HIGH	NONE
97	Lesser Flamingo	*Phoenicopterus minor*	R(n)-LA	NT	0	0	0	0	1	HIGH	NONE
167	Pallid Harrier	*Circus macrourus*	NBM-R	NT	0	1	0	1	0	LOW	NONE
208	Blue Crane	*Anthropoides paradisea*	E-U	NT	0	1	1	0	0	MED	NONE
230	Kori Bustard	*Ardeotis kori*	R-R	NT	1	1	1	0	0	HIGH	LOW
242	Old World Painted Snipe	*Rostratula benghalensis*	R-U	NT	0	0	0	0	1	MED	NONE
247	Chestnutbanded Plover	*Charadrius pallidus*	R-U	NT	0	0	0	0	1	LOW	NONE
305	Blackwinged Pratincole	*Glareola nordmanni*	NBM-LA	NT	0	1	0	0	0	MED	LOW
501	Shortclawed Lark	*Certhilauda chuana*	E-U	NT	1	1	0	1	0	MED	NONE

SS=Substation site; PL=Powerline

The critically endangered species (*Gyps africanus* – Whitebacked vulture) has been recorded within all of the QDS areas associated with the survey area and was observed on numerous occasions during the field survey. This species is at risk through targeted and non-targeted poisonings by stock farmers as well as from collision impacts with overhead powerlines. It utilises large trees within the savanna biome for breeding, which is a habitat unit common within the survey area.

The endangered species are the larger-bodied species as well as large raptors. These species are all vulnerable to collision (high risk) and/or electrocution (low risk) impacts with powerlines as a general lack of manoeuvrability during flight means that they often cannot avoid powerlines during the time between observation and needing to take evasive flight measures. Electrocutions of larger raptors (especially) occur within arid regions where these birds utilise electricity pylons as a substitute for larger trees for roosting and nesting purposes. Intentional and unintentional poisoning of larger raptors (in general) by stock farmers also occurs and is a major source of fatalities amongst this group of birds. Habitat destruction, urban encroachment and general habitat transformation are also considered major factors in driving the conservation status of, not only this group of species, but all of the avifaunal species of conservation concern.

The White stork (*Ciconia ciconia*) and Abdim's Stork (*Ciconia abdimii*) are protected under the BONN Convention. These species are annual migrators to the region and are threatened due to being significantly impacted by collisions with overhead infrastructure and habitat destruction on a global scale. Both of these species were noted during the field survey.

Further to this, there are a variety of non-RDL species that would also suffer undue negative impacts. Most species are limited to collision impacts, but there are species that could possibly suffer electrocution impacts as well. The species that have a preference for the habitat units presented within the survey area and are thought to potentially be impacted by collisions within overhead lines are presented in Table 3.

Table 3: Further non-RDL species that could be impacted by collisions with overhead lines associated within the prject within the survey area.

Rob	English Name	Species	General Status#	Observed
55	Whitebreasted Cormorant	*Phalacrocorax lucidus*	R-C	
58	Reed Cormorant	*Phalacrocorax africanus*	R-C	X
60	Darter	*Anhinga rufa*	R-C	X
62	Grey Heron	*Ardea cinerea*	R-C	X
63	Blackheaded Heron	*Ardea melanocephala*	R-C	X
64	Goliath Heron	*Ardea goliath*	R-U	
65	Purple Heron	*Ardea purpurea*	R-U	X
66	Great White Egret	*Egretta alba*	R-C	X
68	Yellowbilled Egret	*Egretta intermedia*	R-U	
69	Black Egret	*Egretta ardesiaca*	R-LC/R	
71	Cattle Egret	*Bubulcus ibis*	R-C	X
81	Hamerkop	*Scopus umbretta*	R-C	X
83	White Stork	*Ciconia ciconia*	NBM-C	X
85	Abdim's Stork	*Ciconia abdimii*	NBM-C	X

Rob	English Name	Species	General Status#	Observed
91	Sacred Ibis	*Threskiornis aethiopicus*	R-C	X
93	Glossy Ibis	*Plegadis falcinellus*	R-U	X
94	Hadeda Ibis	*Bostrychia hagedash*	R-A	X
95	African Spoonbill	*Platalea alba*	R(n)-C	
99	Whitefaced Duck	*Dendrocygna viduata*	R-C	X
100	Fulvous Duck	*Dendrocygna bicolor*	R-C	
101	Whitebacked Duck	*Thalassornis leuconotus*	R-U	X
102	Egyptian Goose	*Alopochen aegyptiacus*	R-A	X
103	South African Shelduck	*Tadorna cana*	E-C	
104	Yellowbilled Duck	*Anas undulata*	R-A	X
105	African Black Duck	*Anas sparsa*	R-U	X
106	Cape Teal	*Anas capensis*	R-C	
107	Hottentot Teal	*Anas hottentota*	R-C	X
108	Redbilled Teal	*Anas erythrorhyncha*	R-C	
112	Cape Shoveller	*Anas smithii*	Er-C	
113	Southern Pochard	*Netta erythrophthalma*	R-C	
115	Knobbilled Duck	*Sarkidiornis melanotos*	R-LC	
116	Spurwinged Goose	*Plectropterus gambensis*	R-VC	X
117	Maccoa Duck	*Oxyura maccoa*	R-U	
126	Black Kite	*Milvus migrans*	NBM-LC	
126	Yellowbilled Kite	*Milvus aegyptius*	BM-C	X
130	Honey Buzzard	*Pernis apivorus*	NBM-U	X
133	Steppe Eagle	*Aquila nipalensis*	NBM-U	
135	Wahlberg's Eagle	*Aquila wahlbergi*	BM-C	
136	Booted Eagle	*Hieraaetus pennatus*	R/NBM-C	
137	African Hawk Eagle	*Hieraaetus spilogaster*	R-U	
142	Brown Snake Eagle	*Circaetus cinereus*	R-U	X
143	Blackbreasted Snake Eagle	*Circaetus pectoralis*	R-U	X
148	African Fish Eagle	*Haliaeetus vocifer*	R-C	
149	Steppe Buzzard	*Buteo vulpinus*	NBM-C	X
152	Jackal Buzzard	*Buteo rufofuscus*	E-C	X
162	Pale Chanting Goshawk	*Melierax canorus*	Er-C	X
164	Eurasian Marsh Harrier	*Circus aeruginosus*	NBM-R	
166	Montagu's Harrier	*Circus pygargus*	NBM-R	
169	Gymnogene	*Polyboroides typus*	R-C	
170	Osprey	*Pandion haliaetus*	NBM-U	
182	Greater Kestrel	*Falco rupicoloides*	R-C	X
188	Coqui Francolin	*Peliperdix coqui*	R-C	X
189	Crested Francolin	*Dendroperdix sephaena*	R-VC	X
193	Orange River Francolin	*Scleroptila levaillantoides*	R-C	
194	Redbilled Francolin	*Pternistis adspersus*	Er-C	
196	Natal Francolin	*Pternistis natalensis*	Er-C	X
199	Swainson's Francolin	*Pternistis swainsonii*	Er-C	X
203	Helmeted Guineafowl	*Numida meleagris*	R-VC	X
223	Purple Gallinule	*Porphyrio madagascariensis*	R-C	X
226	Common Moorhen	*Gallinula chloropus*	R-C	X
228	Redknobbed Coot	*Fulica cristata*	R-A	X
237	Redcrested Korhaan	*Eupodotis ruficrista*	Es-C	X
239	Whitewinged Korhaan	*Eupodotis afraoides*	E-VC	
297	Spotted Dikkop	*Burhinus capensis*	R-C	X
315	Greyheaded Gull	*Larus cirrocephalus*	R-VC	X
338	Whiskered Tern	*Chlidonias hybridus*	R(n)-LC	
339	Whitewinged Tern	*Chlidonias leucopterus*	NBM-A	
392	Barn Owl	*Tyto alba*	R-C	
395	Marsh Owl	*Asio capensis*	R-C	
401	Spotted Eagle Owl	*Bubo africanus*	R-C	
402	Giant Eagle Owl	*Bubo lacteus*	R-U	

Rob	English Name	Species	General Status#	Observed
547	Black Crow	*Corvus capensis*	R-C	
548	Pied Crow	*Corvus albus*	R-A	X

 # U=Uncommon; C=Common; VC=Very common; LC=Locally common; R=Resident; E=Endemic; Er=Endemic resident; A=Abundant; NBM=Non breeding migrant; BM=Breeding migrant.

The non-RDL species that could potentially be impacted by collisions with the overhead powerlines associated with the proposed development within the survey region are made up of herons, egrets, waterfowl, larger game birds, owls and a variety of larger raptors. The same mitigation measures recommended for averting the impacts on RDL species would be affective in averting the impacts to these species as well. Mitigation measures to abate negative impacts are elaborated on under the relevant section of the report.

Figure 4: A Pale chanting goshawk (left) and Greater kestrel (right) utilising an existing distribution powerline as an advantage lookout point.

6.6. Major migratory corridors

Avifaunal species migrate for a variety of reasons. The migrations that are applicable to the proposed development are those cyclic movements that are undertaken cyclically on a daily (or longer) period of time for foraging/hunting and roosting. Various features are utilised for navigation purposes, which include rivers, prominent linear ridges, and linear infrastructure such as roads. Birds will fly between foraging grounds and roosting areas and between habitat units such as wetlands on a daily basis.

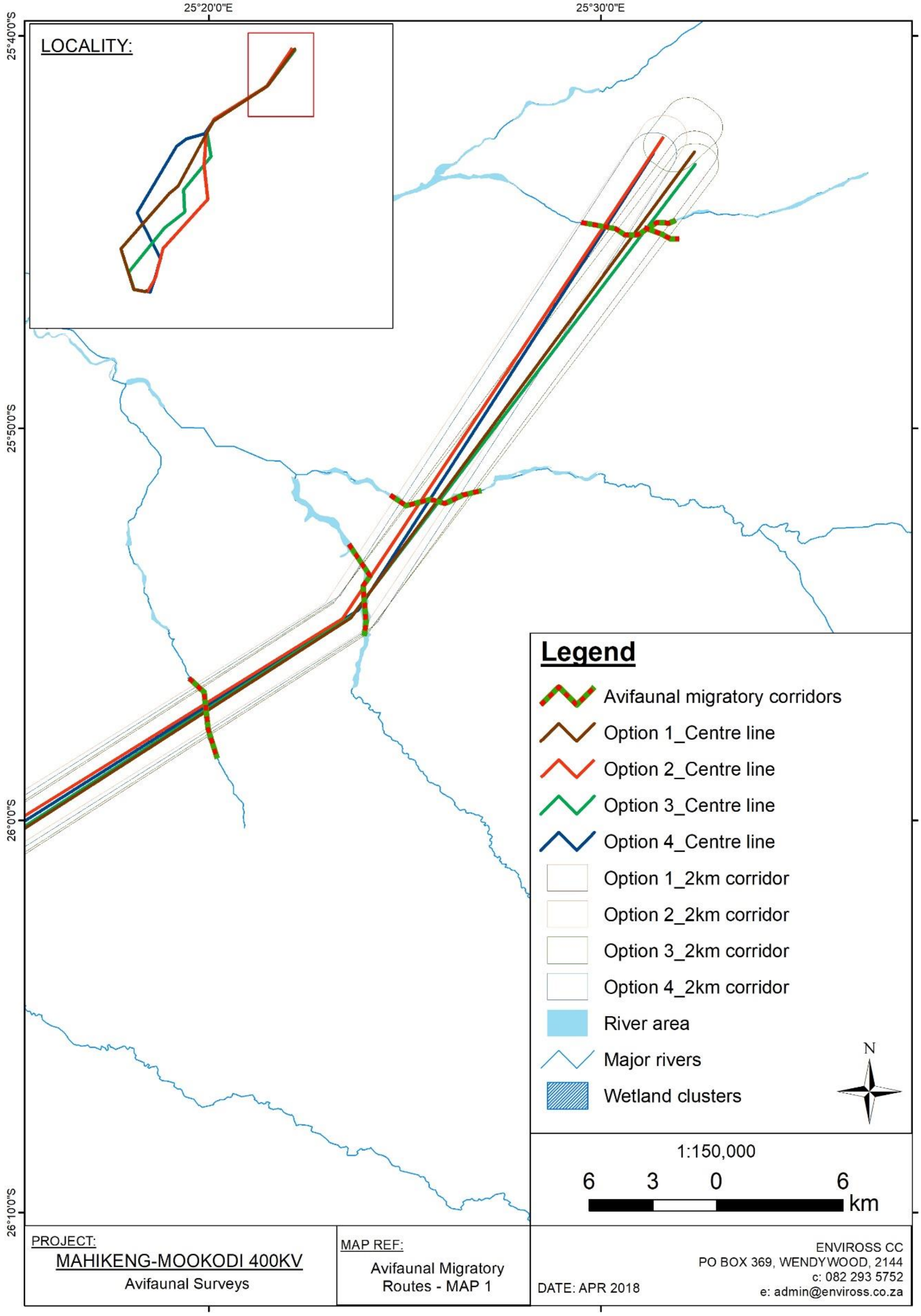

Figure 5: The main migratory routes and how they associate with the various line alternatives within the northern region of the survey area.

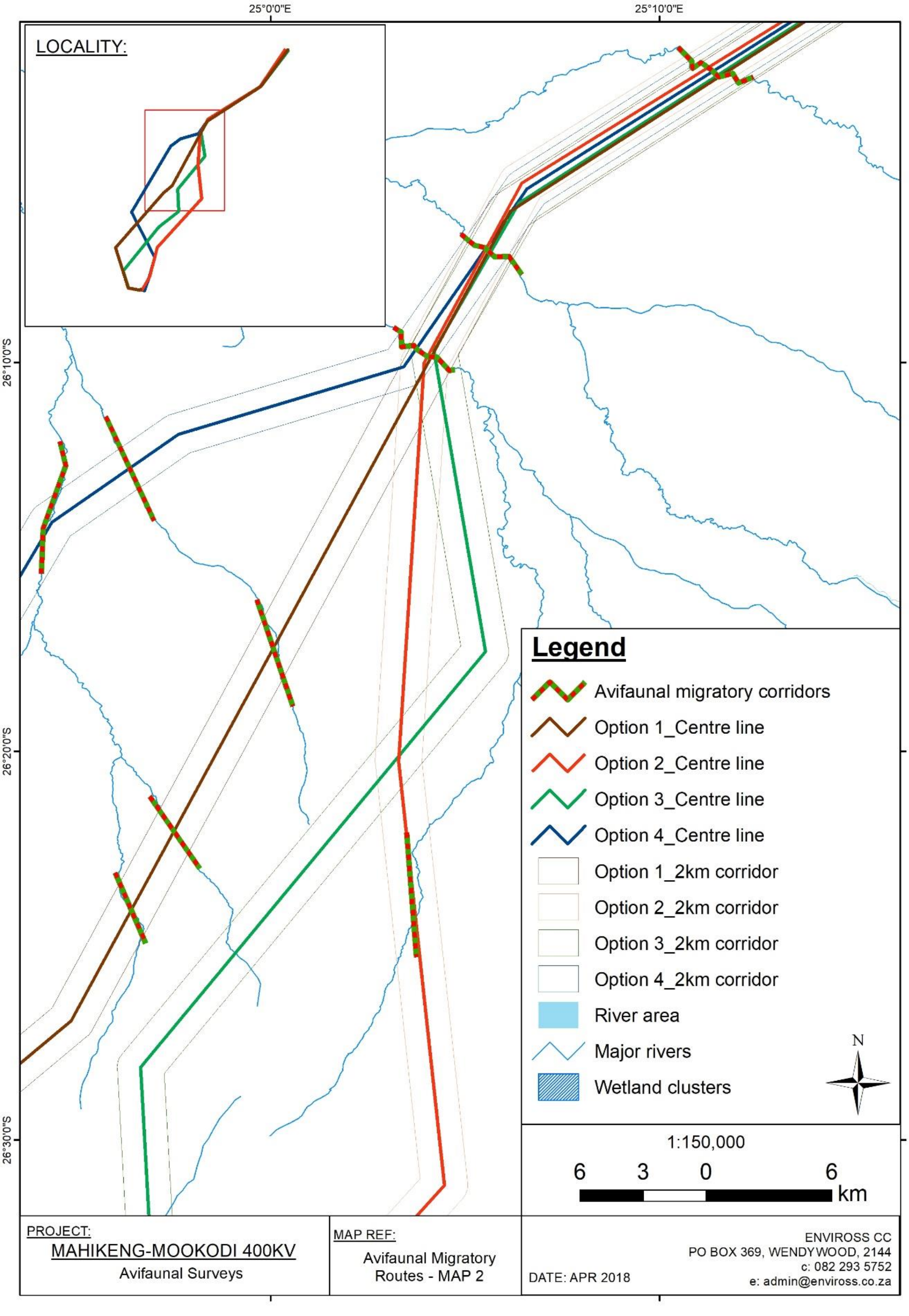

Figure 6: The main migratory routes and how they associate with the various line alternatives within the central region of the survey area.

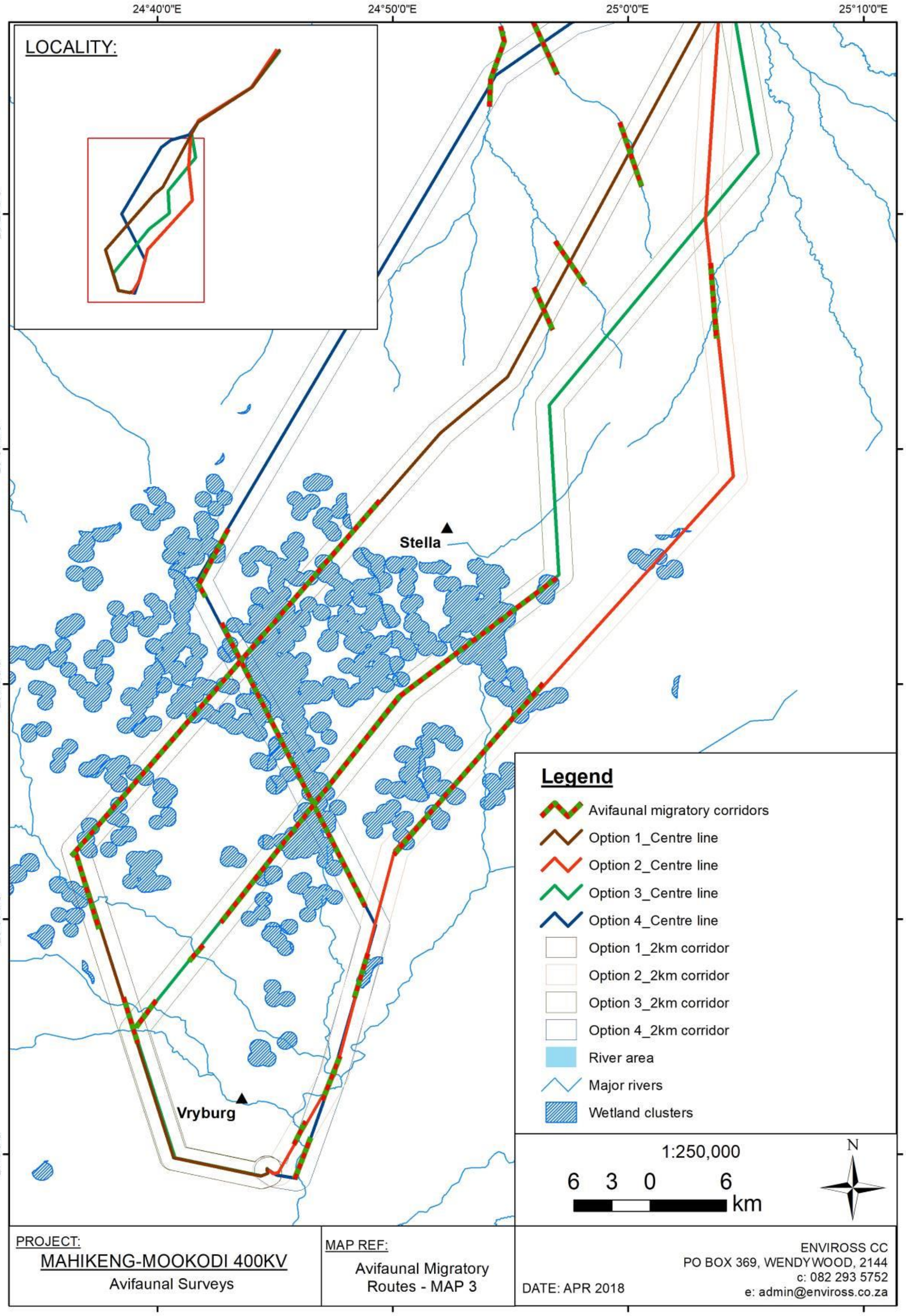

Figure 7: The main migratory routes and how they associate with the various line alternatives within the southern region of the survey area.

Linear aerial infrastructure such as powerlines, if traversing these migratory routes, pose a threat of collision impacts to these birds, with the earth wire very often being the line posing as the most significant line as it is often a single, and therefore difficult to see, wire. The phase conductors are usually clustered and of a greater gauge, which makes them more visible to flying birds, especially in adverse weather conditions and/or low light. The major migratory routes associated with the various line alternatives have been identified and are mapped in Figure 5, Figure 6 and Figure 7. These are the areas that will require mitigation measures to make them more visible. Mitigation measures are outlined under the relevant section of the report.

7. COMPARISON OF ALTERNATIVES

Four powerline alignment alternatives were presented for assessment. The various ecological processes associated with the proposed alignment routes were all considered in calculating an overall impact score for each line. These included habitat units, condition of habitat, association with ecologically sensitive habitat features that are considered important to avifaunal conservation within the region, association with existing linear infrastructure and the overall areas that would require specific mitigation to abate negative impacts to avifaunal species were all aspects considered when alignment alternatives were assessed.

Only one alternative area was presented for the proposed Mahikeng Substation area and therefore the substation is not included within the analysis.

Please note that this comparison deals exclusively to features applicable to avifaunal conservation and makes no reference to further specialist studies that have been utilised in determining the most suitable alignment route. Each aspect has been provided an impact score out of 10. A further factor has been added by multiplying the impact rating by the perceived success rate of the mitigation measures that have been outlined within Section 10. A high perceived success of mitigation is designated a factor of 0.3; a medium perceived success a factor of 0.6 and a low perceived success rate of mitigation, a factor of 1.0. The designated value is provided within brackets after the impact score for each element. This scoring is outlined in Table 4. The overall rating is provided for each alignment option, which is out of a possible 60 points. From the ratings provided, it can be seen that the overall impacts pertaining to the proposed development activities are considered to be of a medium rating. From these scores and ratings, it can be seen that alignment option 2 is regarded as the preferred option. This option has the least association with wetland cluster areas, the lowest rate of crossings of major watercourses and also has an association with an existing overhead powerline for a short distance (the remaining options do not have any association with existing overhead aerial infrastructure). The remaining factors that were considered were all rated similarly for the various options and therefore were not considered to be deciding factors.

From Table 4 it can be seen that alignment Option 2 was rated as the overall lowest impact, with an overall impact rating of 8.1, followed by Option 3 with a calculated rating of 12.3. Options 1 and 4 showed the greatest impact ratings and therefore are the least preferred alternatives.

Table 4: Comparison of the proposed alignment options.

Alignment	Habitat impacts				Loss of large trees	Existing infrastructure association*	Overall rating
	Wetlands	Watercourses	Woodlands	Grasslands			
Option 1	6 (0.6)	6 (0.3)	4 (0.3)	3 (0.3)	4 (0.6)	5 (0.6)	12.9
Option 2	4 (0.3)	4 (0.3)	4 (0.3)	3 (0.3)	4 (0.6)	4 (0.3)	8.1
Option 3	6 (0.6)	4 (0.3)	4 (0.3)	3 (0.3)	4 (0.6)	5 (0.6)	12.3
Option 4	6 (0.6)	6 (0.3)	4 (0.3)	3 (0.3)	4 (0.6)	5 (0.6)	12.9

** The higher score represents a lower association with existing infrastructure (ie a higher association = positive).*

8. SIGNIFICANCE RATINGS OF PERCEIVED ENVIRONMENTAL IMPACTS

Table 5 and Table 6 present the significance ratings of the potential ecological impacts for the *pre-construction and construction* as well as the *operations phases* of the proposed development activities. The ratings are calculated for the scenarios of both before and after the implementation of mitigation measures. This was done in order to show how the degree of impacts can be reduced by careful planning and the following of relatively simple mitigation measures. No very high/fatally flawed impacts have been perceived to be associated with the proposed development activities. The methodologies and ratings system are provided in Appendix A.

Table 5: The impact significance ratings pertaining to the preconstruction and construction phase of the proposed development activities.

PRE-CONSTRUCTION & CONSTRUCTION PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
Clearing of vegetation to accommodate infrastructure and services (roads, etc), which will remove habitat utilised by avifauna.	Direct Impact:	Expected	2	3	4	1.0	9.0 - MOD	Limit the footprint to only areas necessary for the construction process; Utilise single access roads only if service roads are not to be part of operations access roads; Avoid indiscriminate destruction of habitat outside of footprint area.	The survey area suffers varying degrees of vegetation transformation and therefore the significance of this impact also varies. Areas already suffering transformation will have lower impact significance than areas that have retained primary/natural vegetation. This rating is taken as an average of the overall impact.
	Vegetation stripping will be necessary to allow for the establishment of services and infrastructure; Vegetation will have to be removed to allow access for heavy earthmoving equipment, vehicles, etc. This will have varying levels of significance depending on whether it is undertaken in natural areas or areas that have already suffered disturbances.	Cumulative	3	3	4	1.0	10- HIGH		Cumulative loss of the vegetation units to accommodate agriculture is relatively high within the region.
		Residual	1	2	2	1.0	5.0 - MOD		Limited residual impact remains due to the ultimately small footprint area of each tower. Residual impacts will remain where new servitude roads have been established, but this is thought to have limited long-term impacts.
Loss and/or displacement of sensitive avifaunal species.	Direct Impact:	Expected	2	3	4	0.2	1.8 - LOW	Indiscriminate habitat destruction to be avoided and the proposed development should remain as localised as possible (including support areas and services); Observation of the ecological sensitivity map and inclusion of the sensitive areas into planning of access routes, etc will reduce this impact; Site reinstatement and clean up following the completion of the construction phase of each tower site will be important.	The significance of this impact is regarded as being minimal due to the availability of alternate habitat within the area. The wetland and riparian habitats, which have the most potential of supporting RDL or sensitive species, will presumably only suffer marginal/fringing impacts. Sensitive and habitat specialist species will also be dependent on the wetland and riparian habitats.
	Site disturbances and vegetation (habitat) loss may lead to the loss of avifaunal species that are sensitive to disturbances.	Cumulative	2	3	4	0.75	6.75 - MOD		Displacement of sensitive avifaunal species due to habitat destruction and habitat fragmentation eventually leads to isolation and loss of those species. This is, however, considered to be low within the region.

PRE-CONSTRUCTION & CONSTRUCTION PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
		Residual	1	2	2	0.2	1.0 - LOW		Limited residual impact will remain following site reinstatement of each tower footprint following the completion of the construction phase.
Destruction of nesting and/or roosting habitat for avifaunal species.	Direct Impact:	Expected	2	3	4	0.2	1.8 - LOW	A walk-through of the site should be undertaken once tower footprint sites have been established in order to clear the area of any active nests; Limit the footprint to only areas necessary for the construction process; Utilise single access roads only; Avoid indiscriminate destruction of habitat; Rehabilitate areas affected by the construction process as far as possible.	Many large trees occur within the alignment corridors that have a high potential to support nesting of various larger species. Nests of ground-dwelling species will also have to be considered.
	Site clearing will remove all vegetation to accommodate the substation infrastructure development. This may include established nests and/or roosting areas; Servitude clearing for the powerline will also impact nesting/roosting habitat.	Cumulative	2	3	4	0.75	6.75 - MOD		Destruction of nesting habitat displaces the affected species eventually leading to loss of those species.
		Residual	1	2	2	0.2	1.0 - LOW		Following completion of the construction and rehabilitation phases, the site should not be subject to routine disturbances and therefore species will return to the area.
Destruction of ecologically important or sensitive habitat that is utilised by specialist avifaunal species.	Direct Impact:	Expected	2	4	4	1.0	10 - HIGH	Indiscriminate habitat destruction to be avoided and the proposed development should remain as localised as possible (including support areas and services); Site reinstatement and clean up following the completion of the construction phase of each tower site will be important.	The survey area suffers varying degrees of habitat transformation and therefore the significance of this impact also varies. Areas already suffering transformation will have lower impact significance than areas that have retained primary/natural vegetation. This rating is taken as an average of the overall impact.
		Cumulative	2	3	4	1.0	9 - MOD		Cumulative loss of sensitive habitat units is relatively rare as these areas are generally unsuitable for agricultural purposes (the main land use within the area).
	Wetlands are considered sensitive and ecologically important habitat features regardless of ecological state. Destruction of ecologically sensitive habitat units will lead to loss of ecological functionality and destruction/loss of natural biodiversity.	Residual	2	1	2	0.75	3.75 - MOD		The footprint of the proposed development should be limited to the areas that already suffer transformation, taking an ecological sensitivity map into consideration; Limited residual impact remains due to the ultimately small footprint area of each tower. Residual impacts will remain where new servitude roads have been established, but this is thought to have limited long-term impacts.

PRE-CONSTRUCTION & CONSTRUCTION PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
Disturbance features that alter the vegetation structures that will impact avifaunal community structures	Indirect Impact:	Expected	2	4	4	1.0	10 - HIGH	Disturbance of soils will enhance the Ongoing management of exotic vegetation recruitment as well as future recruitment of exotic vegetation must be managed. A monitoring protocol must be developed and utilised during both the construction and operations/management phases of the development.	Exotic vegetation is limited to isolated areas within wetland and riparian habitat (especially) and some isolated occurrences within the terrestrial habitats.
	Disturbances of soils will lead to altered state of vegetation structures. This will often lead to bush encroachment or establishment of exotic invasive species, which will impact on avifaunal community structures.	Cumulative	2	4	4	1.0	10 - HIGH		Cumulative loss of primary vegetation features due to exotic vegetation and vegetation transformation is high at the national level and therefore should be avoided.
		Residual	2	1	2	0.5	2.5 - LOW		Transformation of vegetation structure within areas that have suffered disturbances required active management. If mitigation measures are put into place to manage vegetation degradation then little to no residual impacts should remain.

Table 6: The impact significance ratings pertaining to the operational phase of the proposed development activities.

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
Servitude maintenance will displace species that have become established.	Direct Impact:	Expected	2	2	2	0.2	1.2 - LOW	This impact is regarded as being of limited relevance and of a low significance; Maintenance of the servitude must remain within the designated servitude only and no indiscriminate habitat destruction outside of the designated area should be allowed.	There will be limited need for routine maintenance of the servitude, which is regarded as a short-lived impact feature. This reduces the significance of this impact.
	The servitude for the powerline will require periodic maintenance to abate fire risks and to control tall trees. This maintenance will displace individuals that utilise these areas.	Cumulative	2	3	2	0.2	1.4 - LOW		Limited powerline infrastructure occurs within the area and therefore the cumulative impact of servitude maintenance is limited.
		Residual	1	1	2	0.1	0.4 - LOW		Servitude maintenance should be undertaken in sections, which will allow for continuity of habitat availability. Again, however, this is regarded as having limited significance.
Impacts to avifauna due to collisions with overhead lines.	Direct Impact:	Expected	2	3	4	1.0	9.0 - MOD	Avifaunal utilise watercourses as navigation aids during cyclic migrational movements. The identification of these main migratory routes	Avifaunal species within the region have been shown to learn where powerlines occur and tend to avoid them. This line,

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
								associated with the proposed alignment routes has been undertaken. The powerlines that run through these areas must be fitted with bird flapper devices on the earth wire to increase the visibility of the line. This should be done at least at 10 m intervals; Monitoring for bird collisions must be routinely undertaken and bird flappers should be retro-fitted to sections of the line where collisions are occurring (identified collision hotspots).	however, is proposed within an area where no other lines occur. Therefore some bird fatalities will occur if the lines are not made more visible. Regardless, some fatalities due to collision with the wires will occur, with greater frequency initially, tapering off with time.
	Collisions with overhead powerlines is a leading cause of fatalities of larger-bodied avifaunal species, many of which are Red Data listed. This is largely limited to collision with the single earth wire, which has a low visibility.	Cumulative	3	3	4	1.0	10-HIGH		Powerlines represent the largest proportion of established aerial infrastructure throughout the country and collision impacts are of national concern. Fitment of devices on the earth wires to make the lines more visible is reducing this impact at the national level.
		Residual	1	2	2	1.0	5.0 - MOD		Limited residual impacts will remain if bird flappers are fitted within migratory zones. Isolated occurrences of collision fatalities will always remain, however.

9. DISCUSSION ON PROPOSED MITIGATION MEASURES

The destruction of habitat that will be associated with the proposed powerline development is regarded as one of the most significant short to medium-term impacting features to avifaunal conservation within the area. The impact of fatalities from collision with the powerline by avifaunal species is then regarded as the most significant medium to long-term impact. Much of the survey area is dominated by open mesic savanna-type habitat, which includes occurrences of large trees, which provide an important habitat feature utilised by larger avifaunal species, many of which are the larger raptors. The development of the powerline will require the clearing of a servitude as a safety factor, which will include removal of larger trees that occur beneath or close to the overhead line. Clearing of trees and shrubs directly beneath the overhead line will also have to be undertaken. This will result in displacement of species. Each tower footprint will also be impacted through habitat destruction, but this is thought to be of lesser significance and of a short term. The significance of this impact can be reduced through the reduction of the overall impacting footprint area that is required for service provision (storage yards, service roads, construction camps, etc. that fall outside of the final footprint area). The actual overhead powerline and associated towers are thought to not have a significant long term impact as most of the habitat impacted during the construction phase will be either reinstated as part of a rehabilitation plan, or the vegetation will naturally reinstate. This means that avifauna will be temporarily displaced, but will return back into the area once disturbance impacts (mainly limited to the construction phase) are completed.

Various mitigation measures have been proposed to reduce the impacts of collisions of birds with powerlines. Electrocutions are generally not regarded as an impacting feature for power lines of 132 kV or above due to the distance between the earth and phase conductors being greater than the greatest measured wingspan of South African birds. It is well-known that collisions with the overhead shield (earth) wire far outnumber collisions with the phase (conductor) wires. This is because the earth wire is a single line suspended above the conductor lines, which are often bundled together in groups of four or five lines, or the phase wires are considerably thicker than the associated earth wire. These bundled lines are therefore far more visible in comparison to the earth wire, and collisions occur due to poor visibility. Studies have shown that collisions increase within areas where misty conditions are common (Manville, 2005). Collisions also increase when cloud cover is high, presumably due to the lack of contrast between the lines and the background cloud colour. Mitigation measures should therefore be aimed to making the earth wire more visible within the areas identified as prominent migratory routes. These areas are presented in Figure 5 and Figure 6.

The most favourable mitigation measure to lessen the impacts of bird collisions is to plan the alignment in such a way that migratory routes are avoided and, if this is not possible, to make the lines as visible as possible along these migratory routes. In a linear construction of this magnitude there are numerous factors to consider when choosing a preferred route, and making major alignment shifts are very often not feasible. Bird Flight Diverters (BFD's) were developed in Europe and are attached to the conductor wires. This is a spiral-type device attached directly to the line and is either coloured in contrasting colours (i.e. white devices alternating with black devices. Some are able to absorb UV light during daylight hours and glow at night. Studies, however, have indicated that their use has had limited success in averting collision impacts in South Africa (ACEE, 2001). Another device, known as a *Bird Flapper*, has been used on a large scale in South Africa since 2001 and has proven to be more effective than the use of BFD's. A *Bird Flapper* is a reflective metallic or polycarbonate disc-type device that is loosely attached to the earth wire at fixed distances. The loose-fitting attachment allows the disc to move freely in the wind. The resulting intermittent reflecting of the sun off the disc allows for a device that is highly visible from a greater distance. A variation of the Bird Flapper is to provide it with UV absorbing material that absorb light during the day, which allows it to emit light at night. Fitment frequency of these Bird Flappers has been suggested at 10 m intervals and staggered along parallel lines, resulting in a bird Flapper device being visible along every 5 m of line (ACEE, 2001). These devices should be fitted along all areas were migratory routes have been identified within the survey area (Figure 5, Figure 6 and Figure 7). It is also considered to be more practical and more economical to fit these devices at the time of construction rather than to retrofit them. Some RDL species are known to migrate at night, when line visibility is at its lowest. Flamingos are known to migrate between major water bodies at night or during dusk, where they often fall victim to collisions with overhead infrastructure due to poor visibility. It is assumed that there would be few encounters with flamingos as the habitat type is not conducive to supporting large numbers of both species recorded from the region.

Another mitigation measure that has been suggested is the removal of the earth shield wire from areas where migratory routes have been identified, as long as these areas do not fall within areas that are subjected to major electrical storms (ACEE, 2001). This is considered non-feasible due to technical constraints and implications.

10. CONCLUSIONS & RECOMMENDATIONS

The following final conclusions were drawn following an avifaunal survey of the areas that would be impacted by the proposed Mahikeng-Mookodi 400 kV overhead powerline:

- Impact ratings are generally regarded as being within a medium category. This is largely due to the construction of a powerline within an area where limited powerline infrastructure exists. No fatally flawed or high impact features were identified during the survey following the implementation of mitigation measures;
- Development at the substation sites will have limited significance to the avifaunal communities within the area as these sites are generally suffering habitat transformation from existing land uses;
- It is felt that the impacts associated with the proposed development activities can be successfully mitigated to within acceptable limits;
- The preferred alignment alternative is Option 2;
- Migratory corridors have been identified and it is recommended that mitigation measures to make the lines more visible to birds be implemented within these areas;
- Ongoing monitoring should be undertaken during the operations phase of the development to identify further problem areas and mitigation measures implemented if found to be necessary;
- Habitat units that are considered to be particularly important to avifaunal conservation such as watercourses, riparian zones and wetlands should be impacted as little as possible;
- As much of the natural vegetation, including larger trees within servitude areas should be allowed to remain as practically possible. Only larger trees that pose a direct risk to the overhead lines should be removed;
- A walk down survey of the chosen alignment option must be undertaken to identify nests and/or important roosting areas to manage these aspect appropriately;
- Indiscriminate habitat destruction must not be allowed to take place within areas outside of the construction footprint areas. Any destruction of habitat that has occurred that is not part of the ultimate footprint of the infrastructure must be rehabilitated.

It should be noted that, in order to conserve the ecological features within the region, a holistic conservation approach should be adopted. This includes keeping general habitat destruction to an absolute minimum. Conserving the habitat units will ultimately conserve the species communities that depend on it for survival.

This can only be achieved by the efforts of the contractor during the various processes of the construction phase.

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APPENDIX A: IMPACT ANALYSIS CALCULATIONS & RATINGS

A1. Impact Assessment Methodology

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

A2. Nature of the impact

Each impact should be described in terms of the features and qualities of the impact. A detailed description of the impact will allow for contextualisation of the assessment.

A3. Extent of the impact

Extent intends to assess the footprint of the impact. The larger the footprint, the higher the impact rating will be. The table below provides the descriptors and criteria for assessment.

Table 7: Criteria for the assessment of the extent of the impact.

Extent Descriptor	Definition	Rating
Site	Impact footprint remains within the boundary of the site.	1
Local	Impact footprint extends beyond the boundary of the site to the adjacent surrounding areas.	2
Regional	Impact footprint includes the greater surrounds and may include an entire municipal or provincial jurisdiction.	3
National	The scale of the impact is applicable to the Republic of South Africa.	4
Global	The impact has global implications	5

A4. Duration of the impact

The duration of the impact is the period of time that the impact will manifest on the receiving environment. Importantly, the concept of reversibility is reflected in the duration rating. The longer the impact endures, the less likely it is to be reversible. See Table 8 for the criteria for rating duration of impacts.

Table 8: Criteria for the rating of the duration of an impact.

Duration Descriptor	Definition	Rating
Construction / Decommissioning phase only	The impact endures for only as long as the construction or the decommissioning period of the project activity. This implies that the impact is fully reversible.	1
Short term	The impact continues to manifest for a period of between 3 and 5 years beyond construction or decommissioning. The impact is still reversible.	2
Medium term	The impact continues between 6 and 15 years beyond the construction or decommissioning phase. The impact is still reversible with relevant and applicable mitigation and management actions.	3
Long term	The impact continues for a period in excess of 15 years beyond construction or decommissioning. The impact is only reversible with considerable effort in implementation of rigorous mitigation actions.	4
Permanent	The impact will continue indefinitely and is not reversible.	5

A5. Potential intensity of the impact

The concept of the potential intensity of an impact is the acknowledgement at the outset of the project of the potential significance of the impact on the receiving environment. For example, SO_2 emissions have the potential to result in significant adverse human health effects, and this potential intensity must be accommodated within the significance rating. The importance of the potential intensity must be emphasised within the rating methodology to indicate that, for an adverse impact to human health, even a limited extent and duration will still yield a significant impact.

Within potential intensity, the concept of irreplaceable loss is taken into account. Irreplaceable loss may relate to losses of entire faunal or floral species at an extent greater than regional, or the permanent loss of significant environmental resources. Potential intensity provides a measure for comparing significance across different specialist assessments. This is possible by aligning specialist ratings with the potential intensity rating provided here. This allows for better integration of specialist studies into the environmental impact assessment. See Table 9 and Table 10 below.

Table 9: Criteria for impact rating of potential intensity of a negative impact.

Potential Intensity Descriptor	Definition of negative impact	Rating
High	Significant impact to human health linked to mortality/loss of a species/endemic habitat.	16
Moderate-High	Significant impact to faunal or floral populations/loss of livelihoods/individual economic loss.	8
Moderate	Reduction in environmental quality/loss of habitat/loss of heritage/loss of welfare amenity	4
Moderate-Low	Nuisance impact	2
Low	Negative change with no associated consequences.	1

Table 10: Criteria for the impact rating of potential intensity of a positive impact.

Potential Intensity Descriptor	Definition of positive impact	Rating
Moderate-High	Net improvement in human welfare	8
Moderate	Improved environmental quality/improved individual livelihoods.	4
Moderate-Low	Economic development	2
Low	Positive change with no other consequences.	1

It must be noted that there is no HIGH rating for positive impacts under potential intensity, as it must be understood that no positive spinoff of an activity can possibly raise a similar significance rating to a negative impact that affects human health or causes the irreplaceable loss of a species.

A6. Likelihood of the impact

This is the likelihood of the impact potential intensity manifesting. This is not the likelihood of the activity occurring. If an impact is unlikely to manifest then the likelihood rating will reduce the overall significance. Table 11 provides the rating methodology for likelihood. The rating for likelihood is provided in fractions in order to provide an indication of percentage probability, although it is noted that mathematical connotation cannot be implied to numbers utilised for ratings.

Table 11: Criteria for the rating of the likelihood of the impact occurring.

Likelihood Descriptor	Definition	Rating
Improbable	The possibility of the impact occurring is negligible and only under exceptional circumstances.	0.1
Unlikely	The possibility of the impact occurring is low with a less than 10% chance of occurring. The impact has not occurred before.	0.2
Probable	The impact has a 10% to 40% chance of occurring. Only likely to happen once in every 3 years or more.	0.5
Highly Probable	It is most likely that the impact will occur and there is a 41% to 75% chance of occurrence.	0.75
Definite	More than a 75% chance of occurrence. The impact will occur regularly.	1.0

A7. Cumulative Impacts

Cumulative impact are reflected in the in the potential intensity of the rating system. In order to assess any impact on the environment, cumulative impacts must be considered in order to determine an accurate significance. Impacts cannot be assessed in isolation. An integrated approach requires that cumulative impacts be included in the assessment of individual impacts.

The nature of the impact should be described in such a way as to detail the potential cumulative impact of the activity.

A8. Significance Assessment

The significance assessment assigns numbers to rate impacts in order to provide a more quantitative description of impacts for purposes of decision making. Significance is an expression of the risk of damage to the environment, should the proposed activity be authorised. To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, which takes cognisance of extent, duration, potential intensity and likelihood.

Impact Significance = (extent + duration + potential intensity) x likelihood

Table 12 provides the resulting significance rating of the impact as defined by the equation as above.

Table 12: Significance rating formulas.

Score	Rating	Implications for Decision-making
< 3	Low	Project can be authorised with low risk of environmental degradation
3 - 9	Moderate	Project can be authorised but with conditions and routine inspections. Mitigation measures must be implemented.
10 - 20	High	Project can be authorised but with strict conditions and high levels of compliance and enforcement. Monitoring and mitigation are essential.
21 - 26	Fatally Flawed	Project cannot be authorised

Appendix 6C: Heritage Impact Assessment

PROPOSED MOOKODI-MAHIKENG 400KV POWER LINE, NALEDI, KAGISANO-MOLOPO, RATLOU AND MAHIKENG LOCAL MUNICIPALITIES, NORTH-WEST PROVINCE

Phase 1 Heritage Impact Assessment

20 April 2018

Client: Nemai Consulting
Kristy Robertson

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Jean Beater

EXECUTIVE SUMMARY

INTRODUCTION

The existing Watershed Main Transmission Substation (MTS) is currently un-firm and has insufficient capacity to support the forecasted load in the Watershed MTS area, which includes Lichtenburg and extends to Mahikeng town. Hence there is a need for further network expansion through establishing a new transmission substation in Mahikeng and connecting the existing Mookodi MTS with the new Mahikeng substation. This report deals with the establishment of the proposed Mookodi – Mahikeng 400kV powerline. The proposed powerline is approximately 180 km in length. There are four alternative route options to be assessed. A 2 km corridorfor each route alternative applies (1km on each side) which allows for any possible deviation from the current proposed alignment of the powerline within the corridor which may be necessary

The proposed powerline is approximately 180 km in length hence the development triggers section 38 (1) (a) of the National Heritage Resources Act (NHRA) that refers to the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length. This Phase 1 Heritage Impact Assessment (HIA) was undertaken to identify any heritage resources that may be impacted by the proposed powerline development.

LOCATION

The project is located within several local municipalities, namely, the Naledi Local Municipality (LM), Kagisano-Molopo LM, Ratlou LM, and Mahikeng LM. The proposed alternative routes for the powerline start at the existing Mookodi MTS on the southern outskirts of Vryburg and travel in a north-east direction to end near Mahikeng at the future Mahikeng substation site.

Much of the proposed powerline options cross private farm land where cattle, maize and wild game farming takes as well as crossing communal land where there are numerous villages and subsistence farming practices taking place.

METHODOLOGY

A survey of literature, including previous HIAs that were undertaken in the immediate and surrounding area, was undertaken in order to gain an understanding of potential heritage resources in the project area. A site inspection was undertaken from 3 – 6 April 2018. Representative samples of the four alternative routes were inspected and, where possible, sections of the four routes were surveyed on foot.

SITE INSPECTION RESULTS

The termination point for the proposed powerline (including the future site for the Mahikeng substation) was inspected on foot. The landscape was largely undisturbed and the area was covered with a thick layer of grass interspersed with pockets of shrubs. Several fence posts were observed indicating that the area is being used for the grazing of animals. A rudimentary gravel road provides access to the future substation site. The inspection revealed no visible heritage resources.

A foot survey was undertaken for the area south of the termination point of the proposed powerline routes, through several villages including Moletsamongwe and Phadima. There were a number of settlements in the area as well as undeveloped tracts of land where goat and cattle farming takes place with some subsistence farming occurring near dwellings. Residential structures encountered were fairly recently built. The remains of a several structures were also observed in this area.

Throughout the communal land area, many informal cemeteries were found. Some were small in size but several were very large with one cemetery containing around 100 graves. Many of the graves have legible headstones; however, there were many graves made from mounds of calcite and/or rocks that are unmarked (without headstones). Some of the graves are very recent but many are older than 60 years therefore protected by section 36 of the NHRA.

Several buildings that are older than 60 years were found along the route options. These buildings are protected by section 34 (1) of the NHRA and must therefore not be impacted by the proposed powerline.

The powerline options that pass on the eastern side of Vryburg (Option 2 and 4) will cross an undisturbed rocky outcrop situated just off the R34 road. Rocky outcrops are often archaeological sensitive and should, accordingly, be treated with care and avoided where possible by the powerline. Several pans and borrow pits (quarries) were observed along the powerline route options. These sites can contain archaeological material. However, most of the pans and borrow pits were full of water from recent rains as well as thickly vegetated making archaeological material difficult to detect.

ASSESSMENT OF IMPACTS & STATEMENT OF IMPACT SIGNIFICANCE

An assessment of the potential impacts that the proposed powerline could have on graves, cemeteries and protected buildings indicated that the impact would have a medium ranking (without mitigation) but that the impact could be reduced to a low impact (with mitigation). In terms of archaeological sites, the pre-mitigation assessment indicated that the impact would be high but that with mitigation measures, the ranking could be reduced to a low impact.

The impact significance of the powerline on graves and cemeteries is low as graves and cemeteries are generally easily visible and the proposed walk-down of the selected route option should locate all graves and cemeteries prior to construction.

The impact significance of the powerline on protected structures is low as the structures are easily visible and therefore can be avoided. The proposed walk-down of the selected route option will identify structures to be avoided.

The impact significance of the proposed powerline on archaeological material is rated as a high impact. This is largely due to the nature of archaeological remains where many occur below the ground level making such sites difficult to detect. Impacts are more likely to occur in such cases. However, the threshold of significance will not be exceeded as the project area is not in pristine condition; secondly, if the mitigation measures, such as the walk-down of the selected route option by an archaeologist is applied then significant archaeological sites can be identified prior to the construction process.

SELECTION OF ROUTE OPTION

Four powerline route options were provided as alternatives for the proposed 400kV powerline. The environment that the four powerline options cross is largely the same for all the options and during the site inspection, heritage sites were found along or close to all the options. Hence, the length of the route options is important as the longer the length of a powerline is, the higher the risk or possibility that the powerline could impact on heritage resources. Route option 2 is shorter than the other routes and is therefore the preferred route from a heritage perspective. For this reason, Option 2 is the Best Practicable Environmental Option (BPEO) in the opinion of the heritage specialist.

RECOMMENDATIONS AND CONCLUSION

The following recommendations are made to mitigate potential impacts on heritage resources:

- Route Option 2 is the preferred option from a heritage perspective as it is shortest in length;

- A walk-down of the selected route option by a heritage specialist, preferably an archaeologist, must be undertaken prior to construction in order that all heritage sites are identified and recorded prior to construction;
- All heritage sites identified along the route option and in close proximity must be protected with a 20 m buffer so that the construction process does not impact these sites; and
- A desktop palaeontological assessment must be undertaken as the project area falls into an area of both medium and low fossil sensitivity. The project may only proceed once the desktop palaeontological assessment has been undertaken.

No fatal flaws were identified during this study hence the construction of the proposed powerline can proceed from a heritage perspective as long as the recommendations and mitigation measures contained in this report and in the desktop palaeontological assessment are implemented where necessary.

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AUTHOR DETAILS

Name	Qualifications	Professional Registration
Jean Beater	MA (Heritage Studies) MSc (Environmental Management)	Member of Association of South African Professional Archaeologists (No. 349) Member of IAIAsa (No. 1538)

1. BACKGROUND AND INTRODUCTION

The existing Watershed Main Transmission Substation (MTS) is currently un-firm and has insufficient capacity to support the forecasted load in the Watershed MTS area, which includes Lichtenburg and extends to Mahikeng town. Hence there is a need for further network expansion through establishing a new transmission substation in Mahikeng and connecting the existing Mookodi MTS with the new Mahikeng substation. The proposed Mahikeng substation will undergo a separate Environmental Impact Assessment (EIA) Process. This report deals with the establishment of the proposed Mookodi – Mahikeng 400kV powerline (Nemai Consulting 2018:2).

The proposed 400kV powerline is approximately 180km in length. There are four alternative route options to be assessed. The start point of the line is at the existing Mookodi MTS. The proposed alternative routes for the line travel in a north-east direction and end at the future Mahikeng substation site. A 2km corridor for each route alternative applies (1km on each side) which allows for any possible deviation from the current proposed alignment of the powerline within the corridor which may be necessary (Nemai Consulting 2018:2).

2. LEGISLATIVE BACKGROUND

The proposed powerline is approximately 180 km in length hence the development triggers section 38 (1) (a) of the National Heritage Resources Act (Act No. 25 of 1999) that lists developments that may require a HIA. This subsection refers to the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length which the proposed powerline clearly exceeds.

In addition, the construction of the powerline may result in impacts to graves, structures, archaeological and palaeontological resources that are protected in terms of sections 34, 35, and 36 of the National Heritage Resources Act (NHRA).

In terms of Section 3 of the NHRA, heritage resources are described as follows:
(a) places, buildings, structures and equipment of cultural significance;
(b) places to which oral traditions are attached or which are associated with living heritage;
(c) historical settlements and townscapes;
(d) landscapes and natural features of cultural significance;
(e) geological sites of scientific or cultural importance;
(f) archaeological and paleontological sites;
(g) graves and burial grounds, including—

(i) ancestral graves;

(ii) royal graves and graves of traditional leaders;

(iii) graves of victims of conflict;

(iv) graves of individuals designated by the Minister by notice in the *Gazette*;

(v) historical graves and cemeteries; and

(vi) other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);

(h) sites of significance relating to the history of slavery in South Africa;

(i) movable objects, including:

(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;

(ii) objects to which oral traditions are attached or which are associated with living heritage;

(iii) ethnographic art and objects;

(iv) military objects;

(v) objects of decorative or fine art;

(vi) objects of scientific or technological interest; and

(vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

This Phase 1 Heritage Impact Assessment (HIA) was undertaken to identify any heritage resources that may be impacted by the proposed powerline development.

3. LOCATION AND DESCRIPTION OF EXISTING CONDITION OF PROJECT AREA

The project is located within several local municipalities, namely, the Naledi Local Municipality (LM), Kagisano-Molopo LM, Ratlou LM, and Mahikeng LM which are all situated in the North West Province. The proposed alternative routes for the powerline start at the existing Mookodi MTS on the southern outskirts of Vryburg and travel in a north-east direction to end near Mahikeng at the future Mahikeng substation site. The route alternatives for the project, as listed below, are also indicated on **Figures 1-5**: Option 1 (depicted in yellow); Option 2 (red); Option 3 (green) and Option 4 (turquoise) (Nemai Consulting 2018:2-4).

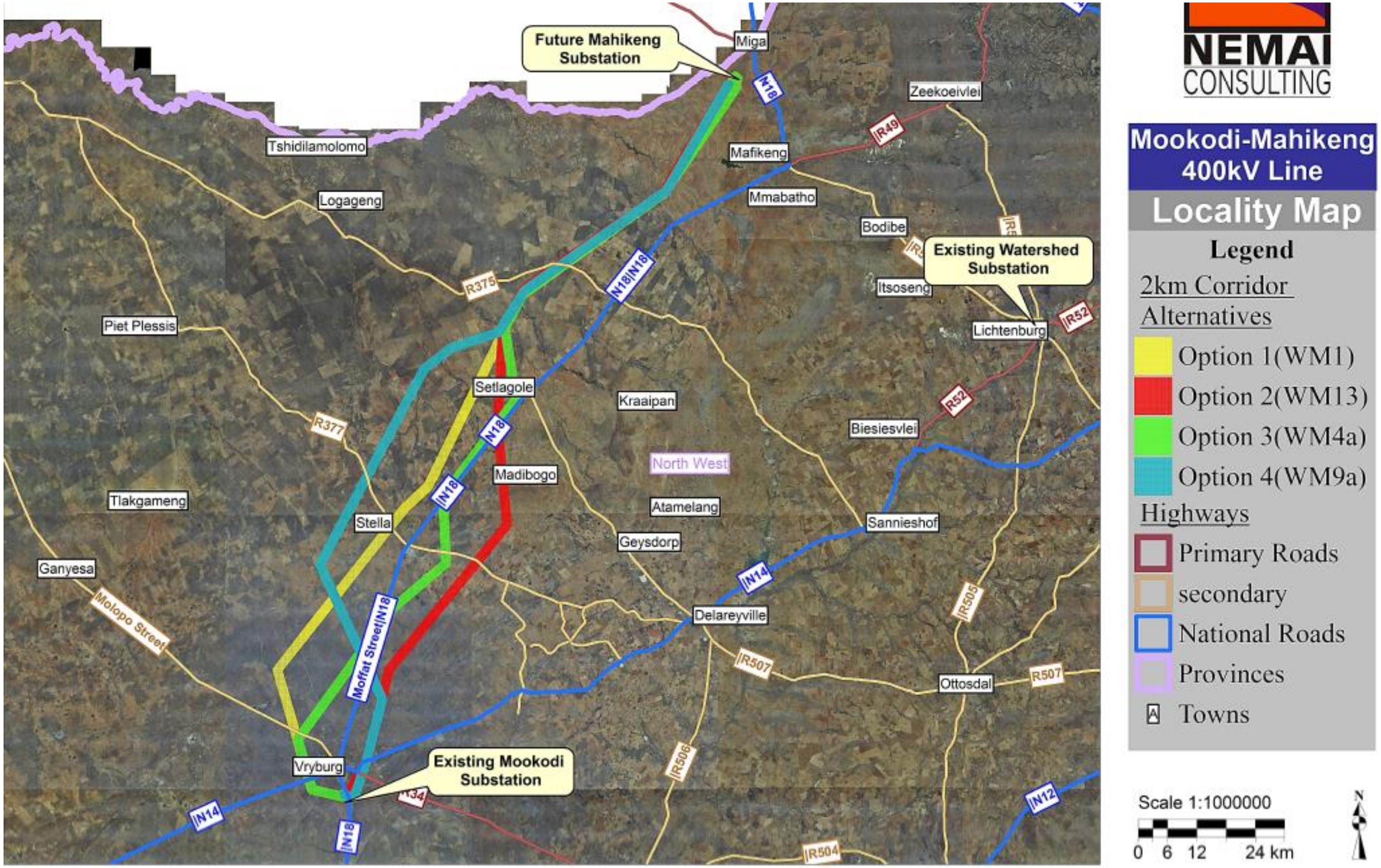


Figure 1: Locality map

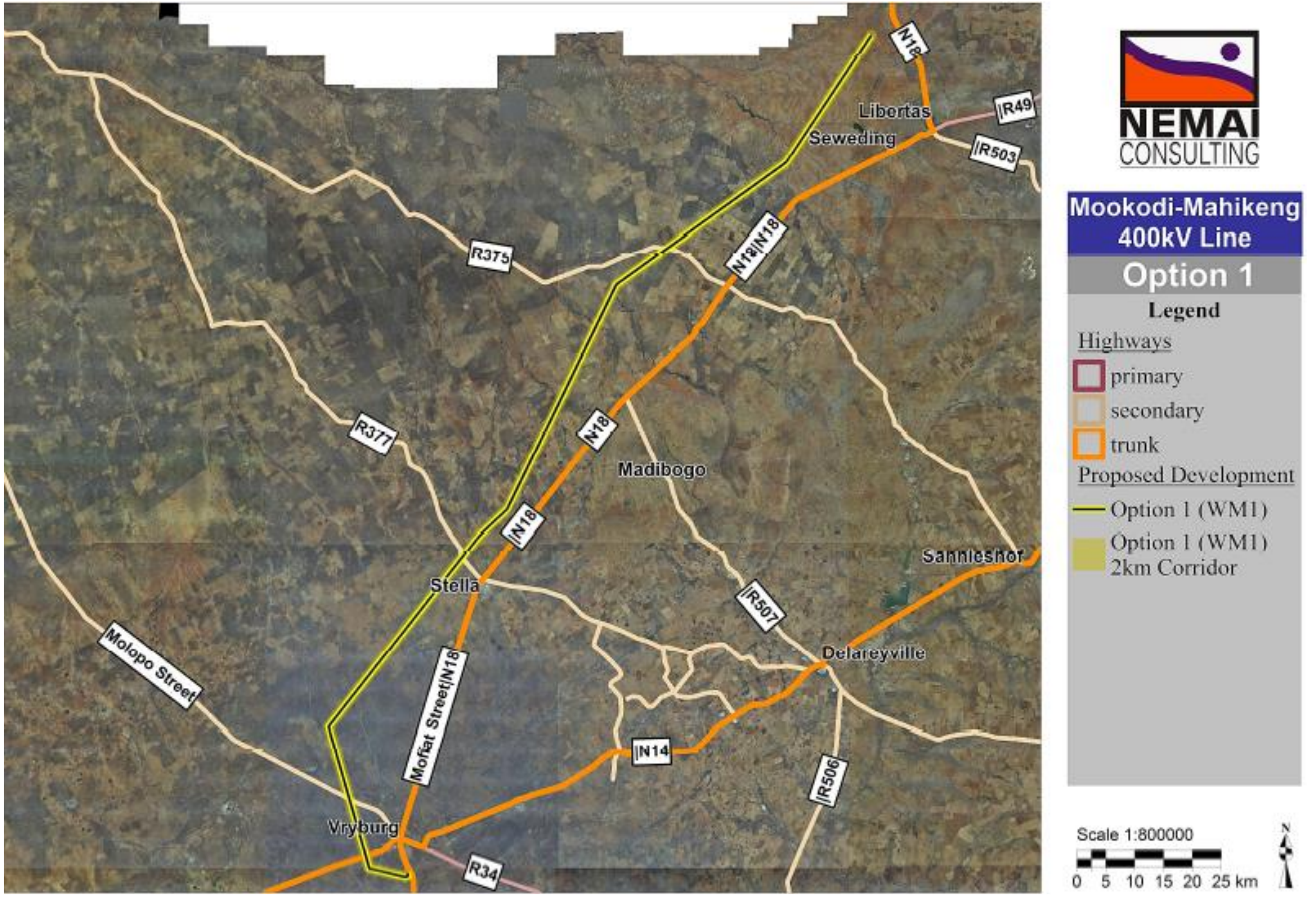


Figure 2: Option 1

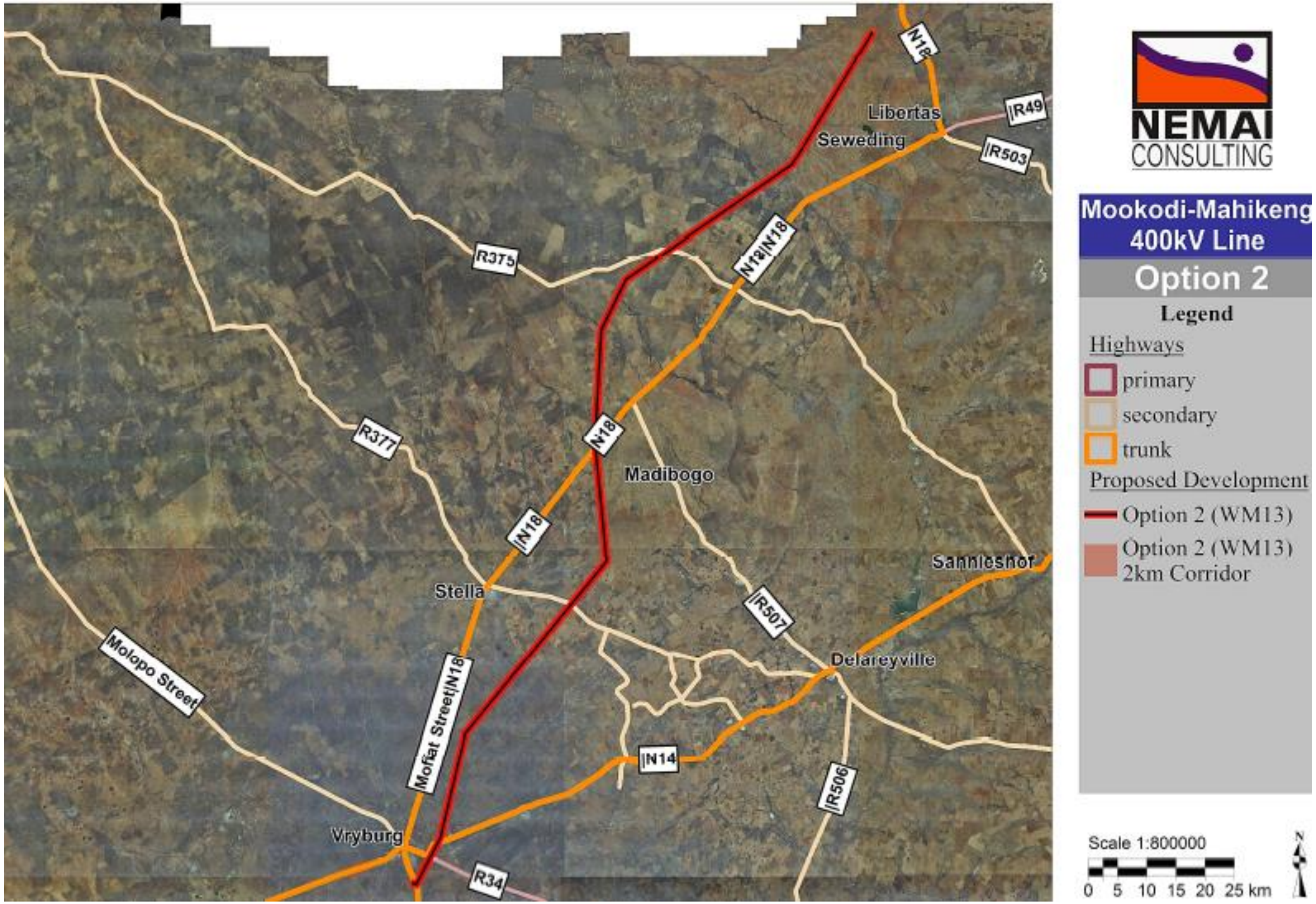


Figure 3: Option 2

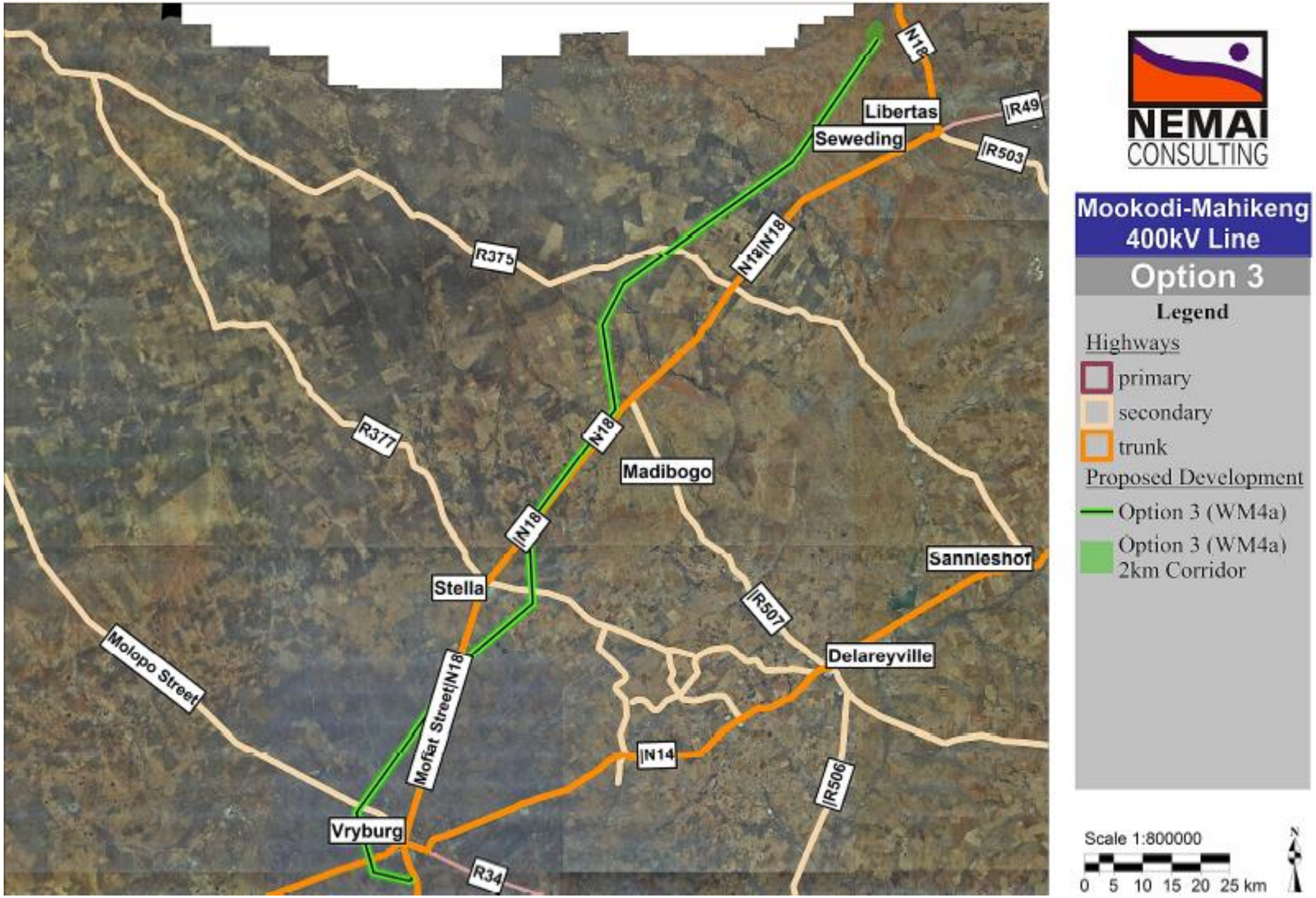


Figure 4: Option 3

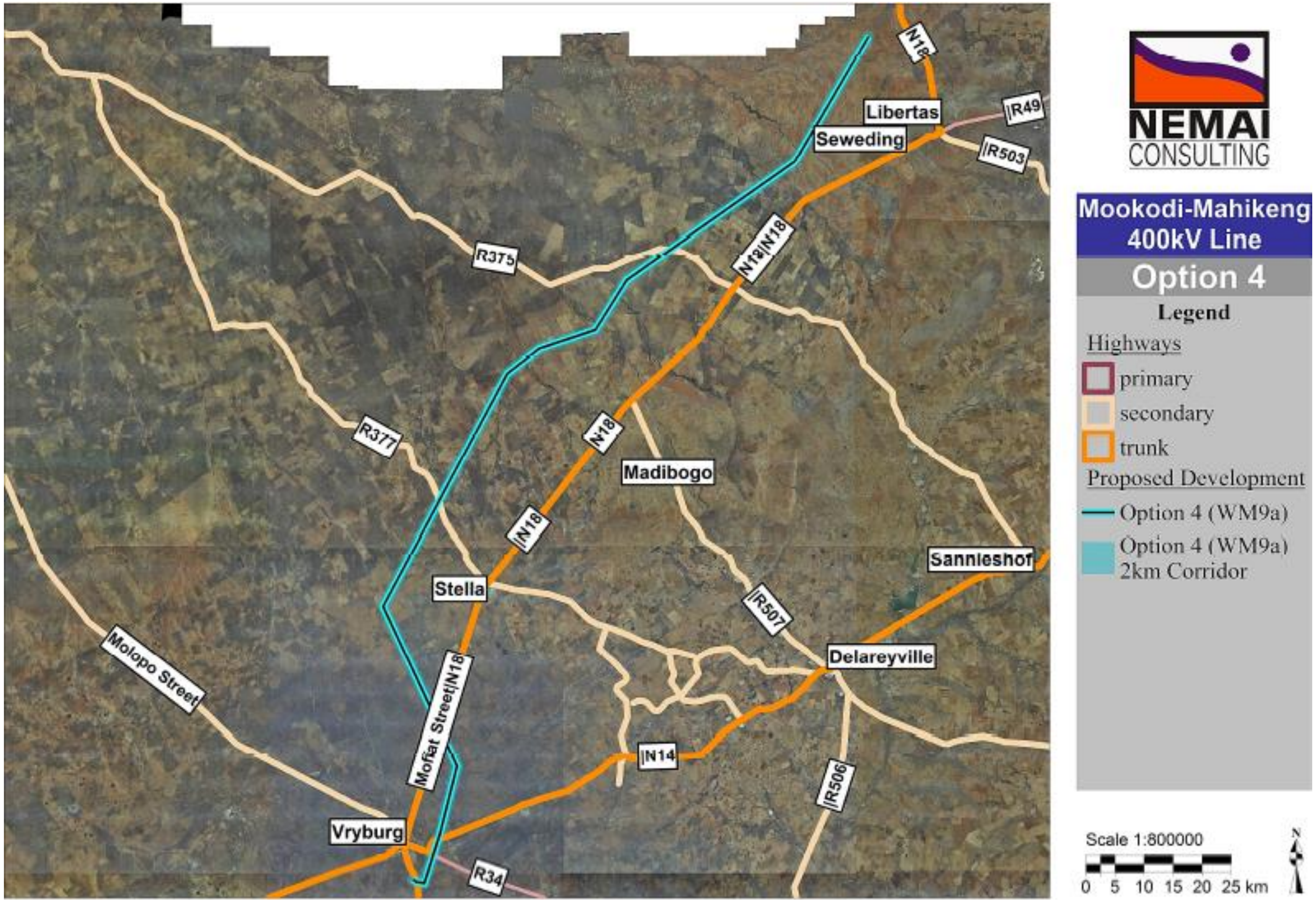


Figure 5: Option 4

The powerline options cross private farm land where cattle, maize and wild game farming takes place which has most likely resulted in the destruction of some heritage resources such as archaeological sites and graves.

In addition, the powerline options also crosses communal land where there are numerous villages and some subsistence farming practices. Again, the growth in villages and associated farming practices will have negatively impacted heritage resources in these areas.

4. APPROACH TO HERITAGE STUDY

- Undertake a HIA in accordance with the NHRA (Act No. 25 of 1999);
- Identify and map all heritage resources in the project area as defined in Section 2 of the NHRA, including archaeological and palaeontological sites on or close (within 100m) of the proposed developments;
- Undertake a desktop palaeontological assessment (evaluate site in terms of SAHRIS);
- The assessment of the significance of such resources in terms of the heritage assessment criteria as set out in the regulations;
- Assessment of the impact of development on such heritage resources;
- An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
- Prepare a heritage sensitivity map (GIS-based), based on the findings of the study;
- Prepare a desktop palaeontological sensitivity map and recommend if a palaeontological study is required;
- Identify heritage resources to be monitored;
- Comply with specific requirements and guidelines of North-West Provincial Heritage Resources Agency (NWPHRA);
- Submit the HIA to NWPHRA and the SA Heritage Resources Agency (SAHRA) (as requested by the NWPHRA);
- Assess the impacts (direct, indirect and cumulative) in terms of their significance (using suitable evaluation criteria) and suggest suitable mitigation measures. In accordance with the mitigation hierarchy, negative impacts should be avoided, minimised, rehabilitated (or reinstated) or compensated for (i.e. offsets), whereas positive impacts should be enhanced. A risk-averse and cautious approach should be adopted under conditions of uncertainty;
- The provision of a statement of impact significance for each issue, which specifies whether or not a pre-determined threshold of significance (i.e. changes in effects to the environment which would change a significance rating) has been exceeded, and whether or not the impact

presents a potential fatal flaw or not. This statement of significance should be provided for anticipated project impacts both before and after application of impact management actions;

- Recommend a monitoring programme to implement mitigation measures and measure performance; and
- Appraisal of alternatives (including the No-Go option) by identifying the Best Practicable Environmental Option (BPEO) with suitable justification.

5. METHODOLOGY

A survey of literature, including previous HIAs that were undertaken in the immediate and surrounding area, gleaned from the SAHRIS database, was undertaken in order to gain an understanding of potential heritage resources in the project area. The SAHRIS database is updated with new HIA reports on a daily basis thus providing users with the most recent HIAs undertaken throughout South Africa.

A site inspection was undertaken from 3 – 6 April 2018. Representative samples of the four routes were inspected and, where it was possible, sections of the four routes were surveyed on foot. A Garmin Etrex hand-held GPS was used to capture the coordinates of heritage sites identified during the site inspection.

6. ASSUMPTIONS AND CONSTRAINTS

This assessment assumes that all the information provided by the Environmental Assessment Practitioner (EAP) regarding the powerline route options are correct and current.

Access to some private farms was, at times, not possible as entrances to farms were often prevented by locked gates.

In addition, heavy rain on the evening of 4 April 2018 made some of the gravel access roads to the route options inaccessible.

Due to the rainfall over summer, vegetation and grass cover was thick in most areas making visibility of low lying heritage resources such as archaeological sites and unmarked graves difficult.

As much of the four powerline route options was investigated during the site inspection. The site inspection allowed the specialist to gain a comprehensive understanding of heritage resources in the study area and the potential impact that the powerline could have on these resources.

7. DETAILS OF THE HERITAGE SPECIALIST

Jean Beater has undertaken heritage impact assessments since 2003. She has worked on several powerline projects including:

- The walk down heritage survey of proposed construction of Neptune-Pembroke 400kV powerlines near East London, Eastern Cape Province (2016);
- The HIA for the Makalu B substation and associated transmission and distribution powerline project, Sasolburg, Free State Province (2017); and
- The HIA for the Mulalo 400/132kV MTS and associated 400kV transmission and distribution powerline project in Secunda, Mpumalanga Province (2017).

8. HISTORICAL BACKGROUND OF LARGER GEOGRAPHICAL AREA

From a reading of the archaeological and HIAs undertaken in the larger surrounding area of the project, a pattern emerges showing that archaeological resources are most commonly clustered around rivers and river valleys, existing and ancient drainage lines, pans, and ridges with rocky outcrops, and that heritage resources are generally absent from flatlands that are some distance from water sources (Nilssen 2016:14).

Very little habitation of the central highveld area took place during Stone Age times. Tools dating to the Early Stone Age (ESA) period are mostly found in the vicinity of larger watercourses, e.g. the Vaal River or the Harts River and especially in sheltered areas such as at the Taung fossil site (some 70 km south of Vryburg). During Middle Stone Age (MSA) times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology. Late Stone Age (LSA) people had more advanced technology and therefore succeeded in occupying even more diverse habitats. Some sites are known to occur in the region. These are mostly open sites located near river and pans. The LSA people also left a rich legacy of rock art. Some of the farms known to have rock engravings are Bernauw Content (which is crossed by Options 2 and 4), Gemsbok Laagte, Klipfontein, Kinderdam, Melalarig, Schatkist, Verdwaal Vlakte (Option 1) and Wonderfontein (van Schalkwyk 2016:9).

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Broederstroom south of Hartebeespoort Dam dating to AD 470. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior Highveld area. Due to their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water (van Schalkwyk:10).

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

The earliest Iron Age settlers who moved into the North West Province region were Tswana-speakers such as the Tlhaping, Hurutshe, Fokeng, Kgatla and Rolong. Stone walled sites dating to the Late Iron Age and which can be linked to the Tswana occupation of the area, are found on a number of farms in the region, e.g. Waai Hoek and Brul Pan. However, the most important one, named Dithakong which is located some distance to the west of the project area. White settlers moved into the larger area during the first half of the 19th century basing their survival on cattle/sheep farming and hunting (van Schalkwyk:10).

Vryburg was established as the capital of the independent Boer Republic of Stellaland in 1882, hence the name of the town. Stellaland was incorporated as a British protectorate into British Bechuanaland in 1884, which in turn became part of the Cape Colony in 1895 (Rossouw undated:8). Vryburg became an important base, during the Anglo-Boer War (1899-1902), for the resupply and refitting of British troops operating in the north-west of the then Cape Colony and western areas of the Boer Republic. Six armoured trains were assembled at Vryburg as part of the defence of railway line northwards to Mahikeng (then Mafeking) (Jones and Jones 1999:238).

The town of Mahikeng was given the name Mahikeng by the Barolong boo Ratshidi who settled in the area during the early nineteenth century. The Barolong spelling of using an H was later changed to an F in order to comply with a more standard Setswana spelling. The name in English means “place of rocks”. In Setswana, Lefika means rock and Mafika is the plural. The ‘eng’ at the end of Mafikeng denotes place of (Vhufa Hashu Heritage Consultants 2012:2). Pistorius (2011:23) has conjectured that the town of Mahikeng may have been established on Late Iron Age stone walled sites considering the fact that the name refer to ‘the place of stone / rocks’.

During the nineteenth century the expansion of the Voortrekkers and the establishment of the Zuid Afrikanse Republic in the then Western Transvaal became a threat to Barolong boo Ratshidi autonomy. As a result, Chief Montshiwa requested British protection. On the 22 May 1884 in Mafikeng, Chief Montshiwa signed a treaty ceding his Sovereignty to the British. Soon afterwards the British government established a garrison in town and the following year, a proclamation was approved that divided Mafikeng into two sections, one for the Barolong and the other for European settlement (Vhufa Hashu Heritage Consultants:18).

The settlers with their 140 farms established the independent Republic of Goosen with Rooigrond as capital 15km to the south-east of Mahikeng. The Republic of Goosen was disabled by a British expeditionary force in 1885 and incorporated in British Bechuanaland and a new town was laid out on a place which the Tswana's called 'Mahikeng' – 'the place of stones' (Pistorius 2011:25).

During the Anglo-Boer War, 1899-1902, the town was besieged by Boer forces for 217 days from October 1899 until 17 May 1900 (Jones and Jones 1999:143). One of the people trapped in Mafikeng was Solomon T Plaatjie who was one of the founders of the African National Congress (ANC) in January 1912.

In 1977, the northern section of the project area was incorporated into the so-called independent homeland of Bopthutshwana. The homeland policy was put in place by the Nationalist government to give black South African's self-government in restricted areas. The homeland policy was disbanded in 1994 and the homelands incorporated into South Africa.

9. SITE INSPECTION RESULTS

It should be noted that the site inspection was undertaken from north to south beginning at Mahikeng and ending at the existing Mookodi substation at Vryburg. The site inspection results will accordingly detail the findings from north to south. The heritage sites identified during the site inspection are depicted on a heritage sensitivity map appended to this report (see **Appendix 1**).

The termination point for the proposed powerline (including the future site for the Mahikeng substation) was inspected on foot. The site of the substation is situated west of Mahikeng. The landscape was largely undisturbed and the area was covered with a thick layer of grass interspersed with pockets of shrubs. Several fence posts were observed indicating that the area is being used for the grazing of animals. A rudimentary gravel road provides access to the future substation site. The inspection revealed no visible heritage resources.

Figure 6: Future Mahikeng substation site with fence posts in background

Figure 7: Future Mahikeng substation site

South of the future substation site, a foot survey was undertaken of the powerline options through several villages including Moletsamongwe and Phadima. There are a number of settlements in the area as well as undeveloped tracts of land where goat and cattle farming takes place with some subsistence farming occurring near dwellings. Residential structures encountered were recently built. The remains of a several structures were also observed in this area and these appeared to be recent structures. Several water boreholes were found during the inspection and at least one existing powerline crosses the area inspected.

Figure 8: Vegetation cover, fencing and powerline

Figure 9: Recently built dwellings

Figure 10: Remains of brick structure

Figure 11: Subsistence farming near dwellings

Throughout the communal land area south of the future Mahikeng substation, many informal cemeteries were found. Some were small in size but several were very large with one cemetery containing around 100 graves. Many of the graves have legible headstones; however, there are many graves or cairns made from mounds of calcite and/or rocks that are unmarked (without headstones). Some of the graves are very recent but several are older than 60 years. Graves older than 60 years are protected by section 36 (3) (b) of the NHRA and graves and cemeteries situated outside a formal cemetery and where it is not the responsibility of any other authority, the NWPHRA or SAHRA must generally conserve and care for such burial grounds and graves according to section 36 (1) of the NHRA.

Figure 12: Graves found in project area

Figure 13: Cemetery in project area

The specialist was referred to the farm Taaiboschspruit by the owner, Mr. Bosch, who stated that there were two graves close to several buildings in various states of disrepair. Although a search of the area was undertaken no graves were located. The abandoned buildings could be older than 60 years but are of low heritage significance due to their advanced state of disrepair and because the buildings are typical outbuildings found on many farms found in the province and in South Africa. The site falls within the buffer area of route Option 1.

A recent grave was located within a farm yard which falls within route Option 3. The grave is situated approximately 200 m west of the N18. The farm complex also falls with Option 3.

Several buildings that are older than 60 years were found along the route options. These buildings are protected by section 34 (1) of the NHRA and should therefore not be impacted by the proposed powerline. Several of the buildings are in good condition (see **Figures 14** and **15**). The specialist could not establish if there were any graves related to the stone dwelling pictured in **Figure 15** as the specialist did not have permission to access the property.

Figure 14: Old dwelling located alongside R377 – Option 1

Figure 15: Stone structure – Option 3

Figure 16: Silo and other structures – Option 3

The EAP informed the specialist that a landowner had made mention of a Bushman grave on the farm Naudespan. The specialist went to see the owner in order to inspect and record the site. The owner, Mr Scholtz, unfortunately, was not in a position to take the specialist to the site but he did correct the information provided. The site is not a grave but rock face/s that have been ‘knapped’ / ‘chipped’ / marked by Bushmen who lived in the area.

According to Mitchell (2002:193), both engravings and paintings were producing well into the 19th century by Bushmen. A Bushman from the Northern Cape stated that in the 1870s his father(s) had executed ‘chippings’ of gemsbok, ostrich and zebra. Mitchell (2002:193) states that engravings occur principally in the Karoo, western Free State and North-West Province. The engraving/s are protected by section 35 (4) of the NHRA which states that no person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite. This site must not be impacted by the proposed powerline if the option where this site is located is chosen as the route for the proposed powerline.

Several pans and borrow pits (quarries) were observed along and in the vicinity of the powerline route options. These sites can contain LSA and MSA material. However, those that were inspected were full of water (due to the recent rains) and thickly vegetated making visibility of archaeological material difficult.

Figure 17: Pan with water

The powerline options that pass on the eastern side of Vryburg (route Options 2 and 4) will cross an undisturbed rocky outcrop at the Vryburg Truck Inn situated just off the R34 road. Rocky outcrops are often archaeological sensitive and should, accordingly, be treated with care and avoided if possible by the powerline. The development of the Truck Inn has partially damaged the outcrop but the remainder is currently undisturbed.

Figure 18: Rocky outcrop: Options 2 and 4

The heritage resources identified during the site inspection are included in the table below. The powerline option/s in which the heritage resource is located is indicated in the first column:

Table 1: Heritage resources identified during site inspection

POWERLINE OPTION	COORDINATES	HERITAGE RESOURCE	MITIGATION
All options	25°50'23.9"S 25°27'43.7"E	Cemetery with ± 50 graves	20 m buffer
All options	25°43'34.2"S 25°30'54.4"E	Small cemetery	20 m buffer
All options	25°44'49.0"S 25°31'43.4"E	Small cemetery	20 m buffer
All options	25°44'49.04"S 25°31'41.4"E	Large cemetery with ± 100 graves	20 m buffer
All options	25°51'23.2"S 25°25'24.6"E	Cemetery with ± 10 graves	20 m buffer
All options	25°51'28.6"S 25°25'26.0"E	Cemetery with between 30 – 50 graves	20 m buffer
All options	25°52'18.2"S 25°25'31.0"E	Cemetery with ± 20 graves	20 m buffer
All options	25°52'09.7"S 25°25'26.1"E	Cemetery with ±10 visible graves	20 m buffer
All options	25°51'54.7"S 25°24'20.9"E	Cemetery with ±20 graves	20 m buffer
All options	25°54'25.6"S 25°23'46.3"E	Cemetery within homestead with 3 graves	20 m buffer
Option 1	26°23'02.4"S 24°56'36.2"E	Possible graves amongst dilapidated buildings	20 m buffer
Option 3	26°27'15.4"S 24°57'37.1"E	Single grave amongst farm buildings	20 buffer around farm complex
Outside project area	26°28'30.0"S 24°42'22.1"E	Protected structure	Not applicable
Outside project area	26°28'28.1"S 24°42'22.5"E	Graves >60 years	Not applicable
Option 4	26°29'35.8"S 24°45'14.7"E	Protected structure	20 m buffer

POWERLINE OPTION	COORDINATES	HERITAGE RESOURCE	MITIGATION
Option 1	26°31'21.95"S 24°50'19.84"E	Protected structure	20 m buffer
Option 3	26°50'47.16"S 24°41'29.59"E	Protected structure	20 m buffer
Option 3	26°50'49.18"S 24°41'30.95"E	Protected structure	20 m buffer
Option 1	26°54'49.85"S 24°39'21.14"E	Remains of structures and stone wall	Avoid placing pylons on walling
Options 2 and 4	26°58'8.06"S 24°46'7.68"E	Rocky outcrop	20 m buffer

Previous HIAs undertaken in the area indicate the proposed establishment of a number of photo-voltaic (solar energy) facilities close to the Mookodi substation. These proposed developments are to take place on the farms Klondike 670, Rosendal 673 and Waterloo 992.

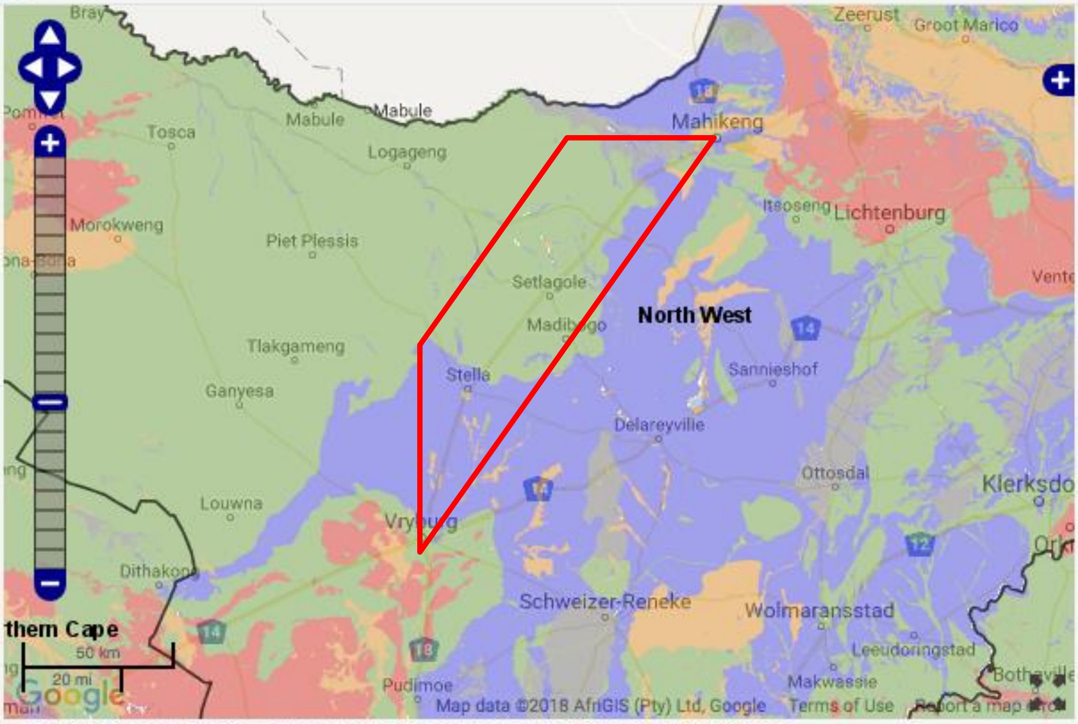
Route options 1 and 3 when exiting from Mookodi substation cross the farms Rosendal 673 and Klondike 670IN. The AMDA Delta solar energy facility is proposed to be situated mainly on the farm Klondike together with the overhead powerline also crossing the farm Rosendal. The proposed facility is situated north-west of the Mookodi substation. The HIA of this development indicated several heritage features that need to be taken into cognisance if either of these options are selected for the proposed Mookodi-Mahikeng powerline. The heritage features that are recommended to be protected include unmarked graves and pans with MSA and LSA material. The details of the sites are included in the table below.

Table 2: Heritage features to be conserved: AMDA Delta solar energy facility

DEVELOPMENT ZONE	COORDINATES	DESCRIPTION OF HERITAGE SITE
AMDA Delta solar energy facility	S26.99337° E24.67861°	Unmarked burial ground with unmarked graves
Grid Connection	Centre point: S26.99171° E24.70376°	Pan site with LSA & MSA material
Grid Connection	Centre point: S27.00739° E24.73964°	Quarry and pan site with LSA & MSA material
Grid Connection	Centre point: S27.01074° E24.73853°	Quarry and pan site with LSA & MSA material

The South African Fossil Sensitivity Map indicates that the project area falls within an area of low (blue colour) to moderate (green colour) fossil sensitivity (see **Figure 19** below). It is therefore recommended that a desktop palaeontological assessment is undertaken of the entire project area in order to establish whether significant fossil finds will be impacted by the proposed powerline. The recommendations and mitigation measures provided by the desktop assessment must be implemented and adhered to where necessary.

PalaeoSensitivity Map



1 in 250 000 geological formation layers are courtesy of the Council for GeoScience

For more information, go to How to Use the Palaeontological (fossil) Sensitivity Map

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 19: Fossil sensitivity of project area indicated with red polygon

10. ASSESSMENT OF IMPACTS

The potential impacts on the heritage resources that were identified were assessed in terms of probability (likelihood of occurring), scale (spatial scale), magnitude (severity) and duration (temporal scale). To enable a scientific approach to the determination of the environmental significance (importance), a numerical value is linked to each rating scale.

The following criteria were applied:

Occurrence

- Probability of occurrence (how likely is it that the impact may occur?); and
- Duration of occurrence (how long the impact may last).

Severity

- Magnitude (severity) of impact (will the impact be of high, moderate or low severity?); and
- Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?). The following ranking scales was used:

Table 3: Ranking scales

Probability:=P 5 – Definite/don't know 4 – Highly probable 3 – Medium probability 2 – Low probability 1 – Improbable 0 – None	**Scale:=S** 5 – International 4 – National 3 – Regional 2 – Local 1 – Site only 0 – None
Duration:=D 5 – Permanent 4 - Long-term (ceases with the operational life) 3 - Medium-term (5-15 years) 2 - Short-term (0-5 years) 1 – Immediate	**Magnitude:=M** 10 - Very high/don't know 8 – High 6 – Moderate 4 – Low 2 – Minor

Status of Impact

+: Positive

-: Negative N:

Neutral

The following formula was applied to calculate the impact significance after the factors were ranked for each impact: SP = (magnitude + duration + scale) x probability

Table 4: Significance of impacts

SIGNIFICANCE	ENVIRONMENTAL SIGNIFICANCE	COLOUR CODE
High (positive)	>60	H
Medium (positive)	30 to 60	M
Low (positive)	<30	L
Neutral	0	N
Low (negative)	>-30	L
Medium (negative)	-30 to -60	M
High (negative)	<-60 (max = 100)	H

The heritage resources of significance that could be impacted by the proposed powerline are:

- Damage and/or destruction of graves and cemeteries
- Damage and/or destruction of structures older than 60 years
- Damage and/or destruction of archaeological material including rock art and rocky outcrops, and fossils.

Table 5: Graves and cemeteries

All powerline route options – pre-construction, construction and operation		
	Without Mitigation	**With Mitigation**
Scale	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Medium (3)	Low (2)
Status	Negative	Negative
Reversibility	No	No
Level of Significance	45 (medium negative)	22 (low negative)
Can impacts be mitigated	Yes	n/a
Mitigation • Prior to construction, a walk-down of the chosen powerline route option must be undertaken by a heritage specialist to identify any grave sites and cemeteries • If any pylons are positioned on graves or cemeteries, then the position of the pylon must be adjusted to avoid impacting on the graves or cemeteries • A buffer of 20 m must be placed around all graves and cemeteries to ensure that during the construction of the powerline, these sites are not damaged.		

• The material demarcating the 20 m buffer must be highly visible and made of durable material to ensure that they are still in place during the operation of the powerlines so that maintenance crews are aware of the sites. • If, for any reason, graves or cemeteries have to be moved, then a Phase 2 HIA will need to be undertaken during which process, the family and relevant communities will have to be engaged with to obtain their permission and to discuss where the remains are to be moved to. In addition, application will have to be made to the NWHRA or SAHRA for the necessary permits. Sub-sections (4) and (5) of section 36 of the NHRA regarding the removal of graves must be adhered to. • **The exhumation and removal of graves is strongly discouraged as graves are highly significant to many people and there are many traditional, cultural and personal sensitivities concerning the removal of graves**.

Table 6: Structures older than 60 years

All powerline route options – pre-construction and construction		
	Without Mitigation	**With Mitigation**
Scale	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Medium (3)	Low (2)
Status	Negative	Negative
Reversibility	No	No
Level of Significance	39 (medium negative)	22 (low negative)
Can impacts be mitigated	Yes	n/a
Mitigation • Prior to construction, a walk-down of the selected powerline route option must be undertaken by a heritage specialist to identify any additional protected structures as well as those protected structures that may be directly impacted by the location of pylons. • If any pylons are positioned on protected structures, then the position of the pylon must be adjusted to avoid impacting on the structure/s • A buffer of 20 m must be placed around all structures (whether protected or not) to ensure that during the construction of the powerline, all buildings (including farm houses and associated buildings) are not damaged by the construction process. • The material demarcating the 20 m buffer must be highly visible and made of durable material to ensure that they are still in place during the operation of the powerlines. • If any building is to be altered, damaged or destroyed then permission from the owner must be obtained. If the building is protected (older than 60 years), then application must be made to the NWHRA or SAHRA for the necessary permits.		

Table 7: Archaeological sites

All powerline route options – pre-construction, construction and operation		
	Without Mitigation	**With Mitigation**
Scale	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	High (4)	Low (2)
Status	Negative	Negative
Reversibility	No	No
Level of Significance	64 (medium negative)	24 (low negative)
Can impacts be mitigated	Yes	n/a

Mitigation

- Prior to construction, a walk-down of the selected powerline route option must be undertaken by an archaeologist to identify archaeological areas (such as pans and quarries) and archaeological sites that may be impacted by the location of pylons.
- If any pylons are positioned on or very close (within 10 m) of archaeological sites, then the position of the pylon must be adjusted to avoid impacting on such sites
- A buffer of 20 m must be placed around significant archaeological sites to ensure that during the construction of the powerline, such sites are not damaged by the construction process.
- The material demarcating the 20 m buffer must be highly visible and made of durable material to ensure that they are still in place during the operation of the powerline so that these sites are not destroyed during the maintenance of the powerline.
- If archaeological sites are impacted by a pylon or by the construction process, then the necessary permits must be obtained from the NWPHRA or SAHRA either for the rescue or destruction of archaeological material dependent on the significance of the material/site.

11. STATEMENT OF IMPACT SIGNIFICANCE

The project area that will be impacted by the proposed powerline is currently disturbed by farming activities and the expansion of settlements. The impact significance of the powerline on graves and cemeteries is low (post-mitigation) as most graves and cemeteries are visible and the recommended walk-down of the selected route option will locate all graves and cemeteries prior to construction. Impacts on graves and cemeteries can be successfully mitigated. From the survey of the project area, it should be noted that it is quite likely that graves may be found in fairly close proximity to farmsteads and, in the traditional authority areas, graves are most likely to be found in centralised cemeteries but occasionally, individual graves will be found close to homesteads.

The impact significance of the proposed powerline on protected structures is low as the structures are generally easily visible and therefore can be avoided. The proposed walk-down of the selected route option will identify all structures to be avoided. Impacts on protected structures can be easily mitigated. From the survey, it is moderately likely that some of the farm houses and associated buildings will be over 60 years of age and therefore protected by the NHRA.

The impact significance of the proposed powerline on archaeological material/sites is rated as a high impact that is reduced to a low significance with the implementation of the proposed mitigation measures. The high impact rating is largely due to the nature of archaeological remains where they can occur below the ground making such sites difficult to detect. Impacts are more likely to occur in such cases. However, the threshold of significance will not be exceeded as the project area is not in pristine condition meaning that activity in the project area will have disturbed or destroyed many sites; secondly, if the mitigation measures, including the walk-down of the selected route option by an archaeologist is applied then significant archaeological sites can be identified prior to the construction process.

12. SELECTION OF POWERLINE ROUTE OPTION

Four powerline route options have been provided as alternatives for the proposed 400kV powerline. The environment that the four powerline options cross is largely the same for all the options and during the site inspection for the Phase 1 assessment, heritage sites were found along or close to all the options. Hence, the length of the route options is important as the longer a powerline is, the higher the risk or possibility that the powerline could impact on heritage resources. Route Option 2 is approximately 8 km shorter than the other route options and is therefore the preferred route from a heritage perspective.

The Best Practicable Environmental Option (BPEO) is defined in National Environmental Management Act as the option that provides the most benefit or causes the least damage to the environment as a whole at a cost acceptable to society in the long term as well as the short term. Route Option 2 is the BPEO for this project in the opinion of the heritage specialist.

The ‘no-go’ option refers to the project not going ahead and therefore there would be no impact on the environment including heritage resources. In contrast, the current Watershed MTS is un-firm and does not have the capacity to meet the forecasted load. This would mean that future electricity demand would not be met and this could potentially restrict economic growth in the affected areas. From a heritage perspective the project area is already disturbed through farming and the expansion of villages and settlements. The ‘no-go’ option will maintain this status quo. The construction of the powerline will have a low impact on heritage resources if the pre-construction, construction and operational phases of the project are managed in line with the recommendations and mitigation measures provided in this report. Therefore, the ‘no-go’ option is not regarded as a reasonable option in light of the future electricity demands of the area.

13. MITIGATION MEASURES

- For any chance finds of heritage resources, all work must cease in the area affected and the Contractor must immediately inform the Project Manager. A heritage specialist must be called to site to inspect the finds. The NWPHRA / SAHRA must also be informed about any chance finds.
- The heritage specialist will assess the significance of the heritage resource/s found and provide guidance on the way forward.
- Permits must be obtained from the NWPHRA or SAHRA if heritage resources are to be removed, destroyed or altered.
- Any heritage resources found close to the construction site must be protected by a 20m buffer in which no construction can take place. The buffer material (danger tape, fencing, etc.) must be highly visible to construction crews.
- Under no circumstances may any heritage material be destroyed or removed from site unless under direction of a heritage specialist.
- Any mitigation measures recommended by the desktop palaeontological assessment must be adhered to and implemented where necessary.

14. RECOMMENDATIONS AND CONCLUSION

The proposed Mookodi-Mahikeng 400kV powerline could impact on heritage resources along all four route options. Heritage resources that occur in the study area include graves, cemeteries containing numerous graves, archaeological sites and protected structures. The recommendations below are provided to mitigate the potential impact of the powerline on heritage resources:

- Route option 2 is the preferred option from a heritage perspective as it is shortest in length;
- A walk-down of the selected route option by a heritage specialist, preferably an archaeologist, must be undertaken prior to construction in order that all heritage sites are identified and recorded prior to construction;
- All heritage sites identified along the route option and in close proximity must be protected with a 20 m buffer so that the construction process does not impact these sites; and
- A desktop palaeontological assessment must be undertaken as the project area falls into an area of both medium and low fossil sensitivity. The desktop assessment would indicate if significant/sensitive fossils will be impacted by the proposed project and provide mitigation measures and the way forward in this regard. The project may only proceed once the desktop palaeontological assessment has been undertaken.

No fatal flaws were identified during this study hence the construction of the proposed powerline can proceed from a heritage perspective as long as the recommendations and mitigation measures contained in this report and in the desktop palaeontological assessment are implemented where necessary.

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APPENDIX 1

HERITAGE SENSITIVITY MAP

Appendix 6D: Desktop Palaeontological Impact Assessment

PALAEONTOLOGICAL DESKTOP ASSESSMENT OF THE PROPOSED MOOKODI – MAHIKENG 400KV LINE, NORTH WEST PROVINCE

Issue Date:	8 June 2018
Revision No.:	0.1
Client:	Nemai Consulting
PGS Project No:	319PIA

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE:

ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North Wes		
Control	**Name**	**Signature**	**Designation**
Author	Elize Butler		Palaeontologist
Reviewed	Wouter Fourie		Principal Heritage Specialists – PGS Heritage
Client			Nemai

CLIENT: **Nemai Consulting**

CONTACT PERSON: **Kristy Robertson – Tel: 011 781 1730**

SIGNATURE: ______________________________

The palaeontological desktop assessment report has been compiled taking into account the NEMA Appendix 6 requirements for specialist reports as indicated in the table below.

NEMA Regs (2014) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report	Page 2 of Report – Contact details and company
The expertise of that person to compile a specialist report including a curriculum vita	Section 2
A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 6
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
An identification of any areas to be avoided, including buffers	Section 6
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	No sensitive areas identified refer to Figure 9
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 7
Any mitigation measures for inclusion in the EMPr	Section 8
Any conditions for inclusion in the environmental authorisation	Section 8
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	Section 8
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable.
A summary and copies if any comments that were received during any consultation process	Not applicable.
Any other information requested by the competent authority.	Not applicable.

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment Report for the proposed Mookodi – Mahikeng 400 kV line in North West. According to the National Heritage Resources Act (No 25 of 1999, section 38), a palaeontological impact assessment is key to detect the presence of fossil material within the proposed development footprint and it is thus necessary to evaluate the impact of the construction on the palaeontological resources.

The proposed development footprint is underlain by sediments of the Kalahari Group (*low Palaeontological sensitivity)*; the Allanridge Formation of the Ventersdorp Supergroup (*moderate Palaeontological sensitivity*); the Schmidsdrift Subgroup (Ghaap Group) and the Vryburg Formation (*both with a moderate Palaeontological sensitivity*) of the Transvaal Supergroup as well as the ancient metamorphic rocks of the Swazian Era. The overall impact is rated as *low*.

All four route alternatives were found to be in the above mentioned geological sediments and therefore none of the routes were preferred above the other and none were a no-go option.

As the Palaeontological sensitivity of the development footprint varies between *low to moderate* the proposed development is thus unlikely to pose a substantial threat to local fossil heritage.

However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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TERMINOLOGY AND ABBREVIATIONS

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MTS	Main Transmission Substation
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

1 INTRODUCTION

The present-day Watershed substation is currently un-firm and has inadequate capacity to support the estimated load in the Watershed Main Transmission Substation (MTS) area which comprises Lichtenburg and extends to Mahikeng town. Additional network expansion will comprise of the establishment of a new transmission substation in Mahikeng (the proposed Mahikeng substation will undergo a separate EIA Process). As part of establishing the site for the planned Mahikeng substation, the latter will be planned with an end state of 3x 500MVA 400/132kV transformers and install 2x 500MVA 400/132kV transformers at first. A 1x 160km Pluto – Mahikeng 400kV line will be established (during a separate EIA Process) and a 1x 180km Mookodi - Mahikeng400kV line will be established.

This proposed line is within the planned scope of work for the present EIA Process.

Eskom Holdings SOC Limited appointed Nemai Consulting to conduct the Environmental Impact Assessment (EIA), in terms of Government Notice (GN) No. R 982 of 4 December 2014 (as amended), for the proposed Mookodi- Mahikeng 400kV Line, which is approximately 180km in length. Four alternative routes are proposed and will be assessed. The origin of the line is at the existing Mookodi MTS, while the proposed alternative routes for the line lies in a north-east direction and end at the proposed Mahikeng substation site (Error! Reference source not found.**1-6**).

1.1 Project Description

The construction of a 400kV line from Mookodi substation to the future Mahikeng substation is proposed. The Mookodi – Mahikeng400kV line is approximately 180km in length, but the distance differs between the different alternative routes.

The following route alternatives are proposed:
1. Option 1 (WM1)
2. Option 2 (WM13)
3. Option 3 (WM4a)
4. Option 4 (WM9a)

Each of the four alternative routes are indicated in **Figure 1-4** with a combined map on **Figure 5**. A 2km servitude is included for each alternative route. As a standard practice and to comply with regulatory requirements, the option of not proceeding with the project is incorporated in the evaluation of the alternatives (the no-go option).

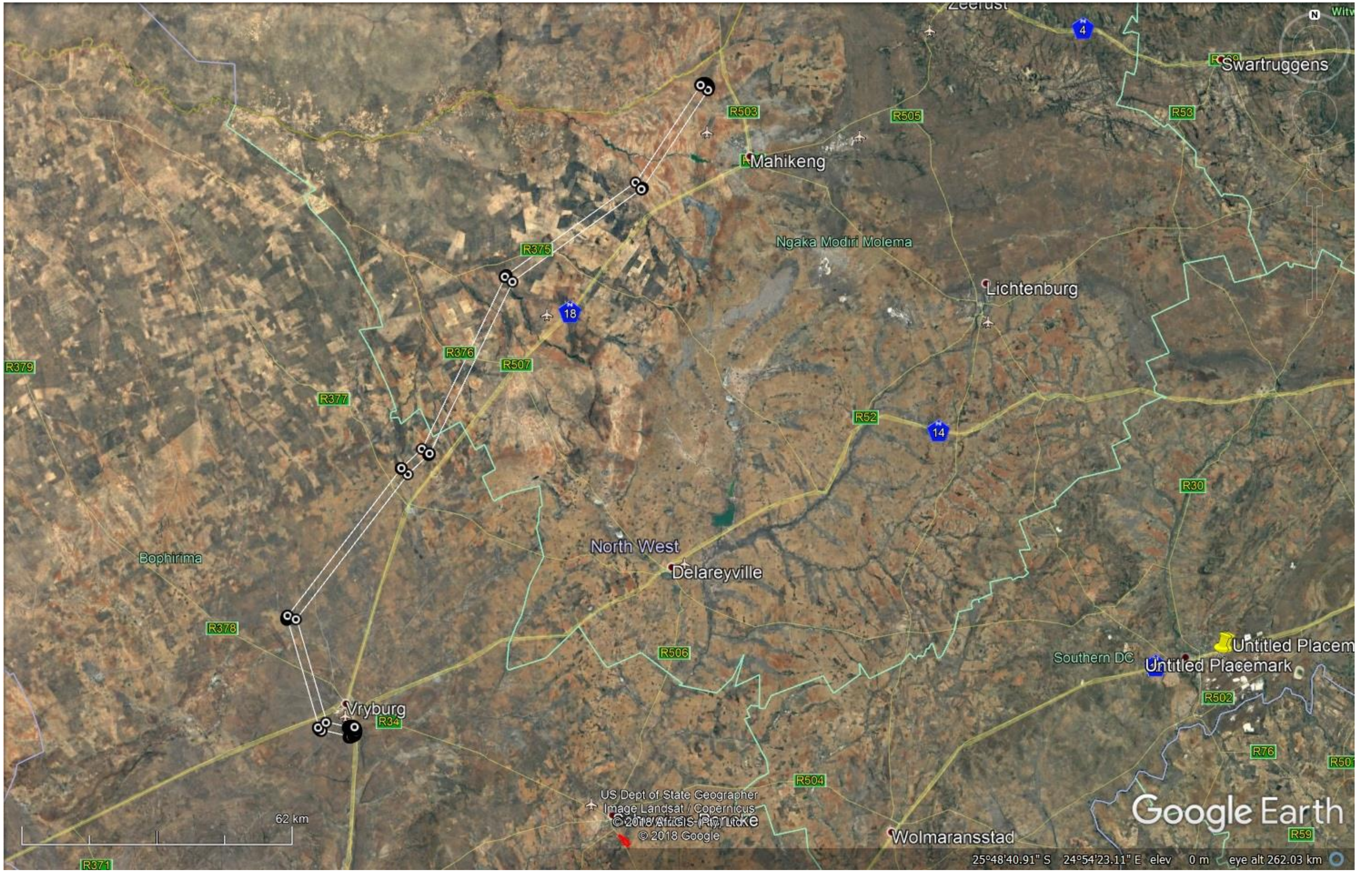

Figure 1. Google Earth Image of the location of the proposed Mookodi – Mahikeng 400kV line in North West: Option 1-including the 2 km corridor. Scale bar represents 62 km.

Figure 2. Google Earth Image of the location of the proposed Mookodi – Mahikeng 400kV line in North West: Option 2-including the 2 km corridor. Scale bar represents 51 km.

Figure 3. Google Earth Image of the location of the proposed Mookodi – Mahikeng 400kV line in North West: Option 3-including the 2 km corridor. Scale bar represents 50 km.

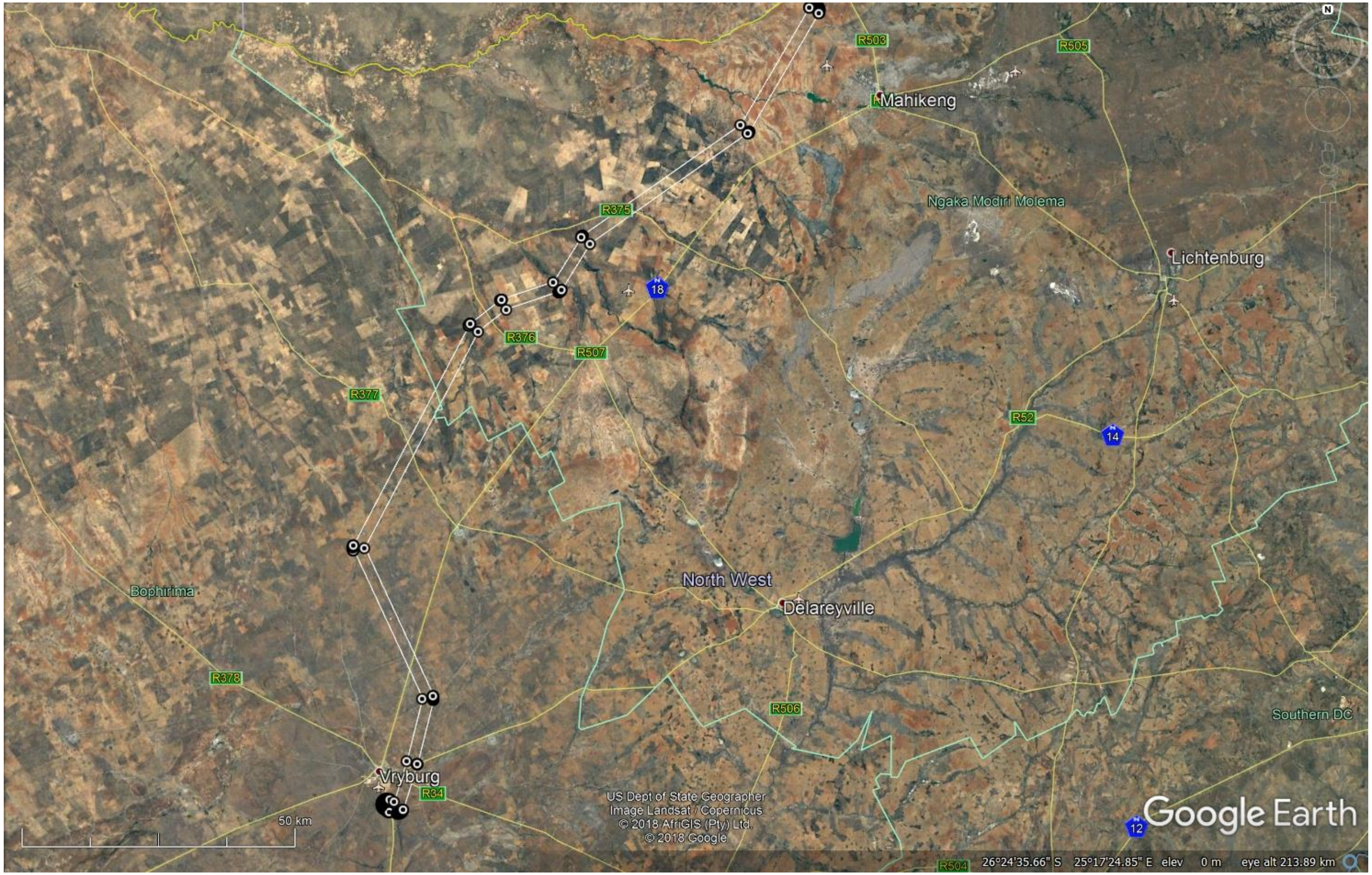

Figure 4. Google Earth Image of the location of the proposed Mookodi – Mahikeng 400kV line in North West: Option 4-including the 2 km corridor. Scale bar represents 50 km.

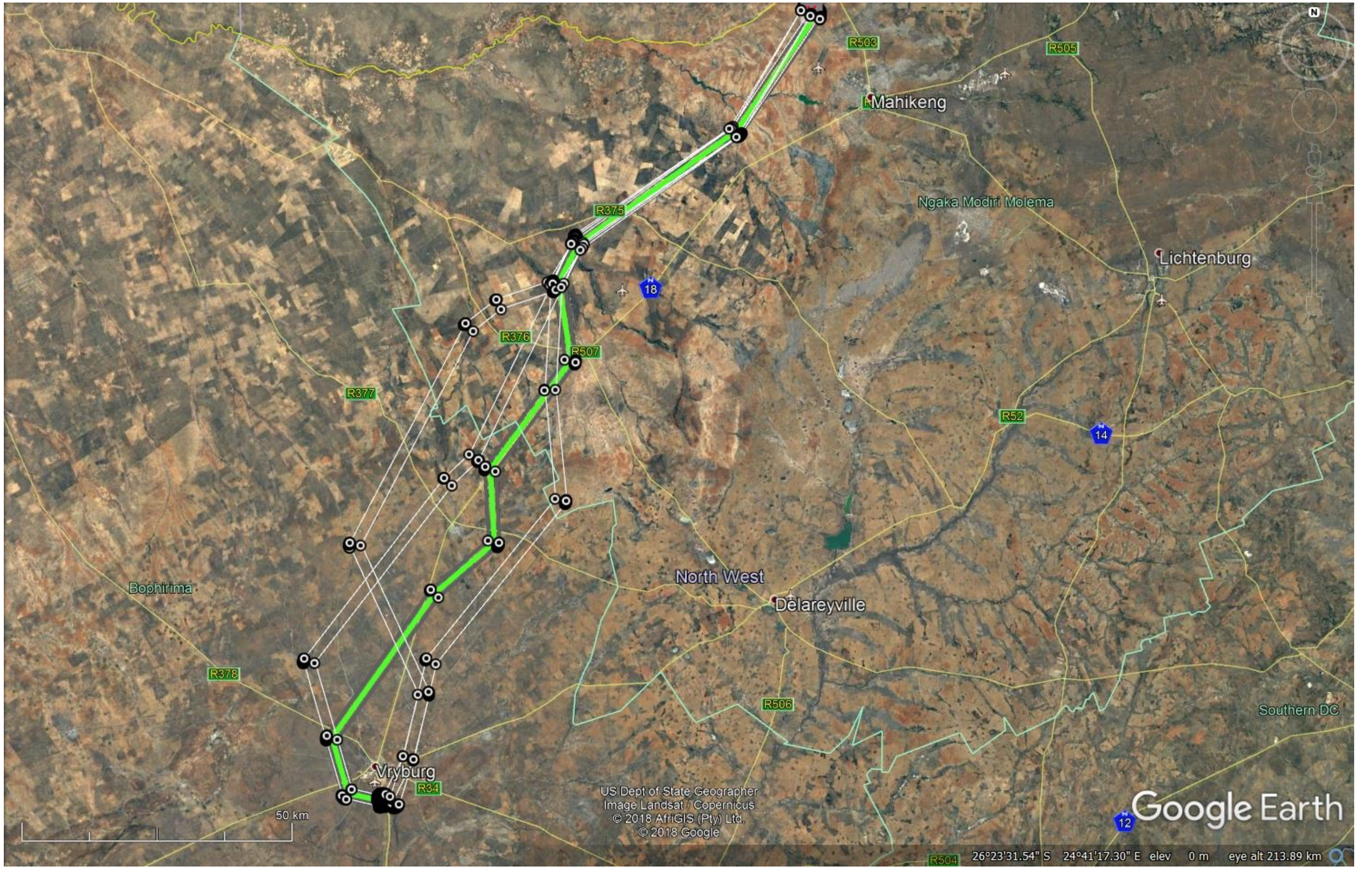

Figure 5. Google Earth Image of the location of the proposed Mookodi – Mahikeng 400kV line in North West: All four options -including the 2 km corridor. Scale bar represents 50 km.

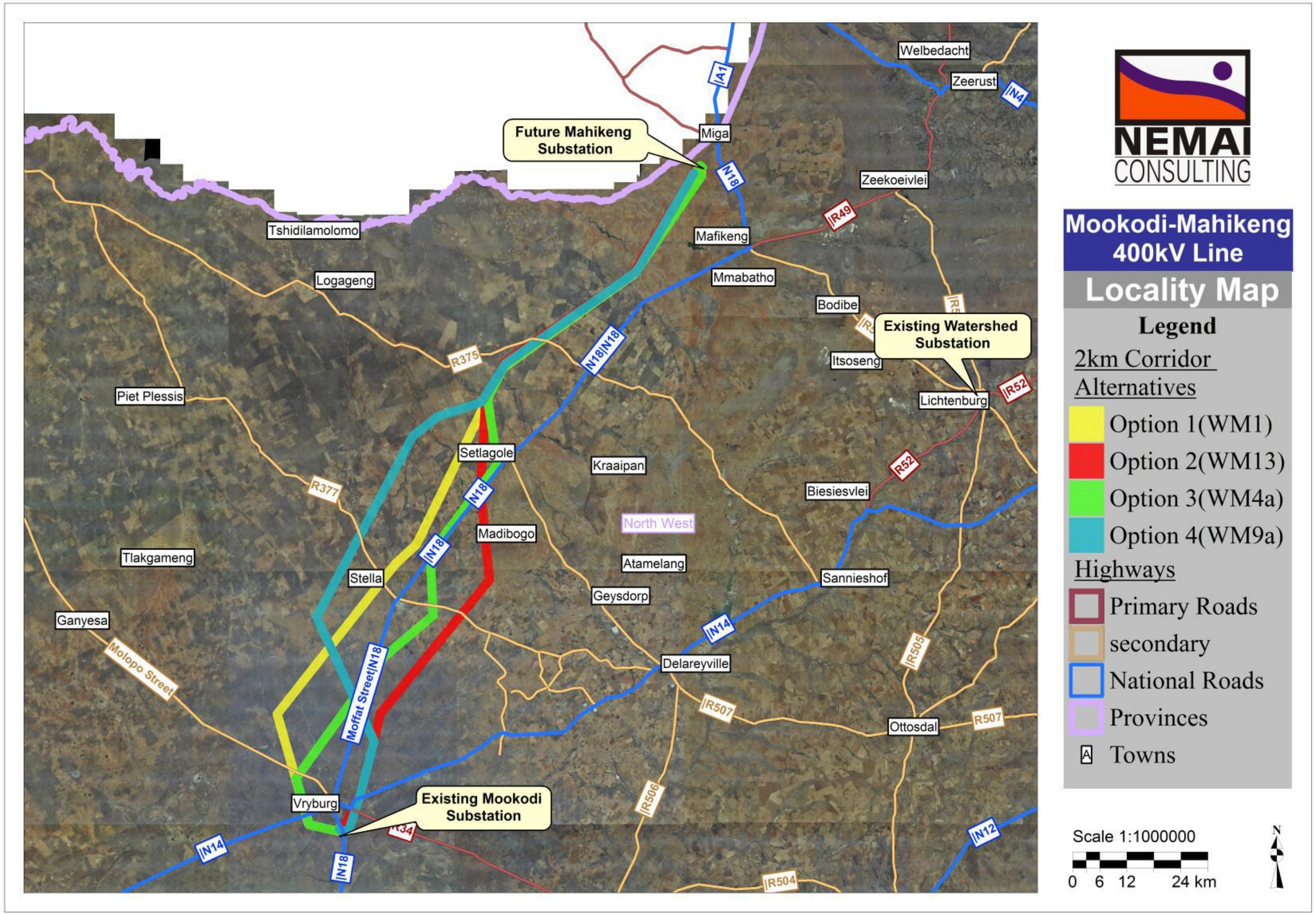

Figure 6. Mookodi – Mahikeng 400kV line as well as route alternatives in North West. Map provided by Nemai Consulting.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 12 years. She has been conducting Palaeontological Impact Assessments since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, moved, broken or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Desktop Assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m^2 in extent;

- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The objective of a Palaeontological Desktop Assessment is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment are: 1) to identify the palaeontological importance of the exposed and subsurface rock formations in the development footprint 2) to evaluate the palaeontological importance of the formations 3) to determine the impact of the development on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

When a palaeontological desktop study is compiled, the potentially fossiliferous rocks (i.e. groups, formations, etc.) present within the study area are established from 1:250 000 geological maps. The topography of the development area is identified using 1:50 000 topography maps as well as Google Earth Images of the development area. Fossil heritage within each rock section is obtained from previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions (identifying fossils found in locations specifically in areas close to the development area). The palaeontological importance of each rock unit of the development area is then calculated. The possible impact of the proposed development footprint on local fossil heritage is established on the following criteria: 1) the palaeontological importance of the rocks and 2) the type and scale of the development footprint and 3) quantity of bedrock excavated.

In the event that rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is required. Based on both the desktop data and field examination of the rock exposures, the impact significance of the planned development is measured with recommendations for any further studies or mitigation. In general, destructive impacts on palaeontological heritage only occur during construction. The excavations will transform the current topography and may destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation comprises the sampling, collection and recording of fossils and may precede construction or, more ideally, occur during construction when potentially fossiliferous bedrock is exposed. Preceding the excavation of any fossil heritage a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact is possible because our knowledge of local palaeontological heritage may be increased.

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed Mookodi-Mahikeng 400 kV line is underlain by various geological sediments (**Figure 7** and **Figure 9**) and can also be seen in the 1: 250 000 geological map 2624 Vryburg (Council for Geoscience, Pretoria)

The geology of the development consists of the following:

- Kalahari Group
- Ventersdorp Supergroup: Allanridge Formation
- Transvaal Supergroup
    - Schmidtsdrif Subgroup, (Ghaap Group)
    - Vryburg Formation (Transvaal Supergroup)
- Swazian Era

5.1 Kalahari Group (Late Cretaceous to Recent; 90 Ma to 0 Ma)

The central of southern Africa was dominated by two major Basins during the Cenozoic namely the Kalahari and Bushveld Basins. The sediments of the Kalahari Basin precede the Cenozoic deposits. The wide-ranging terrestrial sediments of the Kalahari Group was deposited in the Kalahari Basin to the north of the Orange River (Northern Cape) and western part of the North West Province, while the younger Cenozoic deposits are largely confined to the coastal areas. The sediments of the Kalahari Group consist of fluvial gravels, sands, lacustrine and pan mudrocks, diatomites and diatomaceous limestones, evaporates (a natural salt or mineral deposit left after the evaporation of a water body), consolidated to unconsolidated aeolian sands, pedocretes (especially calcrete).

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Cenozoic superficial deposits although they sometimes comprise of significant fossil biotas. Fossils assemblages may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells and freshwater stromatolites are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts). These fossils are usually associated with ancient pans, lakes and river systems.

5.2 Ventersdorp Supergroup (3000 -2100 Million years ago)

After the stabilization of the Kaapvaal Craton a succession of four basins developed of which the Ventersdorp Supergroup was the second last to develop. This ancient Supergroup provides a remarkable volcano-sedimentary supracrustal record that comprises the largest and widespread volcanic rocks on the Kaapvaal Craton. This Supergroup unconformably overlies the Witwatersrand Supergroup and in turn is unconformably overlain by the Transvaal Supergroup. The uppermost formation of the Ventersdorp Supergroup is the **Allanridge Formation**. This formation consists of basaltic lava and tuff and is not known to be fossiliferous.

5.3 Transvaal Supergroup

The Transvaal Supergroup (Late Archaean to Early Proterozoic) is preserved within three structural basins on the Kaapvaal Craton of southern Africa namely the Transvaal and Griqualand West Basins in South Africa and the Kanye Basin in Botswana.

The Ghaap Group of the Griqualand West Basins is divided in the following subgroups: Schmidsdrift, Asbestos Hills and Koegas Subgroup (from the youngest to the oldest).

5.4 Schmidtsdrif Subgroup, (Ghaap Group, Transvaal Supergroup) (Fig 8-9).

The Schmidstrift Subgroup can be divided in two formations, namely the Boomplaas and Clearwater Formations. These formations comprise of carbonates with siliciclastics, iron Formations Late Archaean / Early Proterozoic c. 2.56 Ga. As well as various shallow marine and lacustrine stromatolites (some specimens are very large), oolites, pisolites in carbonates, filamentous and coccoid organic walled microfossils (e.g. cyanobacteria) in siliciclastics/ carbonates and cherts of banded iron formations.

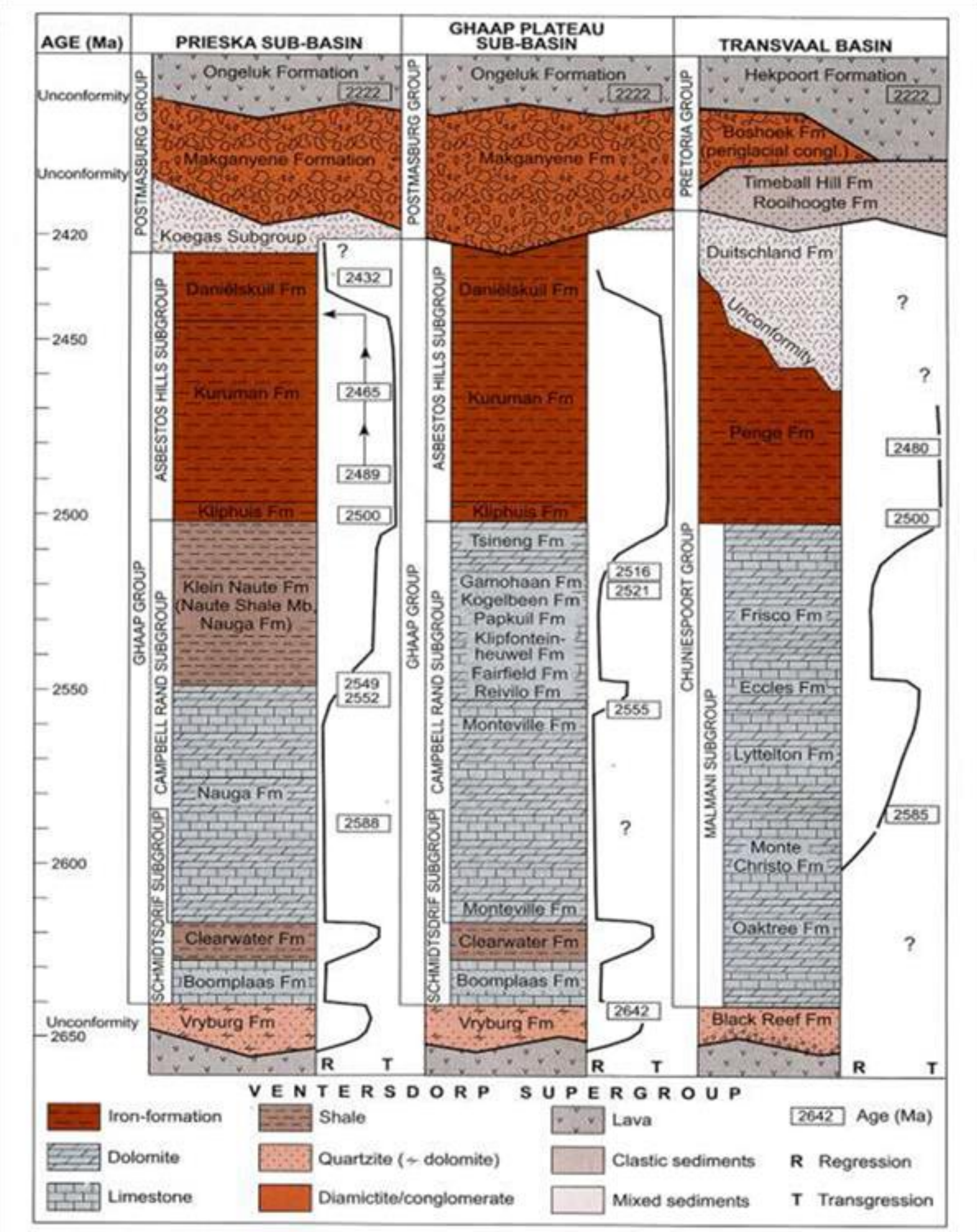

Figure 7. Stratigraphy of the Transvaal Supergroup of the Ghaap Plateau Basin. The middle column (Schmidsdrift Supergroup and Vryburg Formation) shows the rock units represented in the proposed site (Eriksson, et al. 2006).

Figure 8. Example of a well-preserved stromatolite from the Archaean Era.

Stromatolites (**Figure 8**) are layered mounds, columns and sheet-like sedimentary rocks. Originally, they were formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-bases life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

5.5 Vryburg Formation (Transvaal Supergroup)

The Vryburg Formation forms part of the lower Griqualand West Basin of the Transvaal Supergroup.

5.6 Swazian Era

Rocks of the Swazian Era is older than 3100 million years and are highly metamorphosed rocks, comprising banded ironstone and chert

5.7 Kraaipan Group

These cherts and volcanic glasses also present in the similar-aged Barberton Greenstone Belt may contain microbial fossils and microbial trace fossils .

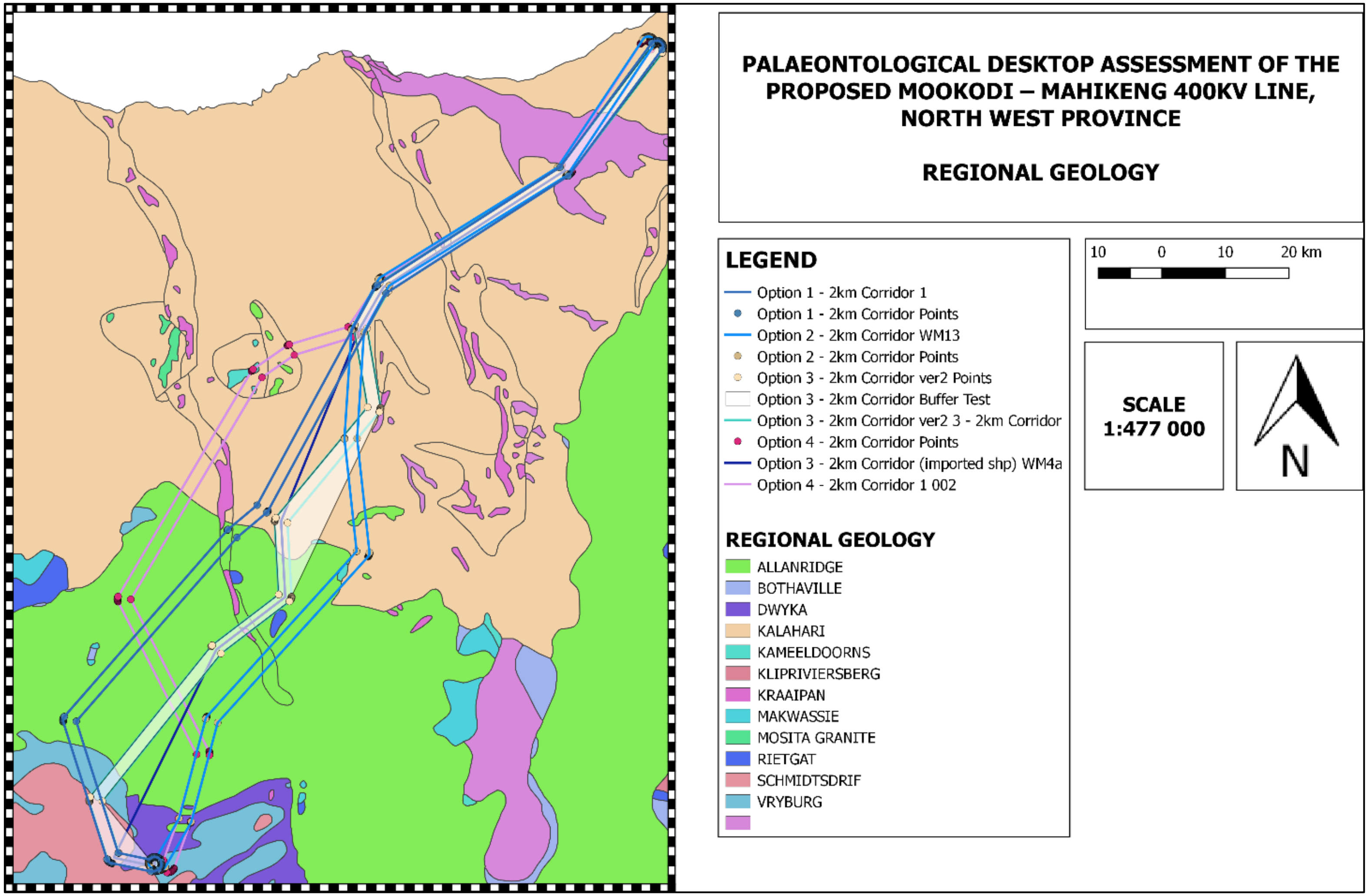

Figure 9. The surface geology of the proposed Mookodi – Mahikeng 400kV line as well as four route alternatives in North West. The proposed development is underlain by the Kalahari Group; the Allanridge Formation of the Ventersdorp Supergroup; the Schmidtsdrif Group, (GhaapP Group, Transvaal Supergroup); and the Vryburg Formation of the Transvaal Supergroup as well as rocks of the Swazian Era. Map drawn QGIS Desktop 2.18.14.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development site is situated within the Naledi-, Kagisano- Molopo and Mahikeng Local Municipalities on the North West Province. All route alternatives starts in Vryburg and lies in a north-east direction ending near Mahikeng (**Figure 1-Figure 6**). A servitude of 2 km (one km on each side) allows for possible deviations from the current proposed alignment of the power lines.

6.1 Methods

A Palaeontological desktop study was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2018), topographical and geological maps and other reports from the same area were used to assess the proposed area of the development. No consultations were undertaken for this PIA.

6.2 Assumptions and Limitations

The accurateness of Palaeontological Desktop Impact Assessments is reduced by old fossil databases that do not always include relevant locality or geological formations. The geology in various remote areas of South Africa may be less accurate because it is based entirely on aerial photographs. The accuracy of the sheet explanations for geological maps is inadequate as the focus was never intended to be on palaeontological material.

The entire South Africa has not been studied palaeontologically. Similar Assemblage Zones but in different areas, might provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations generally assume that unexposed fossil heritage is present within the development area. Thus, the accuracy of the Palaeontological Impact Assessment is improved by a field-survey.

6.3 Methodology for Impact Assessment

In order to ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors, along with the equivalent quantitative rating scale for each of the aforementioned criteria, is given in **Table 1.**

Table 1: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	*Isolated site/ proposed corridor*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

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

6.3.1 Significance Assessment

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

A more detailed description of the impact significance rating scale is given in **Table 2** below.

Table 2: Description of the significance rating scale

RATING		DESCRIPTION
5	VERY HIGH	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	HIGH	Impact is of substantial order within the bounds of impacts which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	MODERATE	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	LOW	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial

		impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	VERY LOW	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

6.3.2 Spatial Scale

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

Table 3: Description of the Spatial significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of possible impacts, and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the proposed site.
3	Local	The impact will affect an area up to 5 km from the proposed site.
2	Study Area	The impact will affect an area not exceeding the boundary of the study area.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

6.3.3 Temporal/Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal or duration scale is rated according to criteria set out in **Table 4.**

Table 4: Description of the temporal rating scale

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

6.3.4 Degree of Probability

The probability, or likelihood, of an impact occurring will be described as shown in **Table 5** below.

Table 5: Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very likely
5	It's going to happen / has occurred

6.3.5 Degree of Certainty

As with all studies, it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used, as discussed in **Table 6.** The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 6: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

6.3.6 Quantitative Description of Impacts

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

Impact Risk = (SIGNIFICANCE(2) **+***Spatial (2)***+** Temporal (5)) X Probability (2)

3 5

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

Table 7: Example of Rating Scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Low	**Study Area**	**Permanent**	**Unlikely**	**High**
Impact on heritage sites	2	2	5	2	1.2

Note: The significance, spatial and temporal scales are added to give a total of 9, which is divided by 3 to give a criterion rating of 3. The probability (2) is divided by 5 to give a probability rating of 0.4. The criteria rating of 3 is then multiplied by the probability rating (0,4) to give the final rating of 1.2

The impact risk is classified according to 5 classes as described in the table below.

Table 8: Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	Very Low
1.1 – 2.0	2	Low
2.1 – 3.0	3	Moderate
3.1 – 4.0	4	High
4.1 – 5.0	5	Very High

Therefore, with reference to the example used for heritage resources above, an impact rating of 1.2 will fall in the Impact Class 2, which will be considered to be a LOW impact.

7 FINDINGS

The proposed development footprint is underlain by sediments of the Kalahari Group (*low Palaeontological sensitivity*); the Allanridge Formation of the Ventersdorp Supergroup (*moderate Palaeontological sensitivity*); the Schmidsdrift Subgroup (Ghaap Group) and the Vryburg Formation (*both with a moderate Palaeontological sensitivity*) of the Transvaal Supergroup as well as the ancient metamorphic rocks of the Swazian Era. The possible impact on palaeontological resources is rated as *low* (**Table 9**) All four route alternatives were found to be in the above mentioned geological sediments and therefore none of the routes were preferred above the other and none were a no-go option.

Table 9: Impact rating on palaeontological resources

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Low	Study Area	Permanent	Unlikely	Low
Impact on palaeontology	2	2	5	2	1.2

8 RECOMMENDATIONS

As the Palaeontological sensitivity of the development footprint varies between *low to moderate* the proposed development is thus unlikely to pose a substantial threat to local fossil heritage. However, should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably in situ) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (e.g. recording, sampling or collection) can be taken by a professional paleontologist.

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Appendix 6E: Agricultural Impact Assessment

AGRICULTURAL IMPACT ASSESSMENT FOR THE PROPOSED MOOKODI-MAHIKENG 400KV LINE

April 2018

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1 BACKGROUND

There is a need to expand the Watershed Main Transmission Substation (MTS) area through establishing a new transmission substation in Mahikeng.

The proposed development includes an approximately 180km transmission line traversing from the existing Mookodi Substation in Vryburg towards the north-east ending at the proposed Mahikeng substation site. A two kilometre corridor for each route alternative applies (one kilometre on each side). This extended study area allows for any possible deviations from the current proposed alignment of the power lines within this corridor, which may be necessary due to findings of the Specialist Studies, outcome of Eskom negotiations with landowners and technical requirements.

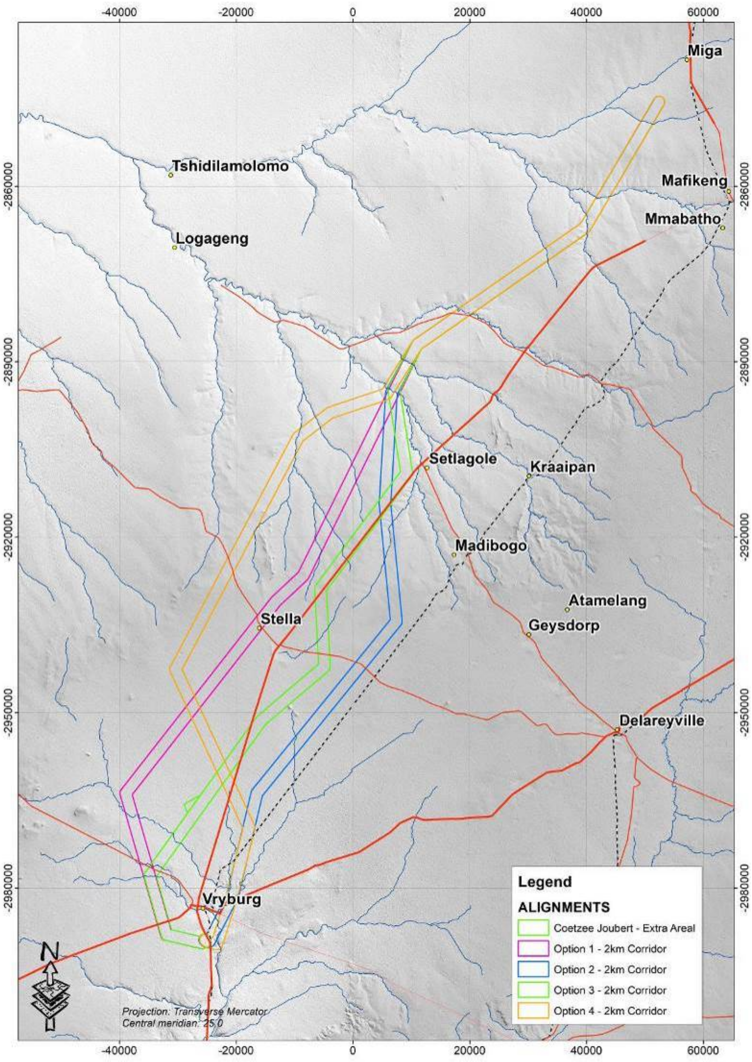


Figure 1. Locality map

The following shall be used as a standard for vegetation clearance for new powerlines with a nominal voltage of 220 to 765 kV for access purposes (inspection, repair and maintenance), safety clearance, and prevention of fires in servitudes and wayleaves:

- Servitude building restriction widths (measured from the centre line of the power line) are 22 m to 40 m.
- Clear from the centre of the power line up to the outer conductor, plus an additional 10 meters on either side.

Alternatives are the different ways in which the project can be executed to ultimately achieve its objectives. The route alternatives for the project are listed below:

- Option 1 (WM1)
- Option 2 (WM13)
- Option 3 (WM4a)
- Option 4 (WM9a)

The key issues that must be considered in the agricultural assessment are the following:

Address potential issues which may include:

- Loss of agricultural land.
- Viability of remaining farming operations.
- Loss of fertile soil, cultivated areas and grazing land.
- Disruptions to farming practices during construction.
- Determine agricultural potential in the project footprint;
- Determine impacts of project from an agricultural perspective; and
- Suggest suitable mitigation measures to address the identified impacts.

The output of the report is:

- a discussion of the natural resources that influence agricultural potential;
- sensitivity to agriculture and the impact on agricultural resources;

- an indication of the impact of the development on the farmers; and ways to mitigate the effect of the project during and after construction.

Land within this area was visited on 29 and 30 March 2018 to do ground truthing of the land uses delineated from satellite images as a backdrop.

2 PROCESS OF THE ASSESSMENT

The present land use was identified from satellite images dated 2017/8 and then verified by field visits.

Google Earth has images taken from 1984 up to now from which cultivated land could be identified.

The approach for the photo interpretation was the use the most recent image as the basis and then compare the results with historical images as well as a GIS dataset of the Department of Agriculture.

The past couple of years experienced extreme droughts, which may have created false interpretations, particularly in areas where subsistence farmers are located. In these instances historical images were relied on.

Forty seven observation points were photographed as part of ground truthing – these are provided as an addendum. The positions are indicated in Figure 2.

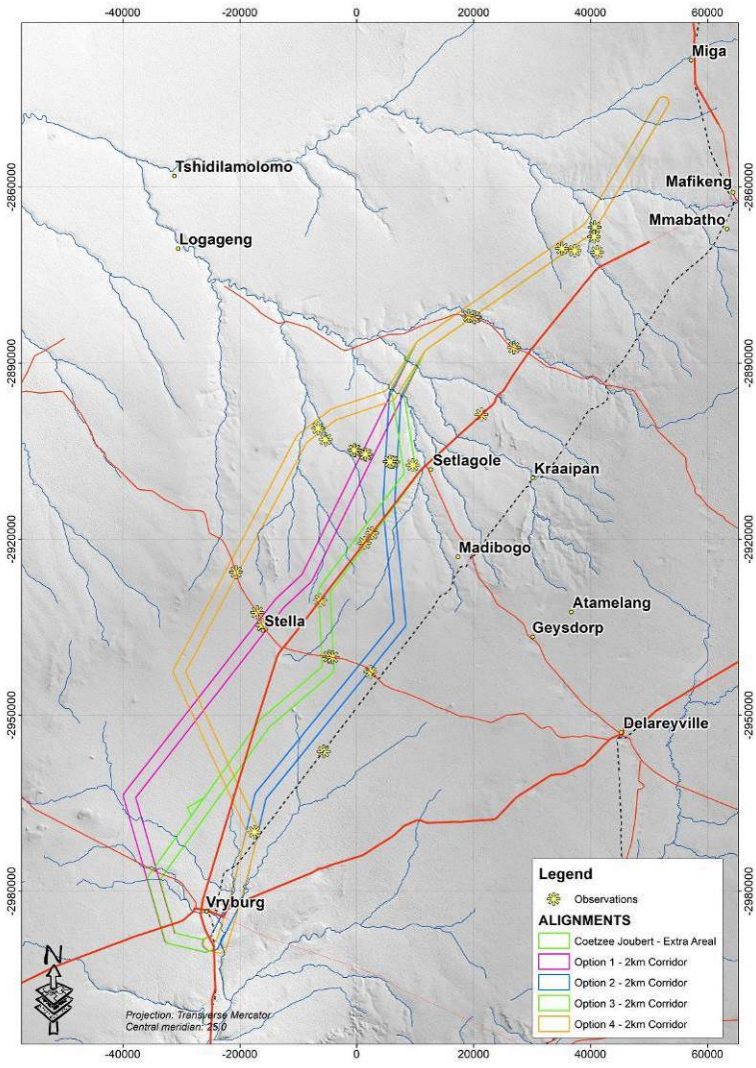


Figure 2. Photo records of observations

The land uses were delineated as five categories:

1) Irrigated land;
2) Land under cultivation ;
3) Fallow;
4) Old lands and,
5) Grazing (open veld or pastures).

The impact assessment will assign values to each category in a matrix to indicate significance of loss.

- It is accepted that the permanent loss in the case of grazing and old lands will be only the footprint of the transmission line tower which will impact about $80m^2$;
- Cultivated land will permanently be lost for a strip of at least 50 metres (the servitude is between 22m and 40m from the centre line);
- A temporary loss for grazing land will be for a strip of 50 metres wide (to allow for vehicle movement) and will last for one season, which is the time allowed for the vegetation to recover;
- Irrigated land usually has expensive infrastructure that will be permanently lost if the line is constructed. The irrigated land will revert to grazing or dryland cultivation after the lines had been installed. It must be noted that in the case of centre pivot irrigation systems, the pivot is sometimes moved to adjacent land. The extent of the irrigated land will is such a case include land with irrigation infrastructure;

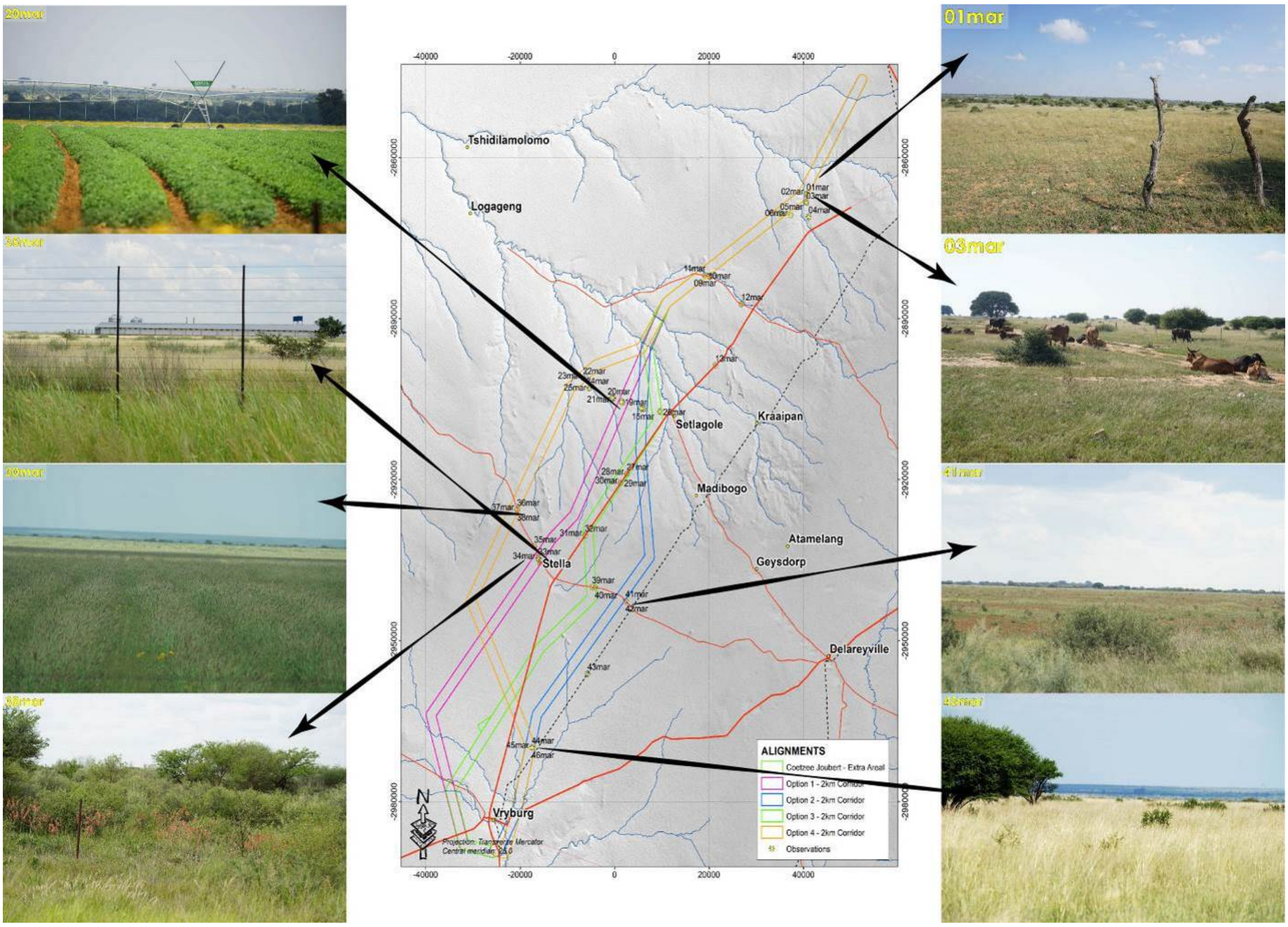


Figure 3. Example of land uses

3 AGRICULTURAL LAND USE

Land uses in agriculture is dynamic and constantly changes, depending on the climate and socioeconomic conditions of the farmer and of the region and even the country. As the viability of cropping diminished with the increase of production cost and product priced that did not increase at the same rate, some of the land has reverted back to veld or was planted to pastures. Opportunistic cultivation is still largely practiced by the subsistence farmers, where the land is only planted after sufficient rain has fallen.

Two areas were found that practice communal grazing. The veld conditions on these lands are still poor due to overgrazing. They, however, are very dependent on the grazing land for their survival and were as a result, included with the commercial farmers in the impact assessment. This also applies to the arable land.

Figures 4 and 5 indicate the changes that took place in 2010 compared to that in 1990. The lighter shaded yellow-brown colour indicate land that had recently been cultivated, the dark grey, has abundant trees and is used as grazing or browsing. The images indicate that the extent of cultivation is much less that is was in 1990. There was a drive by the Department of Agriculture In the early 90's to convert low potential cropping land to pastures. This is very likely the reason for the decline in cultivated cropping land.

However, even under present management systems and circumstances, the land portions that are cultivated varies, likewise the extent.

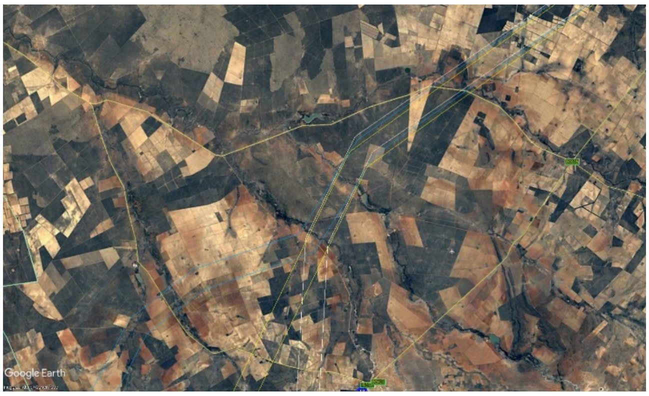


Figure 4. Google image dated 1990

Figure 5. Google image dated 2010

The land uses are as follows:

Table 1. Land uses in the survey area

	Route 1	Route 2	Route 3	Route 4
Cultivated	2 369	2 059	1 887	2 919
Cultivated opportunistic	721	2 018	721	721
Fallow / old lands	5 194	4 749	4 731	5 044
Irrigated	156	63	464	190
Grazing	28 692	26 155	29 720	28 364
TOTAL	**37 132**	**35 045**	**37 522**	**37 238**

- The predominant land use is animal production. Approximately 80% of the land is grazing. The land indicated as *fallow* has recently been cultivated and may, as in the case of *old lands*, been planted to pastures;
- Two poultry production units were identified, both in route alignment 3;
- The area under cultivation is approximately 3 000 hectares under commercial production that lies around Stella and Setlagole. This is also where the deeper soils are found.
- Route 2 passes through land with communal ownership (or for which a Permit to Occupy – PTO had been issued), where the cultivation is opportunistic, in other words, land are not cultivated every year and usually follows incidences of high significant rain showers;
- Route 3 has much more irrigated lands. These lands usually has a high investment in pumps and underground water supply lines and should be avoided if at all possible.

The following figure shows the main activities:

Photo 1. Overgrazed communal grazing land

Photo 2. Crops under irrigation

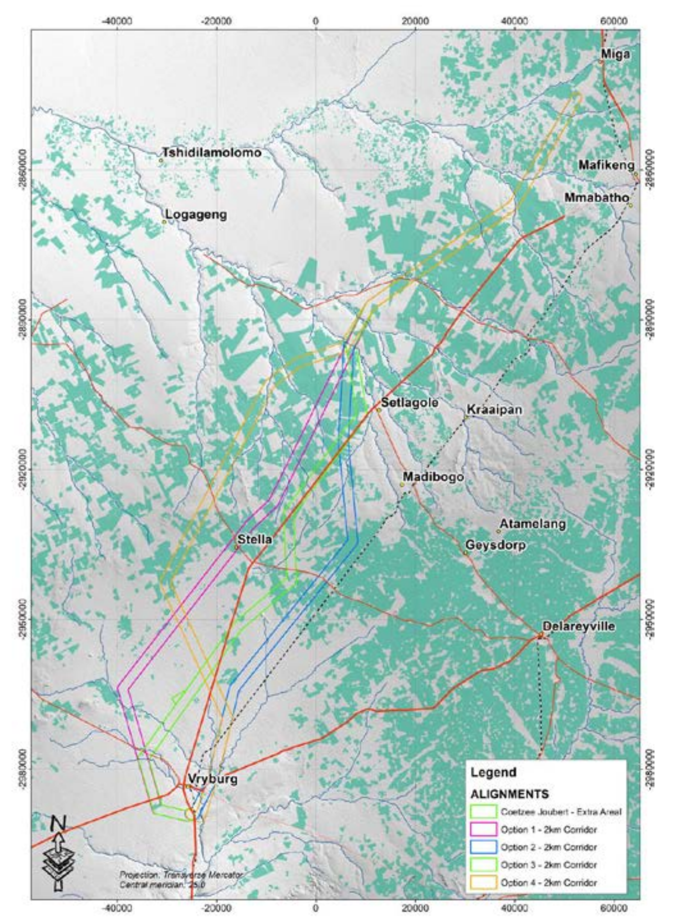


Figure 6. Historically cultivated land according to NDA

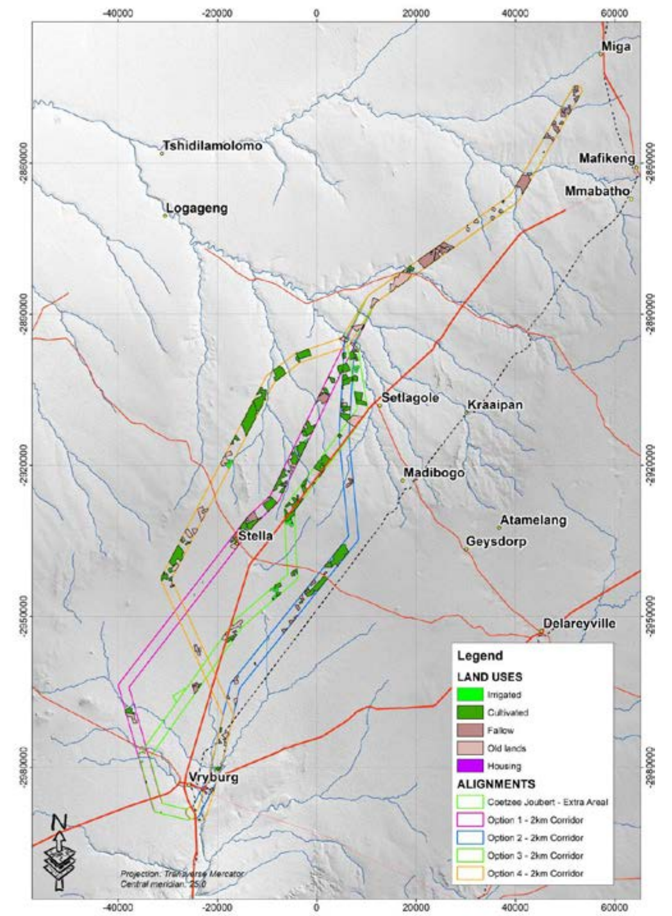


Figure 7. Present land uses

A photo record of the land uses is provided as an addendum.

Irrigated land was found on the following properties:

Table 2. Status of irrigated land (orange shade indicates that the farm may be compromised)

Property	Type of system	Impact /Discussion	R1	R2	R3	R4	Farm size
589/4	Conventional	Low, land can be moved	7				431
582/8	Conventional	Low, land can be moved	3		3		22
582/9	Conventional	Low, land can be moved	5.5		5.5		22
584/6	Conventional	Low, land can be moved	4.4				1110
544/1	Conventional	Low, land can be moved	7.8				833
343/24	Conventional	Low, land can be moved	1				8.6
343/23	Conventional	High, most of the land is irrigated	7				8.6
343/22	Conventional	High, most of the land is irrigated	6				8.9
343/21	Conventional	High, most of the land is irrigated	5				8.1
343/19	Conventional	High, most of the land is irrigated	6				7.3
343/30	Conventional	Low, land can be moved	3				21.6
674/37	Conventional	Low, land can be moved				3.8	17
674/60	Conventional	Viability of the unit may be compromised		15.6		16.6	51.3
674/9	Conventional	Low, land can be moved		4.7		4.7	43.5
674/24	Conventional	Low, land can be moved		2.8		2.8	42
674/12	Conventional	Viability of the unit may be compromised		40		40	88.4
321/12	Conventional	Viability of the unit may be compromised				100	174.2
321/5	Conventional	Low, land can be moved				25	539.5
671	Conventional	Low, land can be moved	2.29		3.29		600

Property	Type of system	Impact /Discussion	R1	R2	R3	R4	Farm size
12280	Pivot	Viability of the unit may be compromised			110		742
249/4	Pivot	Viability of the unit may be compromised			150		602
562	Pivot	Viability of the unit may be compromised			90		167
562/8	Pivot	Viability of the unit may be compromised			20		343
562/7	Pivot	Viability of the unit may be compromised			50		344
28	Pivot	Viability of the unit may be compromised	50				775
Former trust	Pivot	Viability of the unit may be compromised			35		?
254/3	Pivot	Viability of the unit may be compromised			50		290
345/3	Pivot	Viability of the unit may be compromised			50		290.1
349/4	Pivot	Viability of the unit may be compromised			120		602.6
29	Pivot	Viability of the unit may be compromised	100		50		3057
			208	**63**	**736**	**192**	**11 249**

Conclusions

- Route 1 has a number of small irrigation farms close to Vryburg that may not remain viable after construction. It further has two centre pivot systems that will be lost.
- Route 2 has only 63 hectares of irrigated lands. Only one farming unit's viability may be influenced. However, the irrigation is done by conventional system that will not lose its underground infrastructure. The land under the transmission line could still be irrigated after mitigation. This is the preferred suit if compared to the other alignments.
- Route 3. This is the Route with the most units that may not be viable after construction.
- Route 4 has three units may not be viable after construction

4 AGRICULTURAL INFRASTRUCTURE

The impact on agriculture has three components; the replacement of infrastructure, loss on income in cases where the farming opportunity is lost or reduced in size, and the temporary loss of income during the period of construction because the land cannot be cultivated or used as animal grazing.

Permanent infrastructure on farms is critical in the production process and can have a major impact on farming income, especially in the case of irrigation, where pivot irrigation systems are used. Irrigation cannot take place under the transmission tower with the result that if the line traverse the circle, the main supply line will have to be moved to another position, and also away from where the soil fertility had been built up over years. The impact is therefore not only the infrastructure.

The farm infrastructure on each route are as follows (refer to Table 2 and Figure 7):

Table 3. Farm infrastructure within each route

Type	Route 1	Route 2	Route 3	Route 4
Commercial		1		1
Dam	4	2	1	5
Housing	43	36	28	42
Industry			1	
Irrigation	16	1	14	2
Poultry			2	
Rural housing	4	4	4	4
Services	1	3	1	3

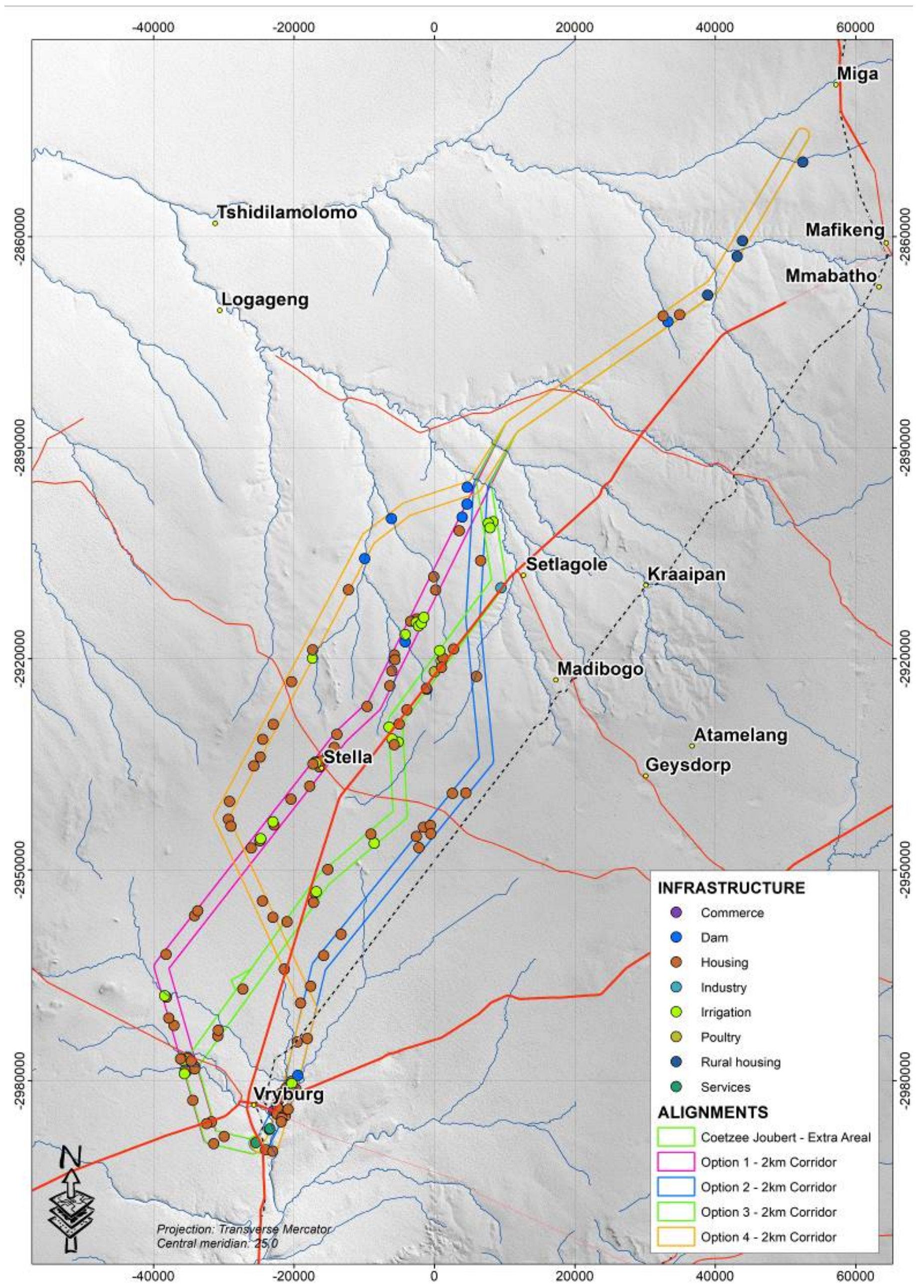


Figure 8. Farm infrastructure within each route

5 NATURAL RESOURCES – BASELINE CONDITION

5.1 Climate

The site is located in the western portion of Northwest Province. It has a typical summer rainfall pattern.
A summary of the climate data is as follows:

Temperature

The average monthly maximum of 32,9 ^{O}C is reached in January while the minimum of 4,5 ^{O}C is in July.
Weather data suggests that the area is experiencing above normal maximum summer temperatures (refer below).

Rainfall

The average annual rainfall is between 500mm and 550mm per year for most of the study area, and up to 600 in the far northern portion. The transmission line falls in the summer rainfall area of the Highveld Region and is suitable for rainfed crop production.

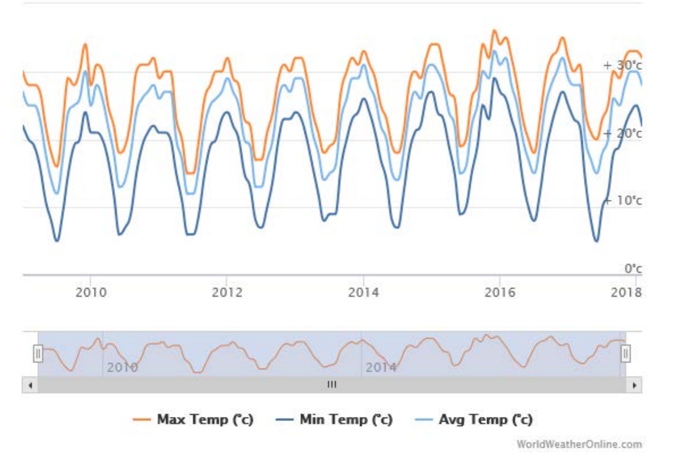


Figure 9. Temperature at Vryburg

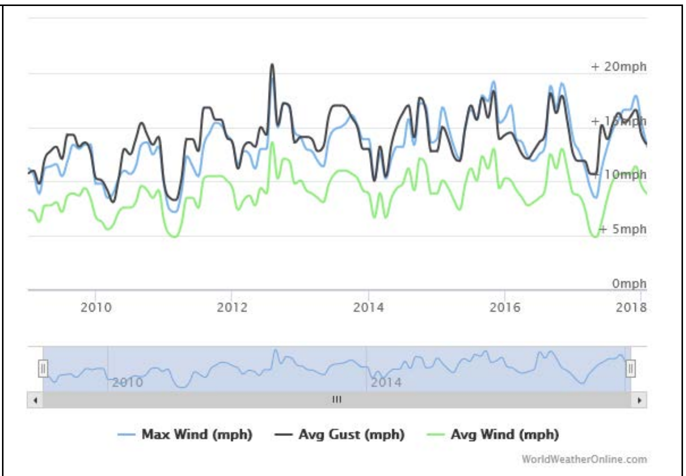


Figure 10. Wind statistics at Vryburg

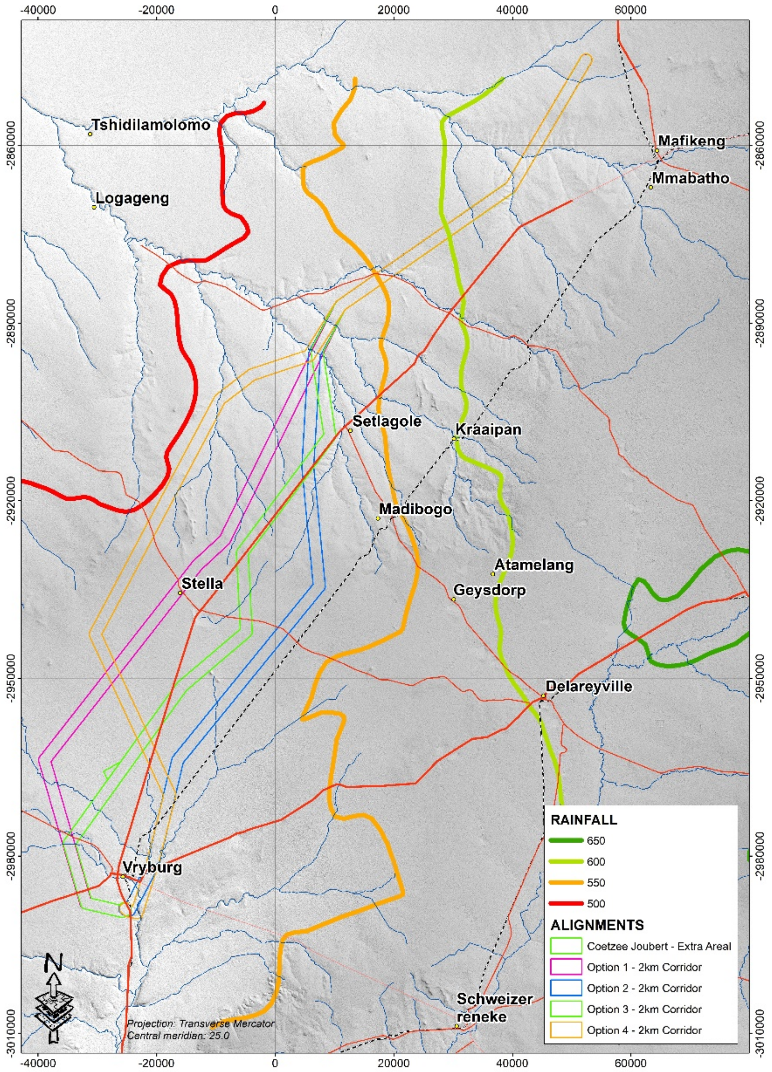


Figure 11. Average long term rainfall statistics

Wind

Average wind speeds are around 8 km/h, but can experience gusts of more than 15km/h or higher.

5.2 Vegetation

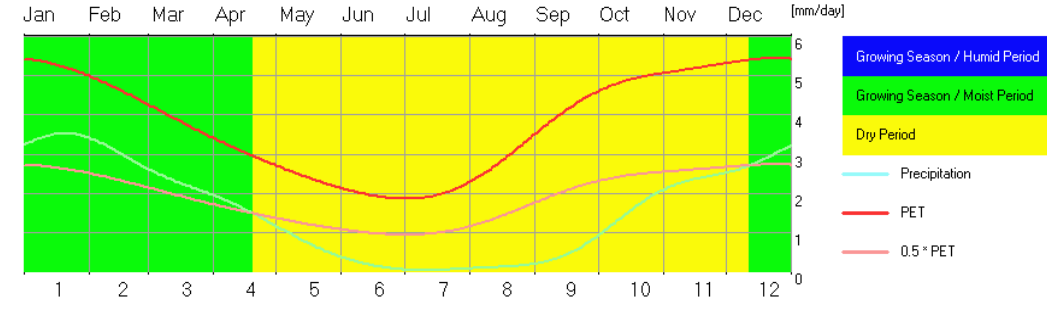


Figure 12. Climatogram

Much of the area is transformed rangeland. The veld is classified as Sourish Mixed Bushveld for the norther part and Kalahari Thornveld for the southern part. It is generally a rather open savanna with *Vachellia caffra* and *A Karroo* the dominant trees. in a fairly tall and dense grassveld dominated by *Cymbopogon plurinodis*, *Themeda triandra*, *Elionorus argenteus* and *Hyparrhenia* spp.

Cultivation that has long ago ceased still is largely free of trees, leaving it a virtual grassveld, often dotted with *Grewia flava* and stunted *Diospyros pallens*. The only tree of general occurrence and importance is *Vachellia erioloba* (Kameeldoring).

When rainfall is plotted against temperature at a ratio of 1:2 the resulting graph indicates the growing season.

The growing season commences in December when precipitation exceeds 50% of transpiration. This lasts until mid-April. The dry season with a rain deficit lasts for almost 8 months of the year. The winter period is dry with little or no vegetative growth.

The grazing capacity of natural veld, according to the Department of Agriculture, is estimated at 10 hectares per large stock unit (LSU) under natural veld conditions.

Stover left after the fields had been harvested can increase the grazing capacity significantly. Maize, grain sorghum or field beans is planted as a cash crop, but also for the stover.

There are also some game farms with browsing animals that rely on the trees and shrubs.

5.3 Geology

The southern portion is on andesite, which yielded soils with a high base status. The soils are generally shallow with rock outcrops.

The northern part is aeolic sands. The soils are usually sandy loam soils with a medium base status.

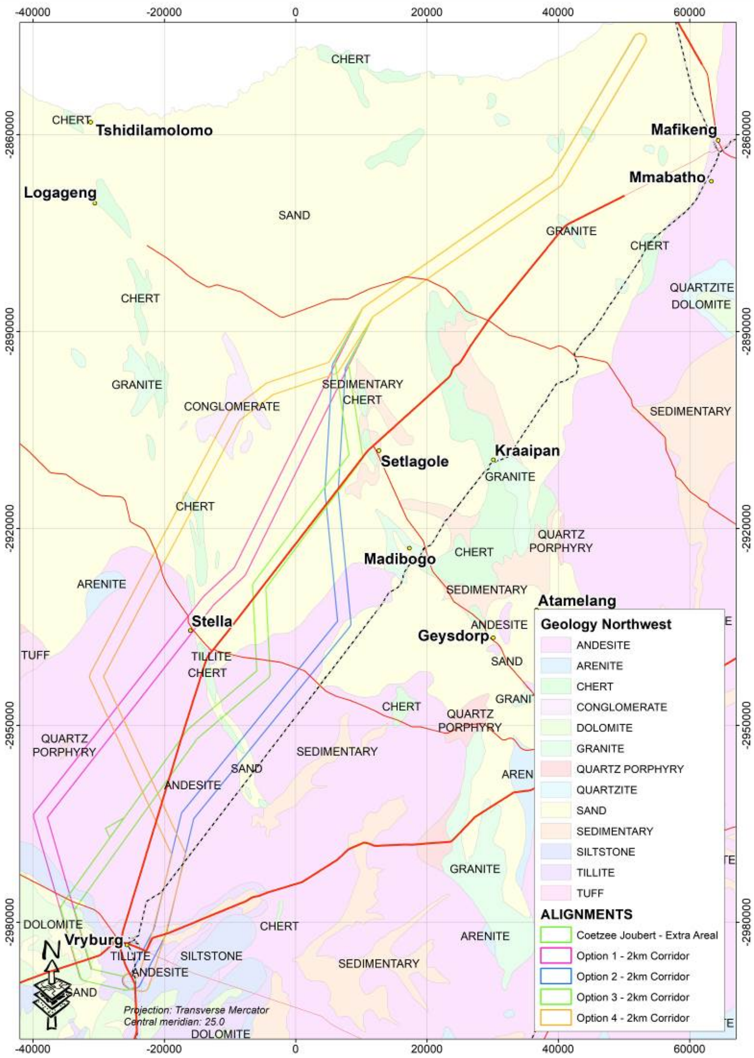


Figure 13. Geology

5.4 Soil

5.4.1 Soil types

Soils that occur on the site is based on the published Land Type Maps of the Department of Agriculture. It indicates the main soil types that occurs within each catena of land zone (refer to Figure 13).

The main soil types are as follows:

- North of Madibogo: moderately deep and deep reddish brown or yellowish soils that are freely draining and with a low clay content. The dominant soil types are Hutton, Clovelly and Glenrosa. The soil derived from eolian sand of Tertiary to Recent age.
- Around Stella: Moderately deep eutrophic yellow and red soils that derived from weathering of andesitic basaltic lavas of the Ventersdorp Supergroup, it is sometimes overlain by calcrete. Swazian granite occurs in places. Pans may occur.
- North of Vryburg and south of Stella: Moderately deep and shallow red and yellow apedal, freely draining soils that derived from weathering of andesitic basaltic lavas of the Ventersdorp Supergroup. Dwyka tillite and pans may occur in places.

The soils around Stella is where most of the cultivated land occurs and where healthy maize, sunflower and field beans were observed.

Irrigated lands occurs mostly around and north of Stella. The soils are sandy loams and reddish brown in colour.

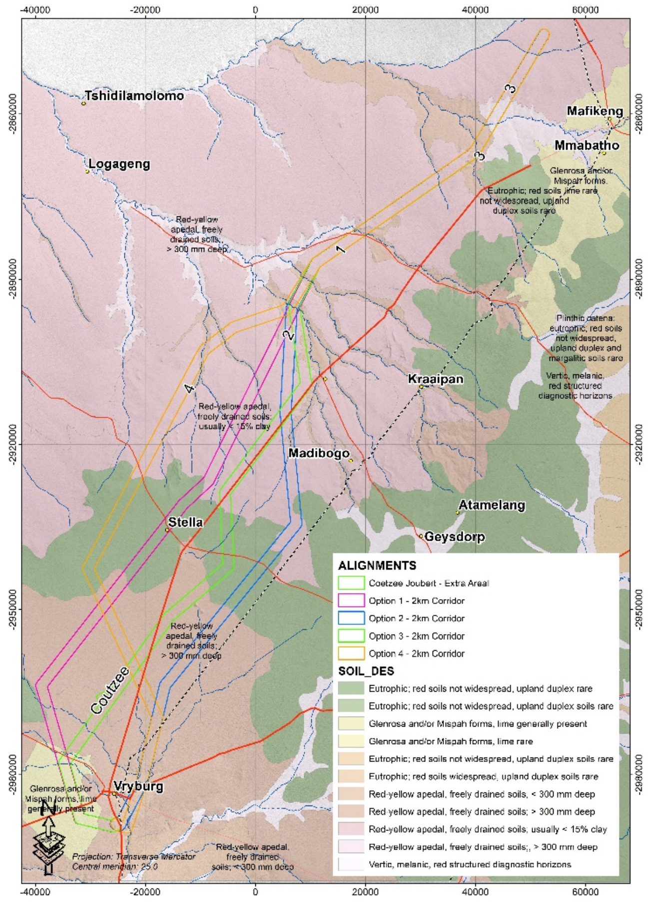


Figure 14. Soil map

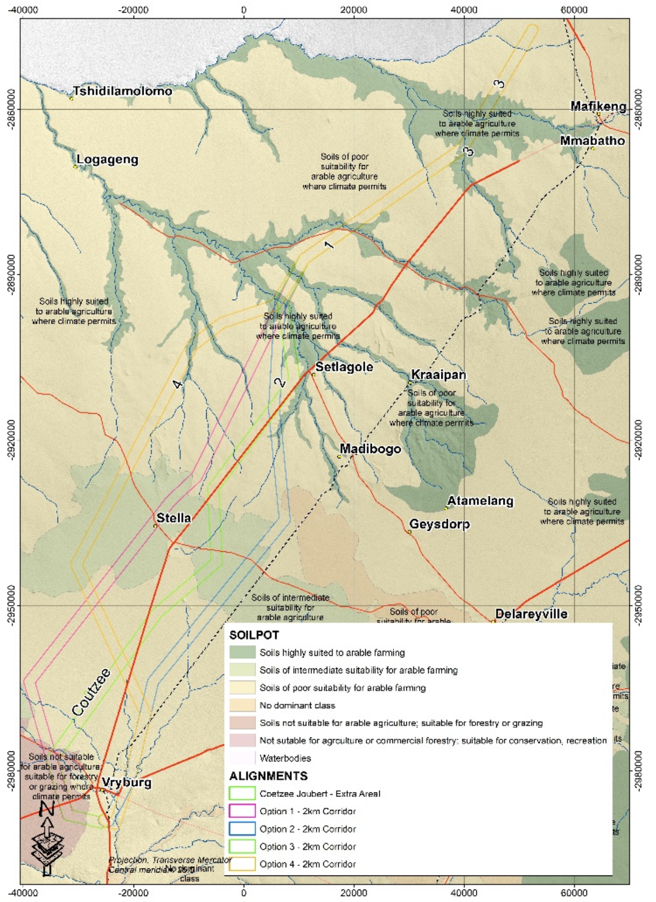


Figure 15. Soil potential

5.4.2 Soil potential

The southern part of the site falls into the so-called Maize Triangle of South Africa. It is an important production area for summer crops. With the new improved short growing maize and other crop cultivars, the crop yields have increased and the production season is now extended beyond what was the norm years ago. It also allows farmers to plan their copping program.

The implication is that farms with deep soils with adequate water holding capacity can store water and then plant at times to reduce the risk of crop failure.

The Department of Agriculture's Land Type maps indicate the land use potential and broadly indicate the following (also refer to Figure 14):

- The Land Type mapping indicates only regional trends and is not intended for detailed assessment;
- The land in the northern parts that derived from aeolian sands are poorly suitable for arable agriculture, but with portions of high potential where the soils are less sandy;
- Land around Stella is medium potential;
- The southern parts are shallow low potential arable land. Most of these lands are more suitable for grazing;
- Pockets of high potential land is found throughout the site.

It is assumed for this study that the land that is cultivated currently is land that is suitable for summer crop production.

5.4.3 Dryland crop production potential

The site is located in the so-called maize triangle of South Africa.

The climate and soils are the main environment factors that determine dryland crop potential on an area. Maize production potential (as sample crop) will be used for determining the impact for this assessment. Although the annual production potential varies between 1,43 to 1,79 tonnes/hectare over the route, the average yield of 1,5 tonnes will be used to calculate the magnitude of the impact for the different routes.

The quantity of maize that is produced within the 2km width buffer of the different routes as well as the 50 metres under the line that will be lost during construction are as follows:

Table 4. Long term maize produced per year (t/ha/year)

	Route 1	Route 2	Route 3	Route 4
In Buffer (2km)	4 635	6 116	3 912	5 459
Under the transmission line	58.0	76.5	49.0	68.3

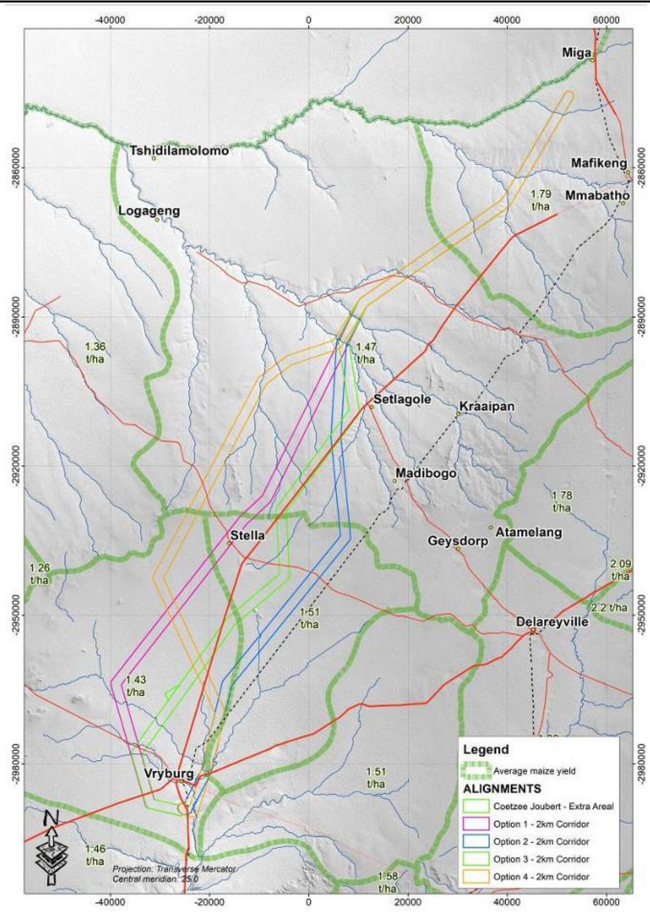


Figure 16. Long term maize yield

Crops that are produced in the study area are maize, grain and feed sorghum, sunflowers, soya and field beans. Pastures of *Cenchrus*, *Rhodes* and *Pennisetum* is planted successfully.

6 IMPACT ASSESSMENT

6.1 Assumptions

- The land uses on which the impact is based are as follows:

Table 5. Land uses (area in hectare or as indicated)

Land uses	Route 1	Route R2	Route R3	Route R4
Cultivated (commercial)	2 369	2 059	1 887	2 919
Cultivated (subsistence)	721	2 018	721	721
Fallow / old lands	5 194	4 749	4 731	5 044
Irrigated land	156	63	464	190
Poultry houses			2 houses	
Grazing	28 692	26 155	29 720	28 364
TOTAL	**37 140**	**35 068**	**37 526**	**37 257**

- A buffer area of 2 kilometres of the transmission line was assessed when identifying land uses.
- Grazing land will be lost for 50 metres along the path of the transmission line for a maximum period of one year – which is for the duration of the construction and the period that it will take the grazing to recover from the construction process.
- Cultivated land will likewise be lost for 50 metres along the path of the transmission line for a maximum period of one year – which is for the duration of one production season. While a servitude will be registered to allow access to the line by ESKOM, the land can be cultivated post construction. The footprint of the tower will be permanently lost.
- Fallow and old lands is now mostly under pastures or upgraded veld grazing, they are however potentially arable and some of it is likely in a rest period in a cropping rotation.
- Irrigated lands are mostly under centre pivot irrigation systems which has permanent and expensive underground infrastructure that will be replaced elsewhere if other land is available. Fertility of irrigated land is usually built up over time and must also be taken into consideration in the evaluation. Traversing the pivot irrigation system will lead to a permanent loss of not only the directly impacted land, but the total area that the pivot covers. This means that irrigated land will revert to dryland cropping land for the post construction period.
- Housing and farming infrastructure is a cost item but will not directly impact on the farming income, unless it is used as packing sheds, which is then part of the production process. Loss of infrastructure should be dealt with under the social assessment of the EIA.
- Poultry production will suffer a low for the period of construction due to the disturbance to the fowls. Two poultry units were identified, both within the buffer area of Route 3.
- High potential land are defined as follows:
  - means land best suited to, and capable of consistently producing acceptable levels of goods and services for a wide range of agricultural enterprises in a sustainable manner, taking into consideration expenditure of energy and economic resources; and
  - includes:

    (i) land capability Classes I, II and III;
    (ii) unique agricultural land;
    (iii) irrigated land; and
    (iv) land suitable for irrigation (deep well-drained soils and assuming irrigation water is available);
- Maize yield under irrigation is assumed as 15 tonnes per hectare.

6.2 Rating criteria

The following rating was used to indicate impacts:

Extent

- Local - extend to the site and its immediate surroundings.
- Regional - impact on the region but within the province.
- National - impact on an interprovincial scale.
- International - impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.

- Low - natural and social functions and processes are not affected or minimally affected.
- Medium - affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.
- High - natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration

- Short term - 0-5 years.
- Medium term - 5-11 years.
- Long term - impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- Permanent - mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability

- Almost certain - the event is expected to occur in most circumstances.
- Likely - the event will probably occur in most circumstances.
- Moderate - the event should occur at some time.
- Unlikely - the event could occur at some time.
- Rare/Remote - the event may occur only in exceptional circumstances.

Significance

Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-

- 0 – Impact will not affect the environment. No mitigation necessary.
- 1 – No impact after mitigation.
- 2 – Residual impact after mitigation.
- 3 – Impact cannot be mitigated.

6.3 Impact description

6.3.1 Loss of agricultural resources

6.3.1.1 Impact description

Loss of high potential agricultural land:

- Extent: Local
  - Irrigated land is the only land that is considered as high potential. If it is under pivot irrigation (because of the permanent nature of the supply line and pumps), then the entire portion applicable will be lost.
  - Route 2 will lose the least high potential land, which is 63 hectares. It is located just north-east of Vryburg. This single pivot will also affect Route 4.
  - Routes 1 and 4 will lose 156 and 190 hectares respectively, and Route 3, will lose 464 hectares.
- Magnitude: High
  - The permanent irrigation infrastructure will be lost permanently. If the farmer has other irrigable land, then it may be possible to relocate the affected land, if not, the farms viability could be compromised.
- Duration: Permanent
  - High potential land will be lost permanently if the pivot cannot be moved to another location.
- Probability: Certain
  - The land where the line traverses will be permanently lost.
- Significance on local community: Low /Moderate
  - The unemployment rate for Mafokeng and Stella is 36% and that at Vryburg, 26%. The affected are where the most jobs will be lost is at Stella.
  - Depending on the enterprise, between one and 20 permanent jobs can be lost per hectare. Most of the irrigated land is under field crops, which has a labour requirement of one per hectare.
  - Route 2 will be least affected, follows by Route 1, Route 4 and then Route 3.
- Significance on regional level: 2 (Residual impact after mitigation)
  - Approximately 951 tonnes of maize will be lost that can be produced on the irrigated land along Route 2. The loss is much greater for the other routes, which is 2 337 tonnes for Route 1, followed by 2 848 tonnes and 6 954 tonnes for Route 4 and Route 3 respectively.

Mitigation

1) There is no mitigation for the loss of high potential land that is under irrigation. The route that has the smallest are under irrigation should be preferred.

Loss of cultivated land

The loss of land under cultivation is temporary and will at most be for one production season. The land can be returned to cultivation after construction, regardless of the servitude registered in favour of ESKOM.

- Extent: Local
  - The only land that will be lost is the approximately 65m^2 where the transmission towers are placed.
- Magnitude: Low
  - Natural and social functions will minimally be affected.
- Duration: Temporary
  - The duration is for one season where the line is constructed and permanent for the footprint of the tower.

- Probability: Certain
  - The activity is certain to occur
- Significance on local community: 2 (Residual impact after mitigation)
  - The land will be returned to cultivation after construction and only the footprint of the tower will be permanently lost.

Mitigation

1) The impact is temporary. The construction period is at most for one production season for the line position, and permanently for the tower footprint. Loss of income from the affected land can only be minimised by keeping the construction period as short as possible.
2) Construction can be scheduled to take place after the crops are harvested. The impact will then only be on the stover value as grazing.
3) Employ dust reducing practices to protect adjoining grazing land.

Loss of grazing land

The loss of grazing land is temporary and will at most be for one production season. The land will remain as grazing after construction.

- Extent: Local
  - The only land that will be lost is the approximately 65 m^2 where the transmission towers are placed.
- Magnitude: Low
  - Natural and social functions will not be affected.
- Duration: Temporary
  - The duration is for one season where the line is constructed and permanent for the footprint of the tower.
- Probability: Certain
  - The activity is certain to occur
- Significance on local community: 2 (Residual impact after mitigation)
  - The land will remain grazing after construction and only the footprint of the tower will be permanently affected.

Mitigation

1) Keep the construction period as short as possible.
2) Employ dust reducing practices to protect adjoining grazing land.

6.3.1.2 Loss of farming infrastructure

The loss of farming infrastructure in this assessment is limited to structures that are directly linked to production, i.e., irrigation supply lines, packing sheds and chicken houses.

Poultry is very sensitive to noise and general disturbance in its surroundings. Both egg production and broilers suffer during the construction period. The loss, however is temporary and will only be affect by Route 3.

- Extent: Local
  - The only land that will be permanently impacted on is the irrigated land under pivots, the actual commercial sites and poultry houses. The latter two can be avoided by placement the line in a position that will have minimum impact.
  - Route 2 has the least impact because it has the least irrigated land.

- Magnitude: High/Low
  - Natural and social functions will not be affected for packing sheds or for the chicken houses, depending on the actual alignment and the footprint of the towers.
  - The irrigation infrastructure will be lost permanently.
- Duration: Permanent
  - The duration is permanent.
- Probability: Certain
  - The activity is certain to occur
- Significance on local community: 3 (Residual impact after mitigation)
  - The irrigated land will be returned as cultivated under dryland conditions after construction.

<u>Mitigation</u>

1) The loss of irrigated land cannot be mitigated and has to be kept as small as possible.
2) Keep the construction period as short as possible to have the lease impact on poultry (if Route 3 is chosen)) The other routes will not be affected.

6.3.2 Indirect Impact of development

Theft and vandalism usually increase during construction and has to be managed.

<u>Mitigation</u>

Theft and vandalism can be reduced by providing security to farmers.

6.3.3 Biological

Some possible environmental impacts of the development are the following:

- Dust along the main roads that is created by large trucks has a severe impact on crop yield and on the livestock capacity of adjoining properties.

<u>Mitigation</u>

Keep the construction period as short as possible and employ dust reduction methods.

6.4 Preferred option

- Loss of irrigated land has the only permanent impact that the construction of the line poses from an agricultural perspective.
- Loss of grazing and land under cultivation is largely temporary and is for a maximum of only one production season.
- Loss of agriculture related infrastructure can be permanent but can be mitigated by placement of the line in order to have the least impact. This is also a social issue due to aesthetics and visual impact, but is outside the scope of the agricultural assessment.
- The following indicates the order of preference:

Table 6. Preference of Route alignments (green shading indicates the preferred route)

	Preference 1	Preference 2	Preference 3	Preference 4
Preference	Route 2	Route 1	Route 4	Route 3
Description	Will lead to the least loss of high potential irrigated land. Only 63ha of irrigated land will be lost. The loss of cultivated land and grazing is temporary and can be mitigated by keeping the construction period short.	Will lead to the loss of 156ha high potential irrigated land.	Will lead to the loss of 190ha high potential irrigated land.	This is the least preferred route. It will lead to the loss of 464 high potential irrigated land. Also, this is where most of the agricultural related infrastructure is located that will be permanently lost.

6.5 Summary of impacts

The impacts are as follows:

Table 7. Impact assessment

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost Route 1	Area lost Route 2	Area lost Route 3	Area lost Route 4
1	**Loss of high potential arable land**										
	Before mitigation	Permanent loss of high potential farming land	Local	High	Permanent	Certain	Moderate	156	63	464	190
	Mitigation	No mitigation possible for the loss of land Place the line to avoid irrigated land	Local	High	Permanent	Certain	Moderate	156	63	464	190
2	**Loss of cultivated land**										
	Before mitigation	Temporary loss cropping land and disruption of farming process	Local	Low	Temporary	Certain	Low	155	204	130	182
	Mitigation	Place the line to avoid cultivated land The impact is temporary. The construction period is at most for one production season for the line position, and permanently for the tower footprint. Loss of income from the affected land can only be minimised by keeping the construction period as short as possible. Construction can be scheduled to take place after the crops are harvested. The impact will then only be on the stover value as grazing. Employ dust reducing practices to protect adjoining grazing land.	Local	Low	Temporary	Certain	Low	0	0	0	0
3	**Loss of grazing land**										
	Before mitigation	Temporary loss of grazing land	Local	Low	Temporary	Certain	Low	1 435	1 308	1 486	1 418
	Mitigation	Keep the construction period as short as possible. Employ dust reducing practices to protect adjoining grazing land.	Local	Low	Temporary	Certain	Low	0	0	0	0

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost Route 1	Area lost Route 2	Area lost Route 3	Area lost Route 4
4	**Loss of agricultural production**										
	Before mitigation	Permanent loss of irrigated crops. Maize yield under irrigation is 15t/ha that will be lost and replaced with 1,5 that is the yield for dryland production.	Local	Moderate	Permanent	Certain	Low	4 635 tonne maize	6 116 tonne maize	3 912 tonne maize	5 459 tonne maize
		Loss of dryland crops. The loss will be for one production season.	Local	Low	Temporary	Certain	Low	58 tonne maize	76 tonne maize	49 tonne maize	68 tonne maize
		Loss of grazing land. The loss will be for one production season.	Local	Low	Temporary	Certain	Low	143 LSU	131 LSU	149 LSU	142 LSU
		Loss of poultry production. For the period of construction	Local	Low	Temporary	Certain	Low	0	0	2 units	0
	After mitigation	Loss of irrigated land Can be partially mitigated by changing the land use to dryland crops or by moving the infrastructure but only if the farmer has suitable land.	Local	Moderate	Permanent	Certain	Low	4 635 tonne maize	6 116 tonne maize	3 912 tonne maize	5 459 tonne maize
		Dryland crops Keep the construction period as short as possible. Employ dust reducing practices to protect adjoining grazing land.	Local	Low	Temporary	Certain	Low	0	0	0	0
		Grazing land Keep the construction period as short as possible. Employ dust reducing practices to protect adjoining grazing land.	Local	Low	Temporary	Certain	Low	0	0	0	0
5	**Loss of agricultural infrastructure**										
	Before mitigation	The irrigation infrastructure will be permanently lost.	Local	Moderate	Permanent	Certain	High	156	63	464	190
	Mitigation	Move infrastructure to alternative site, provided the farmer has suitable land and water is available	Local	Low	Permanent	Uncertain	Low	?	?	?	?

7 SUMMARY AND CONCLUSIONS

The proposed development includes an approximately 180km transmission line traversing from the existing Mookodi Substation in Vryburg towards the north-east ending at the proposed Mahikeng substation site. The predominant land use is animal production where approximately 80% of the land is grazing.

There are two poultry production units, both in route alignment 3.

The area under cultivation is approximately 3 000 hectares under commercial production that lies around Stella and Setlagole. This is also where the deeper soils are found.

Route 2 passes through land with communal ownership that is not cultivated every year and usually follows incidences of high significant rain showers.

Route 3 has much more irrigated lands than the other options. These lands usually has a high investment in pumps and underground water supply lines and should be avoided if at all possible.

- Irrigated land is the only land that is considered as high potential. If it is under pivot irrigation (because of the permanent nature of the supply line and pumps), then the entire portion applicable will be lost. Route 2 has only 63 hectares of irrigated lands. Only one farming unit's viability may be influenced. However, the irrigation is done by conventional system that will not lose its underground infrastructure. The land under the transmission line could still be irrigated after mitigation. This is the preferred suit if compared to the other alignments.
- The loss of land under dryland cultivation is temporary and will at most be for one production season. The land can be returned to cultivation after construction.
- The loss of grazing land is also temporary and also for one production season. The land will remain as grazing after construction.
- The loss of farming infrastructure in this assessment is limited to structures that are directly linked to production, i.e., irrigation supply lines, packing sheds and chicken houses.

Preferred option

Loss of irrigated land has the only permanent impact that the construction of the line poses from an agricultural perspective.

In order of preference, the options are as follows:

1) Route 2
2) Route 1
3) Route 4
4) Route 3

8 REFERENCES

1) Grondklassifikasie Werkgroep, 1991. Grondklassifikasie, 'n Taksonomiese sisteem vir Suid Afrika, Departement van Landbou-ontwikkeling, Pretoria.
2) Veld types: Musina and Rutherford.
3) Department of Agriculture, the grazing capacity D*evelopment of Agricultural Land Framework Bill , 2016*
4) South African Atlas of Agrohydrology and Climatology, Water Research Commission, Pretoria

9 ADDENDA

9.1 Land uses

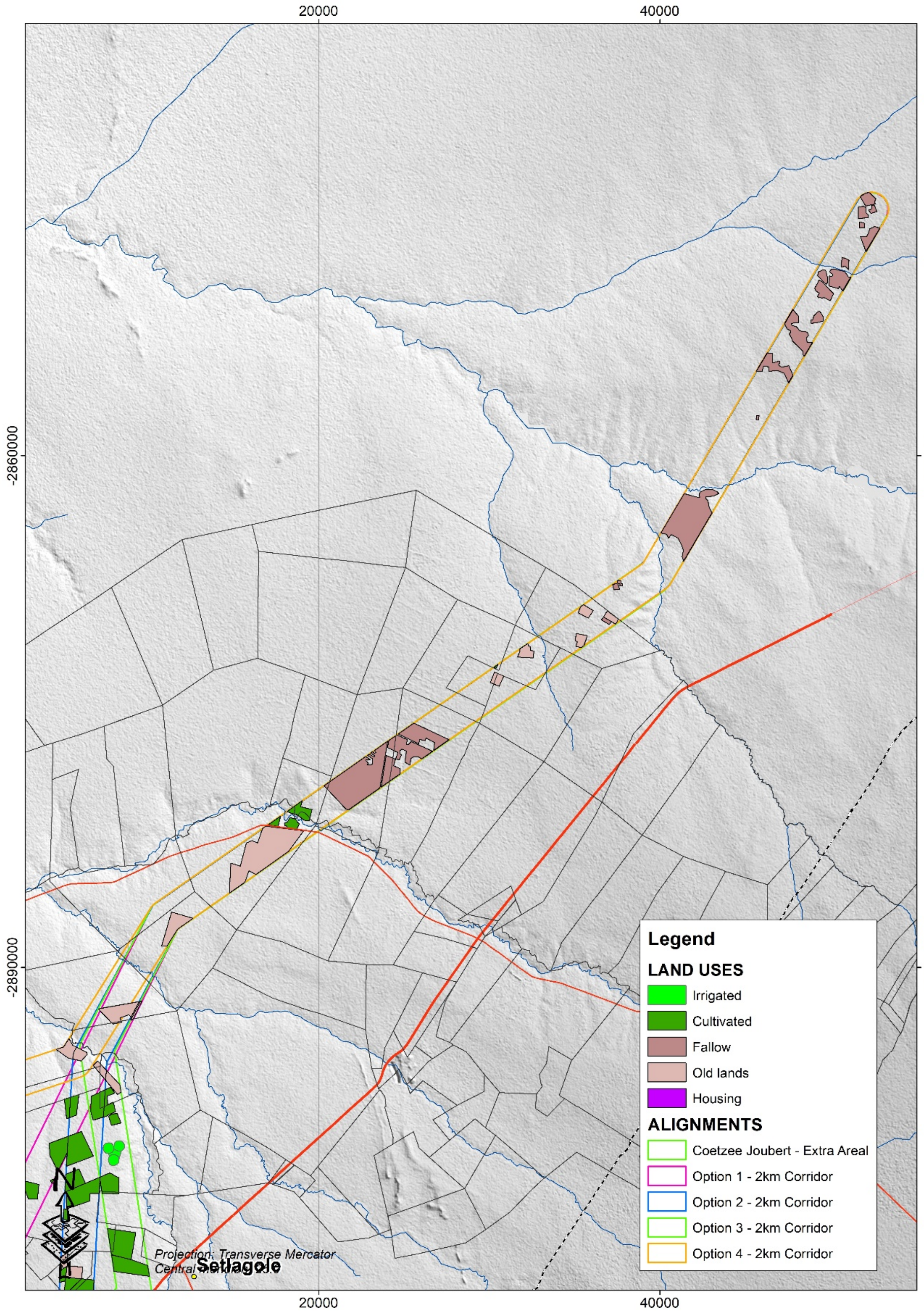


Figure 17. Land uses of the northern section

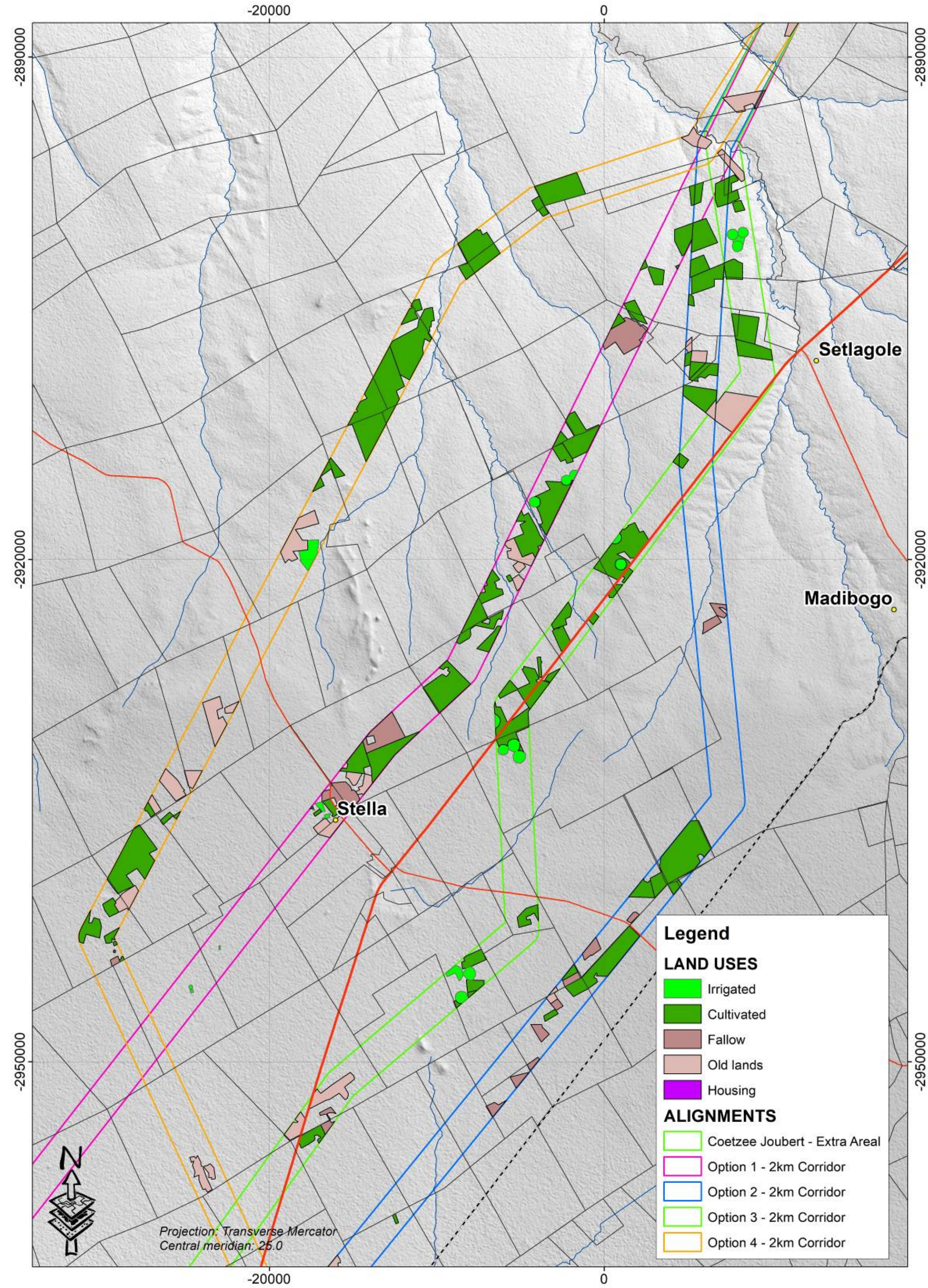


Figure 18. Land uses of the central section

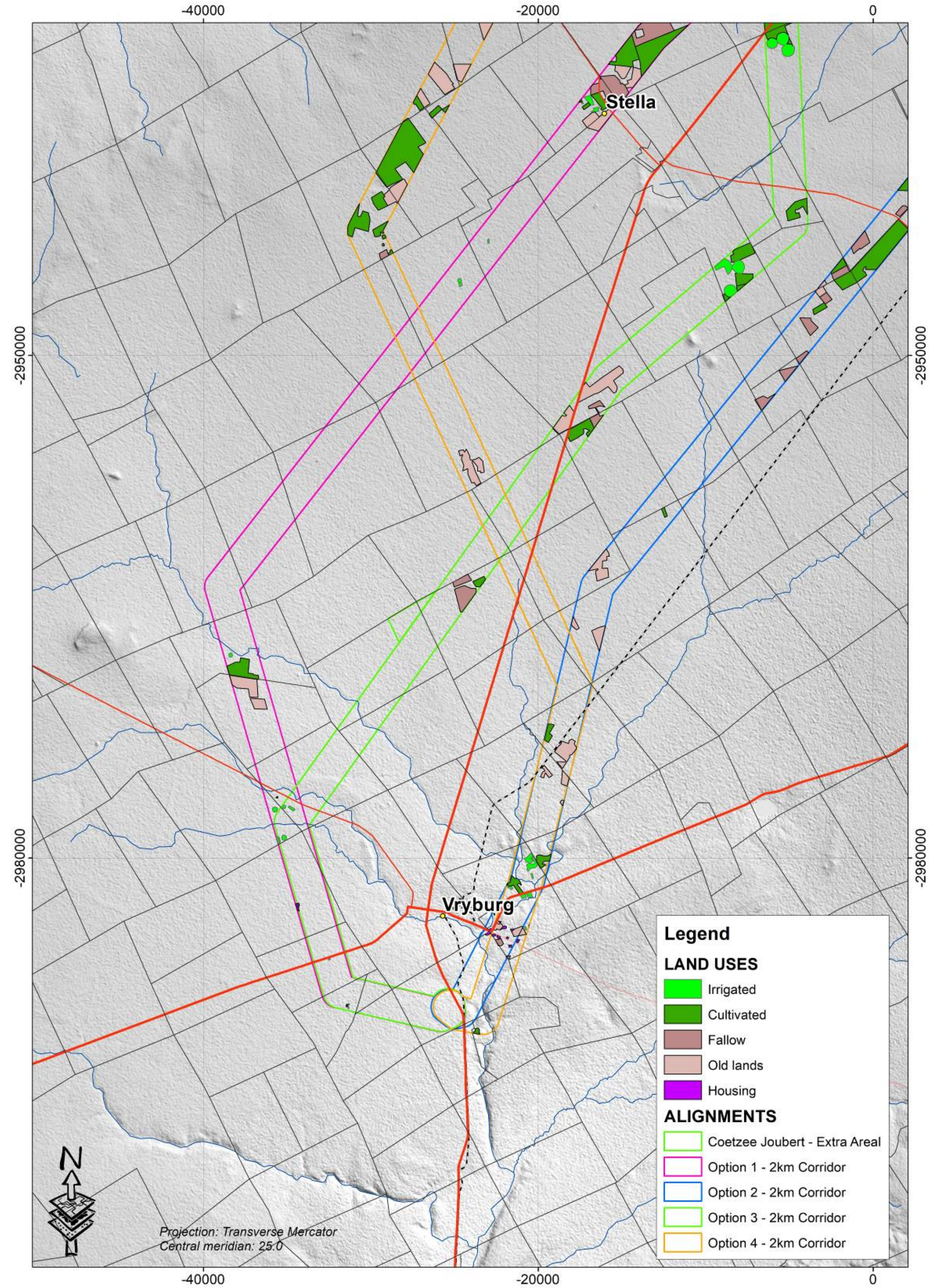
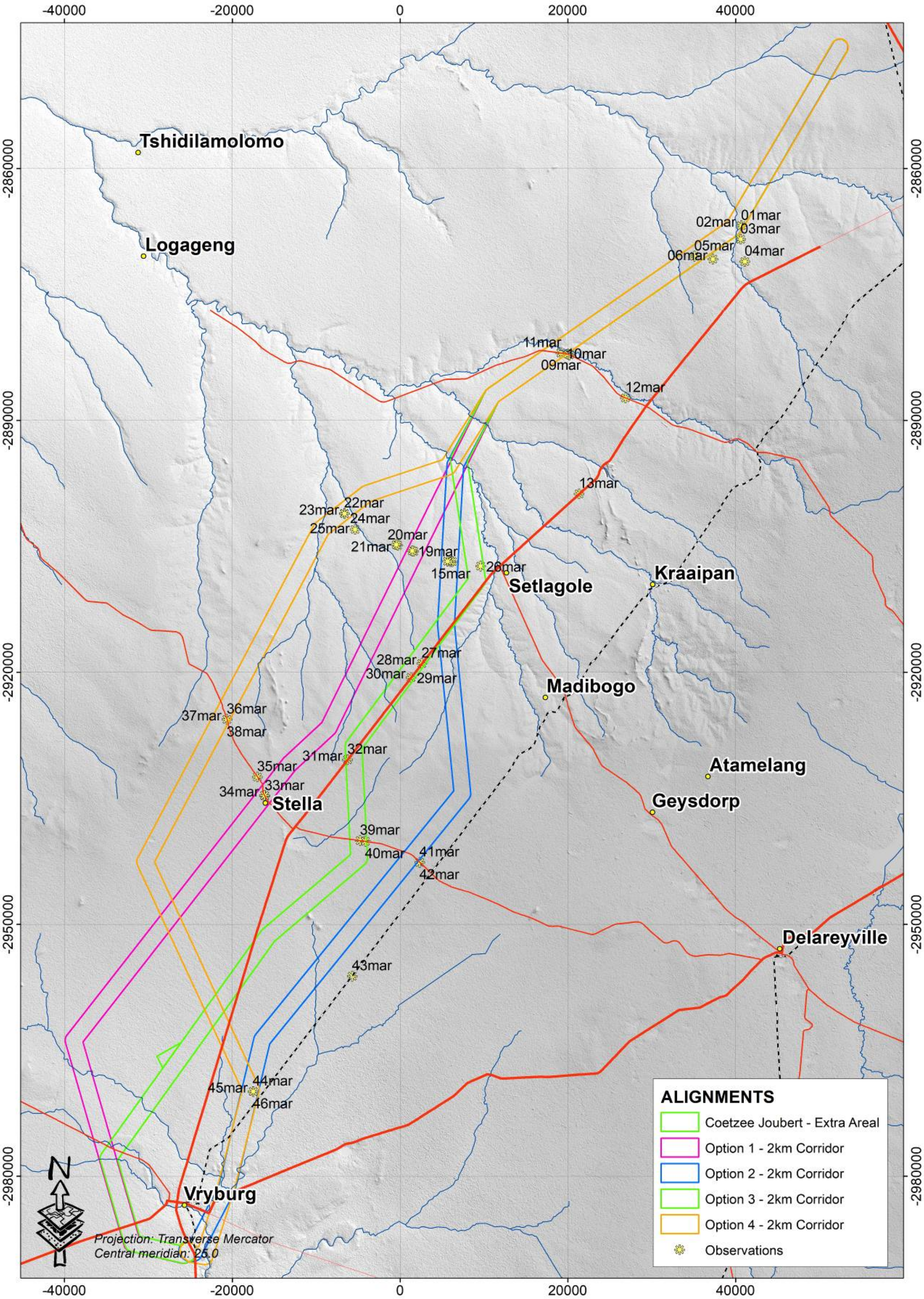


Figure 19. Land uses of the southern section

9.2 Photo records

Position of phots

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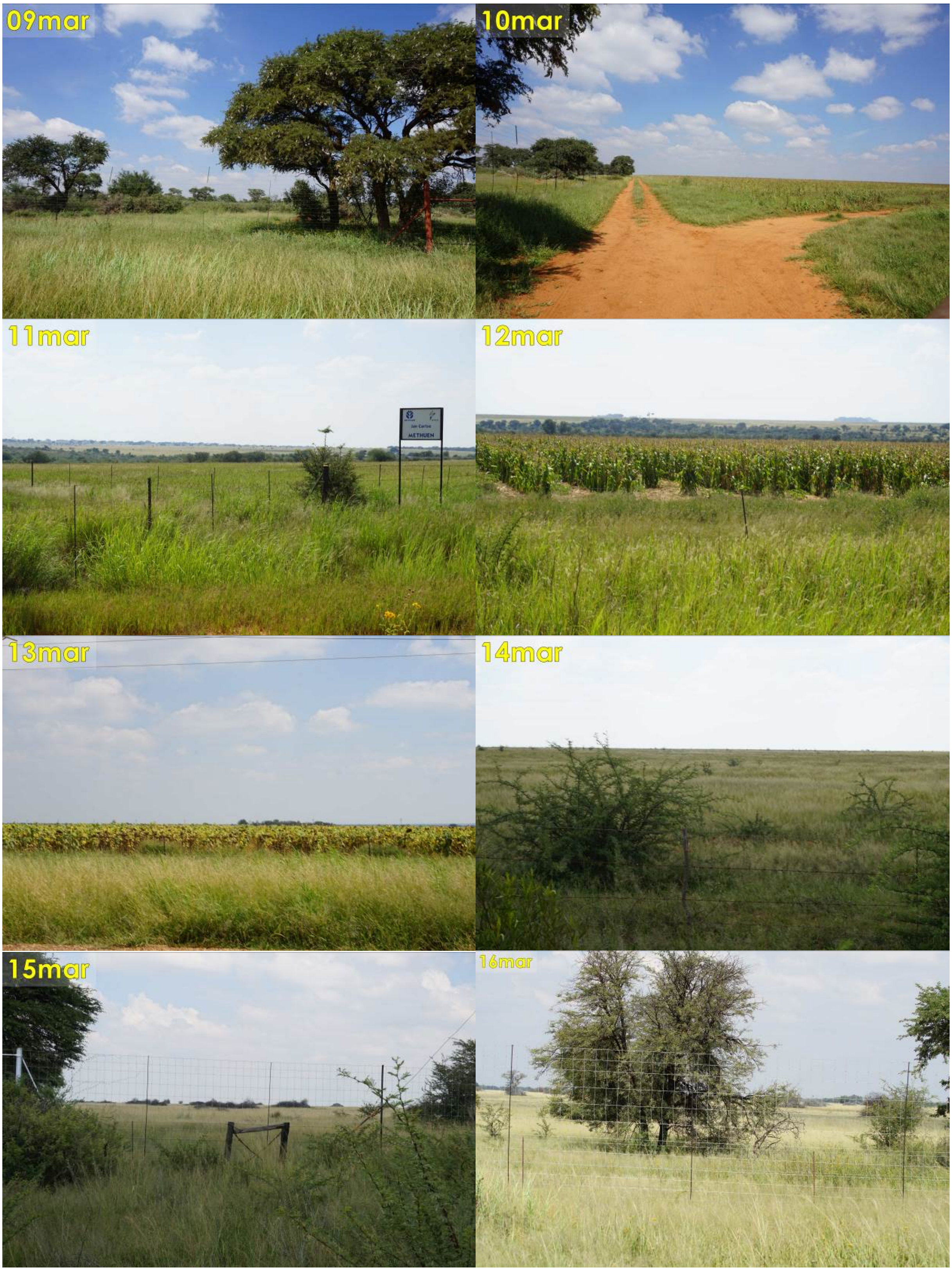
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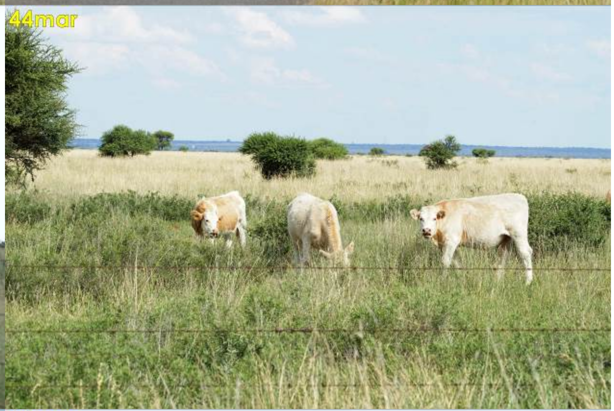
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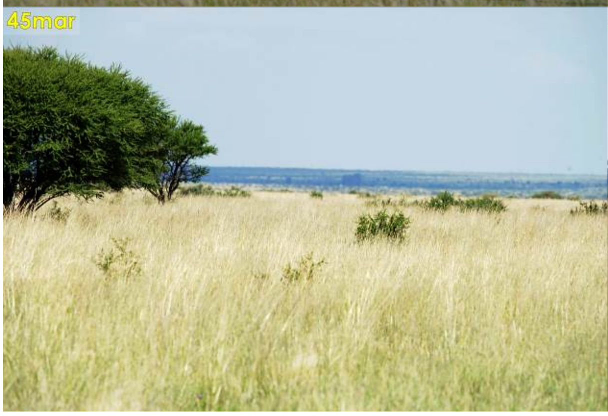
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Appendix 6F: Visual Impact Assessment

ESKOM (PTY) LTD

VISUAL IMPACT ASSESSMENT (VIA)

VARIOUS PROPERTIES FROM MOOKODI TO MAHIKENG SUBSTATION, NORTHWEST PROVINCES, SOUTH AFRICA

REPORT NO: 18-412-SPS-REP (EIA PHASE)

REPORT

ENVIRONMENTAL & PROJECT MANAGEMENT PROFESSIONALS

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DOCUMENT AND QUALITY CONTROL

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Approved for distribution:				
0.0	15/05/2018	Vernon Siemelink		Final report

QUALITY CONTROL BY:

Nature of Signoff	Responsible Person	Role / Responsibility	Qualifications
Author	Neel Breitenbach	Visual Impact and Air Quality specialist	Senior Environmental Consultant B.Sc. Geography
Quality Reviewer	Leoni le Roux	Administrator	Professional Secretary and Personal Assistant
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It is however important to note that although all effort is put into conducting a thorough audit, due to the length of time for an audit, or the nature of activities viewed on the day of the audit, only a sample of the operations can be reasonably assessed.

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EXECUTIVE SUMMARY

Eskom (Pty) Ltd (Eskom) appointed Nemai Consulting (Pty) Ltd (Nemai), an independent consulting company, to conduct an Environmental Impact Assessment (EIA) to evaluate the potential environmental and social impacts of the proposed Mookodi-Mahikeng Powerlines project. Nemai appointed Eco Elementum (Pty) Ltd to undertake the Visual Impact Assessment for the Mookodi-Mahikeng Powerlines project.

The Mookodi-Mahikeng 400kV Line is required to transmit electricity to the new Mahikeng Substation which forms part of the scope for the overall network system, in which the proposed Pluto – Mahikeng 400kV line (separate EIA Process) will improve reliability of the Watershed Substation constraints which are not sufficient to support and supply the demand growth in Mahikeng town. The study is dependent on the proposed Mookodi and Ngwedi substations which will de-load the Watershed load by approximately 180MW by the year 2021, of which 100MW is for Mookodi and 80MW for the Ngwedi substation. The load shifts from Watershed creates some relief in load however it is not sufficient in restoring the firm capacity in the 20-year planning horizon. There is however a project to install a 250MVA 275/132kV transformer and capacitor banks on the 88kV and 132kV bus bar by year 2021 which improves Watershed firm capacity in the short term. The load growth at Mahikeng and the limitations of the existing Watershed substation triggers the need for the new transmission injection in Mahikeng substation to be established at the load centre to accommodate the new load, de-load Watershed and align with the long-term strategic view for regional trade.

The scope of work for this Visual Impact Assessment will include:

1. Describe the existing visual characteristics of the proposed sites and its environs;
2. Viewshed and viewing distance using GIS analysis up to 3km from the proposed structures;
3. Visual Exposure Analysis;
4. Viewer Sensitivity analysis;
5. Overall Visual Impact; and
6. Determine Visual Impact Significance ranking of project.

Summary Of Findings

GIS Visual Impact Rating

The final Visual impact of the proposed infrastructure was calculated using all the datasets above, then summarising all the pixel values of each corridor option to get to a final rating as shown in Table 1 below. **Option 2** is the preferred option.

Table 1: GIS Calculated Visual Impact.

Alternative	Rank	Sum of GIS Pixel Values	Mean of GIS Pixel Values	% Difference from Lowest
Option 1	2	2832702	2.709	+4.6%
Option 2	**1**	2702506	2.753	0%
Option 3	4	3034484	2.902	+11%
Option 4	3	2837609	2.732	+5%

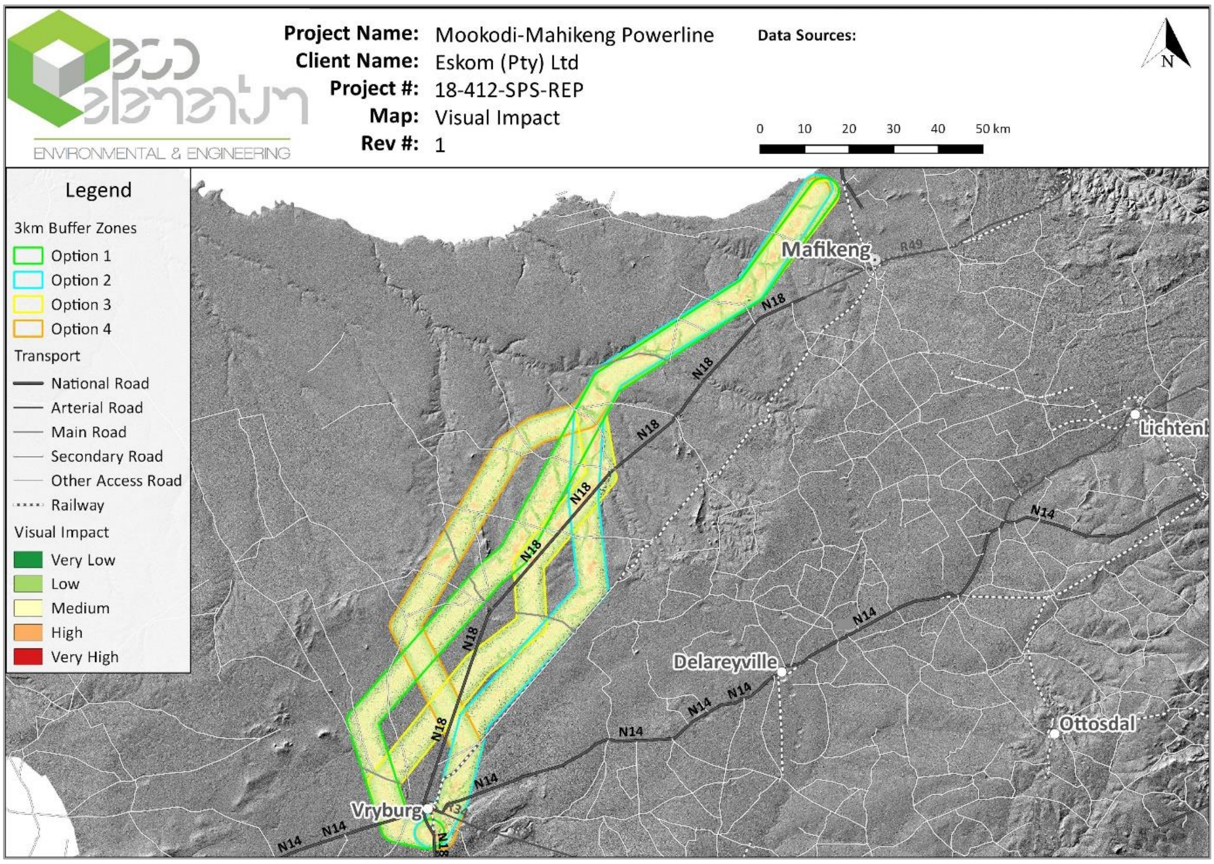

Figure 1: GIS Visual Impact of the proposed Mookodi-Mahikeng Powerlines project

Significance Rating

The construction and operation phase of the proposed Mookodi-Mahikeng Powerlines related activities and associated infrastructure will have a MEDIUM visual impact on the natural scenic resources and the topography. However, with the correct mitigation measures the impact might decrease to a point where the visual impact can be seen as less significant although still MEDIUM. The moderating factors of the visual impact of the proposed infrastructure in the close range are the following:

- Number of human inhabitants located in the area;
- Natural topography and vegetation;
- Mitigation measures that will be implemented such as the establishment of barriers or screens;
- The size of the operation; and
- Absorption capacity of the landscape.

In light of the above-mentioned factors that reduce the impact of the facility, the visual impact is assessed as MEDIUM VISUAL IMPACT after mitigation measures have been implemented.

Table 2: The overall Assessment of the Visual Impact

Nature of impact: The overall Assessment of the Visual Impact of the area.		
	No Mitigation	**With Mitigation**
	Proposed	**Proposed**
Extent	3	2.33
Duration	3.33	3.33
Magnitude	6.67	5.33
Probability	4	3.33
Significance Rating (SR)	Medium (52)	Medium (36.67)
Status (positive, neutral or negative)	Negative	
Reversibility	No	
Irreplaceable loss of resources	Yes	
Can impact be mitigated	Yes	
Mitigation:	All mitigation as discussed in each individual project element	
Cumulative Impact:	Cumulative of each individual project element	

The Visual Impact due to the construction activities and associated project infrastructure can be seen as having a MEDIUM impact on the surrounding environment and inhabitants before mitigation measures are implemented. After mitigation, the visual impact can be seen as lowered although still classified as MEDIUM. Thus, mitigation measures are very important and two of the most significant mitigation measures are the rehabilitation of the area after construction has been concluded and reducing the visibility of the Powerlines as much as possible. If the mitigation of the impact is not done correctly then the visual impact will become a concern. However, with correct mitigation, the impact will be of minimal visual intrusion for the type of proposed structures.

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Definition of Terms

Assessment	A systematic, independent and documented review of operations and practises to ensure that relevant requirements are met.
Construction	The time period that corresponds to any event, process, or activity that occurs during the Construction phase (e.g., building of site, buildings, and processing units) of the proposed project. This phase terminates when the project goes into full operation or use.
Critical viewpoints	Important points from where viewers will be able to view the proposed or actual development and from where the development may be significant.
Cumulative Impacts	The summation of the effects that result from changes caused by a development in conjunction with the other past, present or reasonably foreseen actions (The landscape Institute, Institute of Environmental Management & Assessment. 2002)
Decommissioning	to remove or retire (a mine, etc.) from active service.
Environmental Component	An attribute or constituent of the environment (i.e., air quality; marine water; waste management; geology, seismicity, soil, and groundwater; marine ecology; terrestrial ecology, noise, traffic, socio-economic) that may be impacted by the proposed project.
Environmental Impact	A positive or negative condition that occurs to an environmental component as a result of the activity of a project or facility. This impact can be directly or indirectly caused by the project's different phases (i.e., Construction, Operation, and Decommissioning).
Field of view:	The field of view is the angular extent of the observable world that is seen at any given moment. Humans have an almost 180º forward-facing field of view. Note that human stereoscopic (binocular) vision only covers 140º of the field of view in humans; the remaining peripheral 40º have no binocular vision due to the lack of overlap of the images of the eyes. The lower the focal length of a lens (see below), the wider the field of view.
Landscape Integrity	Landscape integrity is visual qualities represented by the following qualities, which enhance the visual and aesthetic experience of the area.
Mitigation (in the context of Visual Impact Assessment):	Any action taken or not taken in order to avoid, minimise, rectify, reduce, eliminate, or compensate for actual or potential adverse visual impacts.
Operation	The time period that corresponds to any event, process, or activity that occurs during the Operation (i.e., fully functioning) phase of the proposed project or development. (The Operation phase follows the Construction phase, and then terminates when the project or development goes into the Decommissioning phase.)
Record of Decision	Is an environmental authorisation issued by a state department.
Scenic value	Degree of visual quality resulting from the level of variety, harmony and contrast among the basic visual elements.
Sense of place	The character of a place, whether natural, rural or urban, it is allocated to a place or area through cognitive experience by the user.
Visual absorption capacity (VAC):	The ability of elements of the landscape to "absorb" or mitigate the visibility of an element in the landscape. Visual absorption capacity is based on factors such as vegetation height (the greater the height of vegetation, the higher the absorption capacity), structures (the larger and higher the intervening structures, the higher the absorption capacity) and topographical variation (rolling topography presents opportunities to hide an element in the landscape and therefore increases the absorption capacity).
Visual character	The overall impression of a landscape created by the order of the patterns composing it; the visual elements of these patterns are the form, line, colour and texture of the landscape's components. Their interrelationships are described in terms of dominance, scale, diversity and continuity. This characteristic is also associated with land use.
Visual Exposure	Visual exposure is based on distance from the project to selected viewpoints. Visual exposure or visual impact tends to diminish exponentially with distance. The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed mine activities and associated infrastructure were not visible, no visual impact would occur. Visual exposure is determined by the viewshed or the view catchment being the area within which the proposed development will be visible.
Visual Integrity	Visual sensitivity can be determined by a number of factors in combination, such as prominent topographic or other scenic features, including high points, steep slopes and axial vistas.
Visually sensitive	Areas in the landscape from where the visual impact is readily or excessively encountered.

Abbreviations

CA:	Competent Authority
DEA:	Department of Environmental Affairs (The former Department of Environmental Affairs and Tourism)
DMR:	The Department of Mineral Resources (The former Department of Minerals and Energy)
DWA:	Department of Water Affairs (Is now referred to the Department of Water and Sanitation – DWS)
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Plan
EMPr:	Environmental Management Programme
I&AP's:	Interested and Affected Parties
IWUL:	Integrated Water Use License
IWWMP:	Integrated Water and Water Management Plan
MPRDA:	Mineral and Petroleum Resources Development Act, 28 of 2002
NAAQS:	National Ambient Air Quality Standards
NEMA:	National Environmental Management Act, 107 of 1998
NEMAQA:	National Environmental Management: Air Quality Act, 39 of 2004
NEMBA:	National Environmental Management: Biodiversity Act, 10 of 2004
NEMWA:	National Environmental Management: Waste Act, 59 of 2008
NHRA:	National Heritage Resources Act, 25 of 1999
NWA:	National Water Act, 36 of 1998
ROD:	Record of Decision
VAC:	Visual Absorption Capability
VIA:	Visual Impact Assessment
WSA:	Water Services Act, 108 of 1997
WUL*:*	Water Use Licence

PROJECT INFORMATION

Table 3: Applicant Details

Name of Applicant:	Eskom (PTY) Ltd
Project Location:	The project is located within the Naledi Local Municipality (LM), Kagisano-Molopo LM, Ratlou LM, and Mahikeng LM in the North West Province.
Project Name:	Proposed Mookodi- Mahikeng 400kV Line
Project Aim:	The Mookodi-Mahikeng 400kV Line is required to transmit electricity to the new Mahikeng Substation which forms part of the scope for the overall network system, in which the proposed Pluto – Mahikeng 400kV line will improve reliability of the Watershed Substation constraints which are not sufficient to support and supply the demand growth in Mahikeng town

Table 4: EAP Details

EAP Company:	NEMAI Consulting
Postal Address:	PO Box 1673 Sunninghill 2157
Contact Person:	Kristy Robertson
Contact Number:	011 781 1730
Email:	kristyr@nemai.co.za

Table 5: Specialist Details

Specialist Company:	Eco Elementum (Pty) Ltd
Company Reg. No.:	2012/021578/07
Physical Address:	Office E2 The Willows Office Park Die Wilgers Pretoria 0184
Postal Address:	26 Greenwood Crescent Lynnwood Ridge 0040
Contact Person:	Vernon Siemelink
Contact Number:	072 196 9928
Email:	vernon@ecoelementum.co.za info@ecoelementum.co.za
Website:	www.ecoelementum.co.za

1. INTRODUCTION

Eskom (Pty) Ltd (Eskom) appointed Nemai Consulting (Pty) Ltd (Nemai), an independent consulting company, to conduct an Environmental Impact Assessment (EIA) to evaluate the potential environmental and social impacts of the proposed Mookodi-Mahikeng Powerlines project. Nemai appointed Eco Elementum (Pty) Ltd to undertake the Visual Impact Assessment (VIA) for the Mookodi-Mahikeng Powerlines project.

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Table 6: Project Locality

Farm Name:	**Various**
Application Area:	~180 km
Magisterial District:	Various in North West Province
Distance and direction from nearest town:	Various along the ~180 km route.

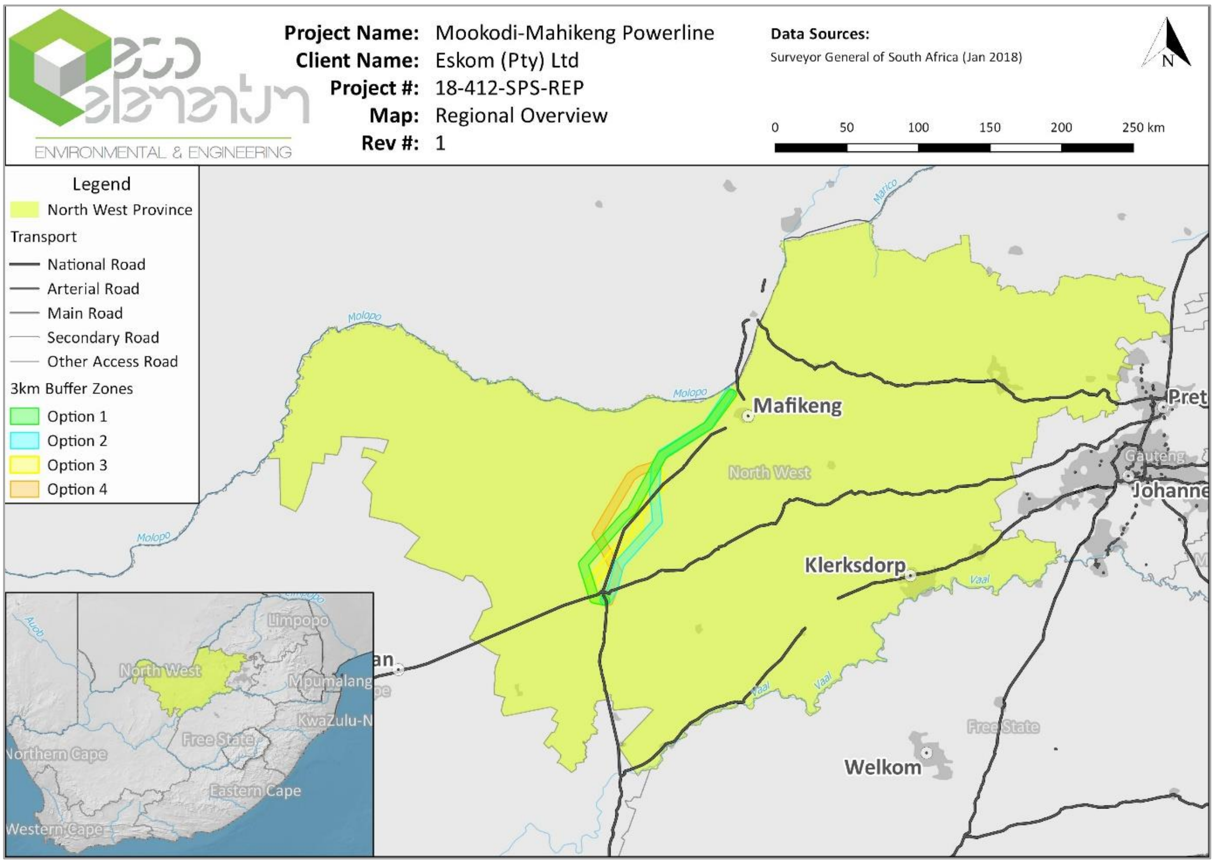

Figure 2: Locality map indicating the regional overview of the proposed Mookodi-Mahikeng Powerlines project

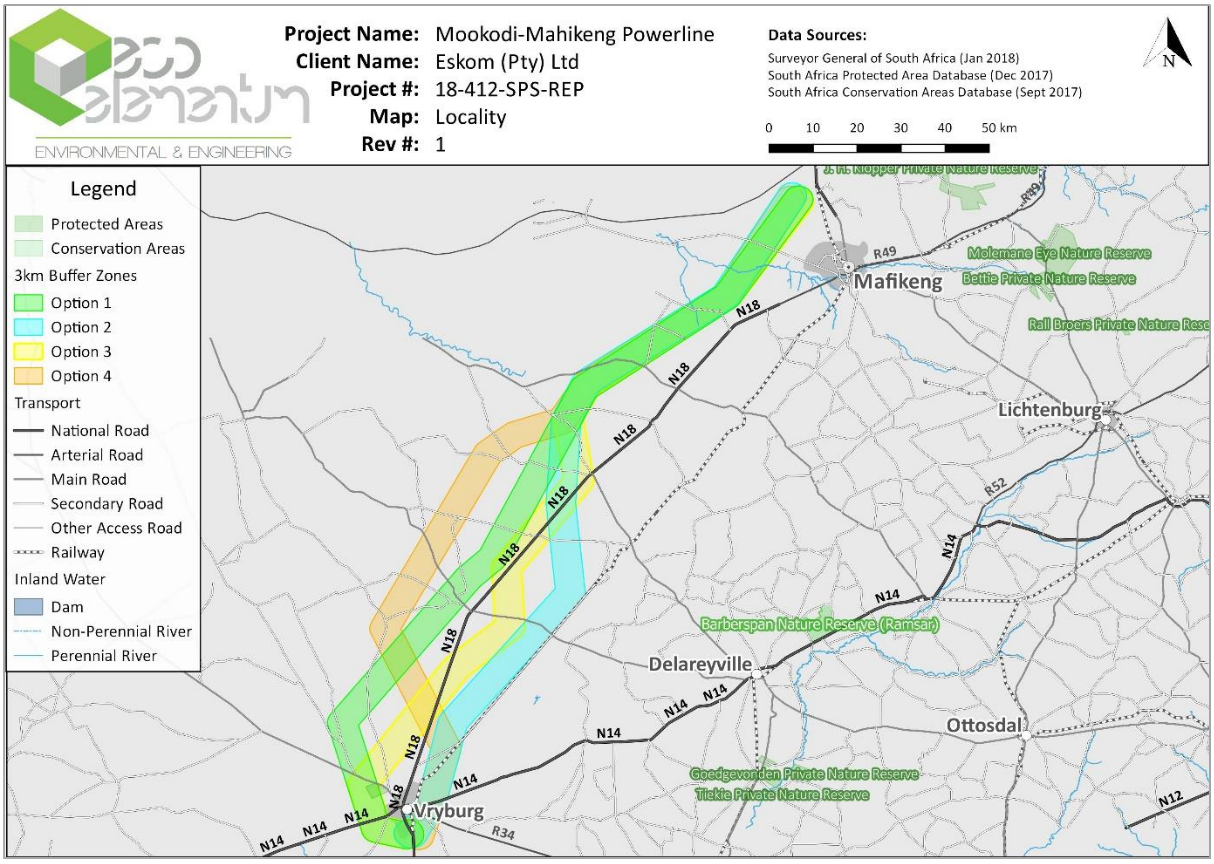

Figure 3: Locality map of the Mookodi-Mahikeng Powerlines project.

2. SCOPE OF WORK

The scope of work for this Visual Impact Assessment will include:

1. Viewshed and viewing distance using GIS analysis up to 3 km from the proposed structures.
2. Visual Exposure Analysis comprising the following aspects:
    - Terrain Slope;
        - Slope angle is determined from the Digital Terrain Model (DTM) and the location of the proposed structures given a ranking depending on the steepness of the slope;
    - Aspect of structure location;
        - Aspect of the slope where the structures are to be built, are calculated from the DTM and given a ranking determined by the Sun angle.
    - Landforms;
        - Landform of the location of the proposed structures are determined from the DTM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys.
    - Slope Position of structure;
        - Using GIS analysis, the position of the proposed structure is determined and ranked according to the position on the slope the structure is to be built.
    - Relative elevation of structure;
        - Using the DEM the elevation of the proposed structure relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas.
    - Terrain Ruggedness;
        - The terrain ruggedness is determined from the DEM and given a ranking based on the homogeneousness of the terrain.
3. Viewer Sensitivity;
    - The Viewer sensitivity ranking of the surrounding areas is determined using various land cover and land use datasets and ranked according to the sensitivity of the related structures to the environment.
4. Overall Visual Impact;
    - Combing all the above dataset a final visual impact of the proposed structures is calculated.
5. Determine Visual Impact Significance ranking of project.

3. STUDY AREA

3.1 Location

3.1.1 Topography

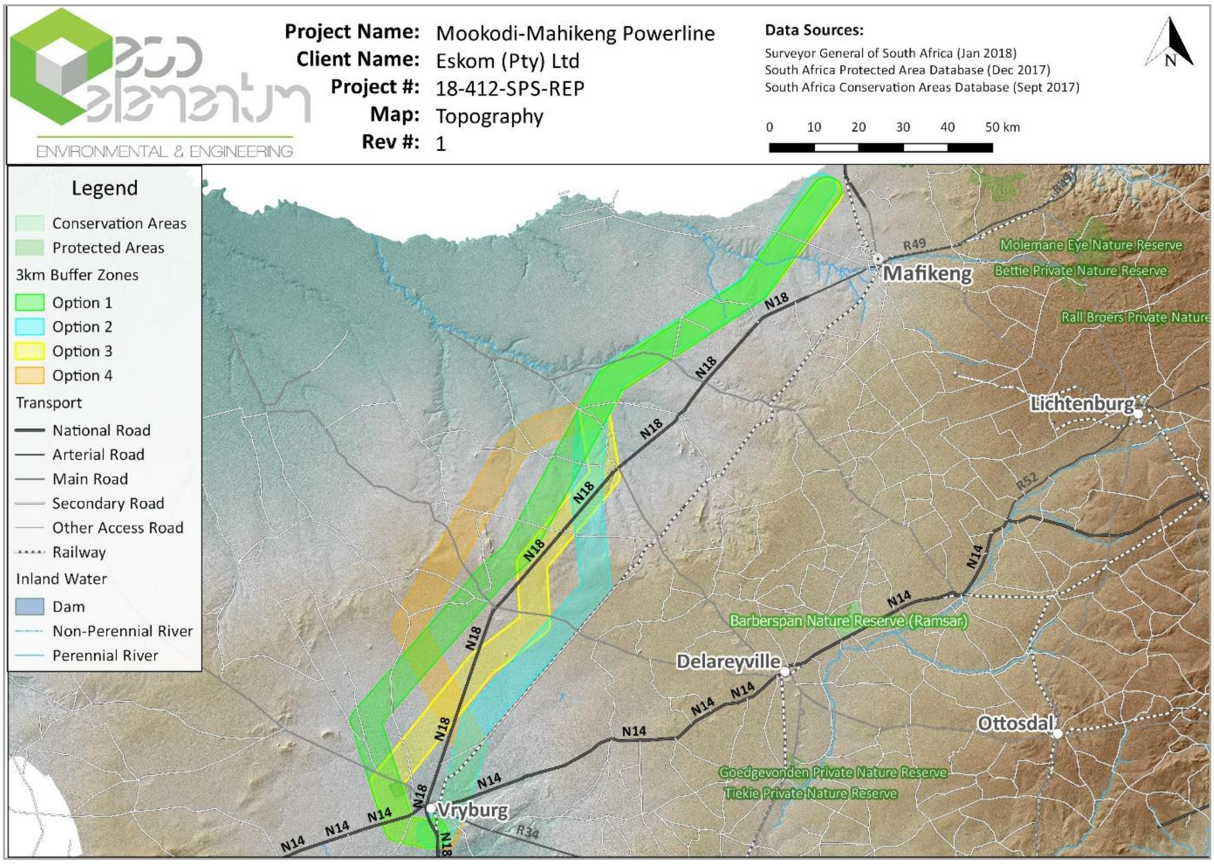

Figure 4: Map showing the Topography surrounding the Mookodi-Mahikeng Powerlines project.

The proposed Mookodi-Mahikeng Powerlines project area is situated in a predominant flat area with very few topographical features spanning the proposed length.

3.2 New Infrastructure

The proposed Mookodi-Mahikeng Powerlines project will comprise of newly built pylon structures. Three main tower types are typically used for 400kV lines, Guyed-V, Cross-Rope, and Bend/Strain. The highest of these three are assumed to be used.

Table 7 show the maximum height of the relevant proposed structures.

Table 7: Maximum Heights of Relevant Infrastructure.

Description	Height (m)
Pylon	40

4. METHODOLOGY

The following sequence was employed in this Visual Assessment Report:

4.1 GIS Assessment Of Visual Impact

1. Viewshed and viewing distance using GIS analysis up to 3 km from the proposed structures.
    - In order to model the decreasing visual impact of the structures, an Euclidean distance ranking was done from the centreline of the proposed Powerlines and superimposed on the viewshed to determine the level of visual exposure. The closest zone to the proposed structures indicates the area of most significant impact and the zone further than 3 km from the structures indicates the area of least impact.
2. A Visual Exposure Analysis was conducted that included the following parameters:
    - Terrain Slope:
        - Slope angle is determined from the Digital Terrain Model (DTM) and the location of the proposed structures given a ranking depending on the steepness of the slope; and
        - Structures built on steep slopes are assumed more visible and exposed than those on flat surfaces.
    - Aspect of structure location:
        - Aspect of the slope where the structures are to be built, are calculated from the DTM and given a ranking determined by the Sun angle.
        - Structures on flat surface are illuminated by the sun the whole day and thus visible from all directions. In the southern hemisphere structures on North facing slopes are less visible from the south, structures on East and West facing slopes are only illuminated during half of the day thus less visible where structures on the southern slopes are mostly in the shade.
    - Landforms:
        - Landform of the location of the proposed structures are determined from the DTM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys.
    - Slope Position of structure:
        - Using GIS analysis, the position of the proposed structure is determined and ranked according to the position on the slope the structure is to be built.
    - Relative elevation of structure:
        - Using the DEM the elevation of the proposed structure relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas. Structures built on higher ground are more visible than those built in low-lying areas.
    - Terrain Ruggedness:

- The terrain ruggedness is determined from the DEM and given a ranking based on the homogeneousness of the terrain. Rugged terrain has a tendency to increase the visual absorption characteristics of the terrain.

3. Viewer Sensitivity:
    - The Viewer sensitivity ranking of the surrounding areas is determined using various land cover and land use datasets and ranked according to the sensitivity of the related structures to the environment.
4. Overall Visual Impact:
    - Combing all the above datasets, a final potential visual impact of the proposed structures is calculated. This is done by adding all the above values for the entire length of the proposed options.

4.2 Visual Impact Significance

- A visual impact significance rating is determined using the following criteria:
    - Extent of the site;
    - Duration of the project;
    - Magnitude of the project; and
    - Probability that it will have a visual impact.

4.3 Assumptions

- The core study area can be defined as an area with a radius of not more than 3 km from the structures. This is because the visual impact of Powerlines beyond a distance of 3 km would be so reduced that it can be considered negligible even if there is direct line of sight.
- A height of 40 m was used for the pylons.
- The assessment was undertaken during the planning stage of the project and is based on the information available at that time.

4.4 Limitations

- Visual perception is by nature a subjective experience, as it is influenced largely by personal values. For instance, what one-viewer experiences as an intrusion in the landscape, another may regard as positive. Such differences in perception are greatly influenced by culture, education and socio-economic background. A degree of subjectivity is therefore bound to influence the rating of visual impacts. In order to limit such subjectivity, a combination of quantitative and qualitative assessment methods were used. A high degree of reliance has been placed on GIS-based analysis viewshed, visibility analysis, and on making transparent assumptions and value judgements, where such assumptions or judgements are necessary.
- The viewshed generated in GIS cannot be guaranteed as 100% accurate. Some viewpoints, which are indicated on the viewshed as being inside of the viewshed, can be outside of the viewshed. This is due to the change of the natural environment by surrounding activities as well as natural vegetation that play a significant role and can have a positive or negative influence on the viewshed.

4.5 LEGAL REQUIREMENTS

There are no specific legal requirements for visual impact assessment in South Africa. Visual impacts are, however required to be assessed by implication when the provisions of relevant acts governing Environmental Impact Management are considered.

5. GIS ASSESSMENT OF VISUAL IMPACTS

5.1 VISIBILITY

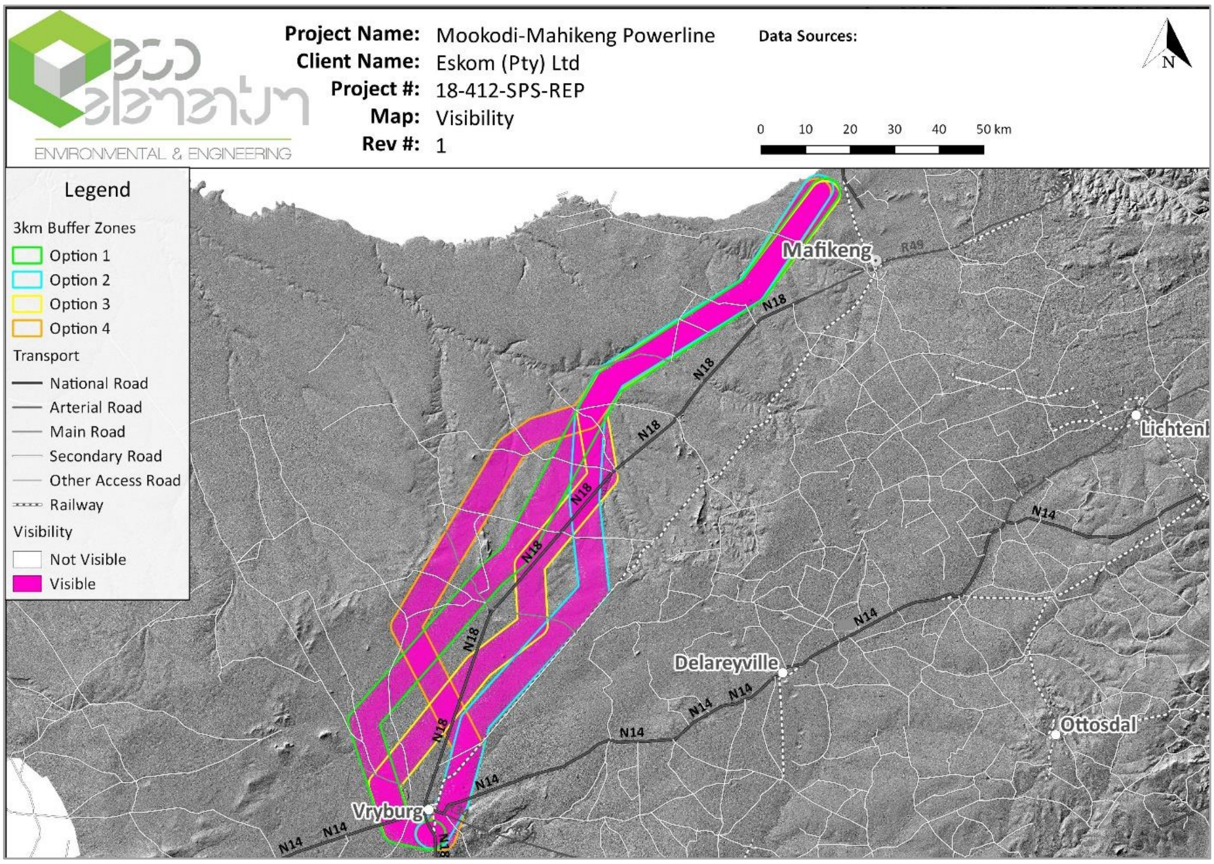

Figure 5: Visibility of the proposed Mookodi-Mahikeng Powerlines project

A visibility analysis was run to determine the locations from which the proposed infrastructure would be visible within the 3 km buffer of the centre line of the Powerlines.

5.2 VISUAL EXPOSURE

Visual exposure is based on distance from the project within the 3 km buffer zone from the proposed centre line of the Powerlines. Visual exposure or visual impact tends to diminish exponentially with distance. The visibility or visual exposure of any structure or activity is the point of departure for the Visual Impact Assessment. It stands to reason that if the proposed structures were not visible, no visual impact would occur. Visual exposure is determined by the following variables:

- Slope angle;
- Aspect of slope;
- Landforms;
- Slope Position of structure;
- Relative Elevation of structure; and
- Terrain Ruggedness.

5.2.1 Slope

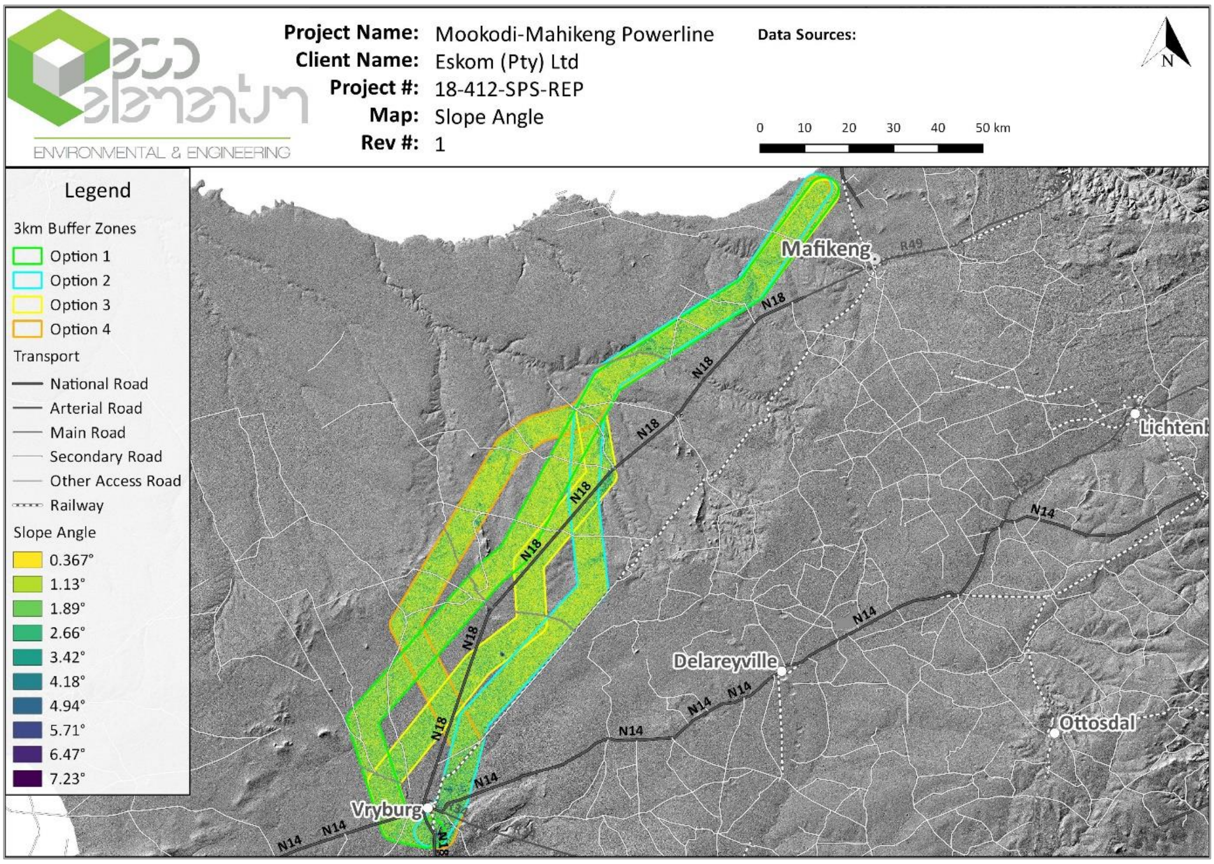

Figure 6: Slope angles of the terrain in the 3 km buffer area surrounding the proposed Mookodi-Mahikeng Powerlines project

5.2.2 Aspect

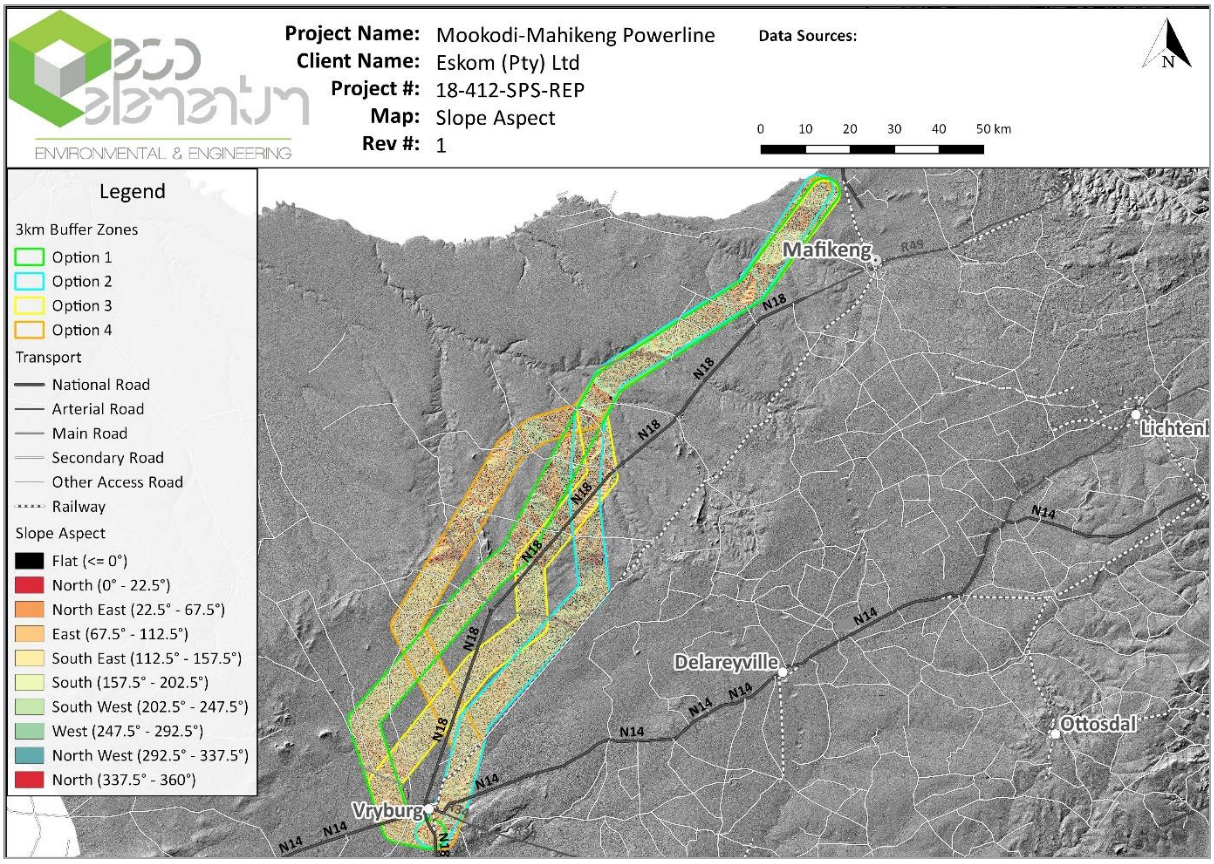

Figure 7: Slope Aspect direction of the terrain in the 3 km buffer area surrounding the proposed Mookodi-Mahikeng Powerlines project

5.2.3 Terrain Ruggedness

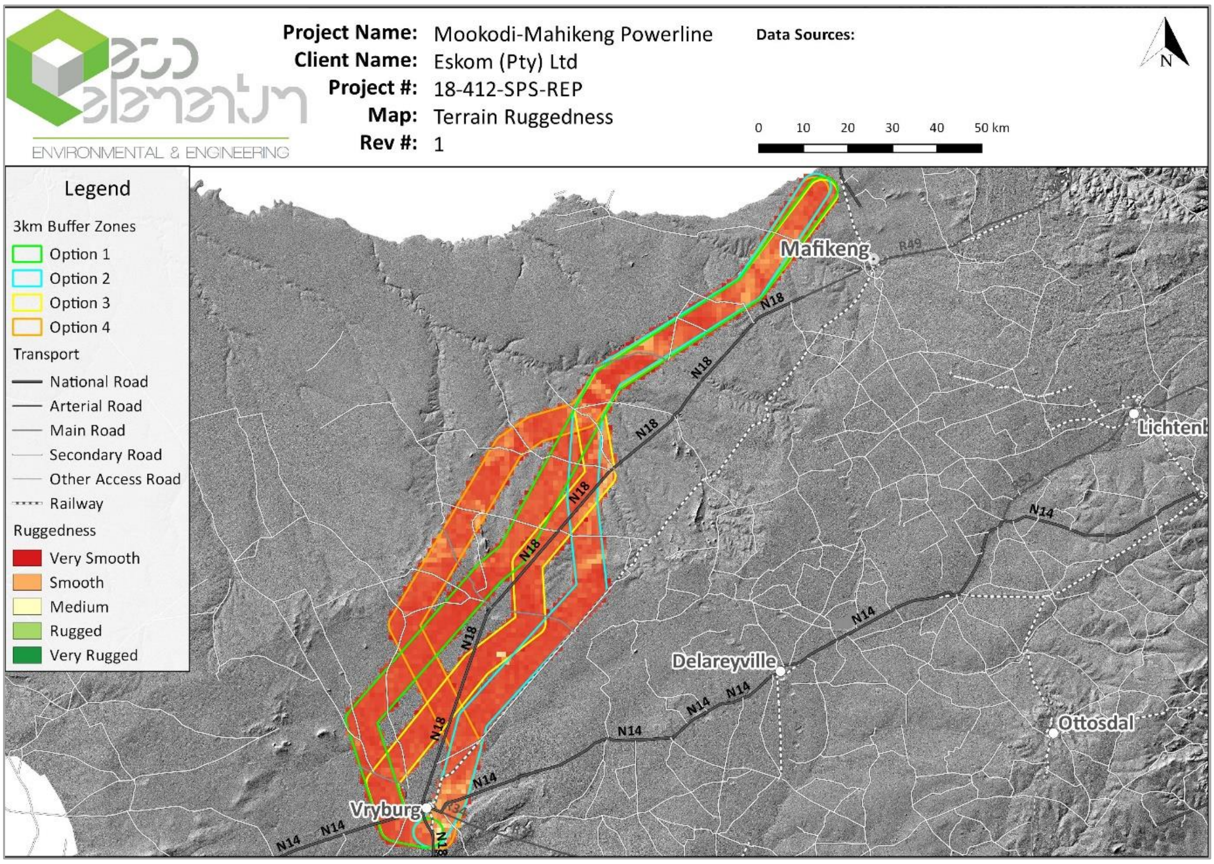

Figure 8: Terrain ruggedness in the 3 km buffer area surrounding the proposed Mookodi-Mahikeng Powerlines project

5.2.4 Relative Elevation

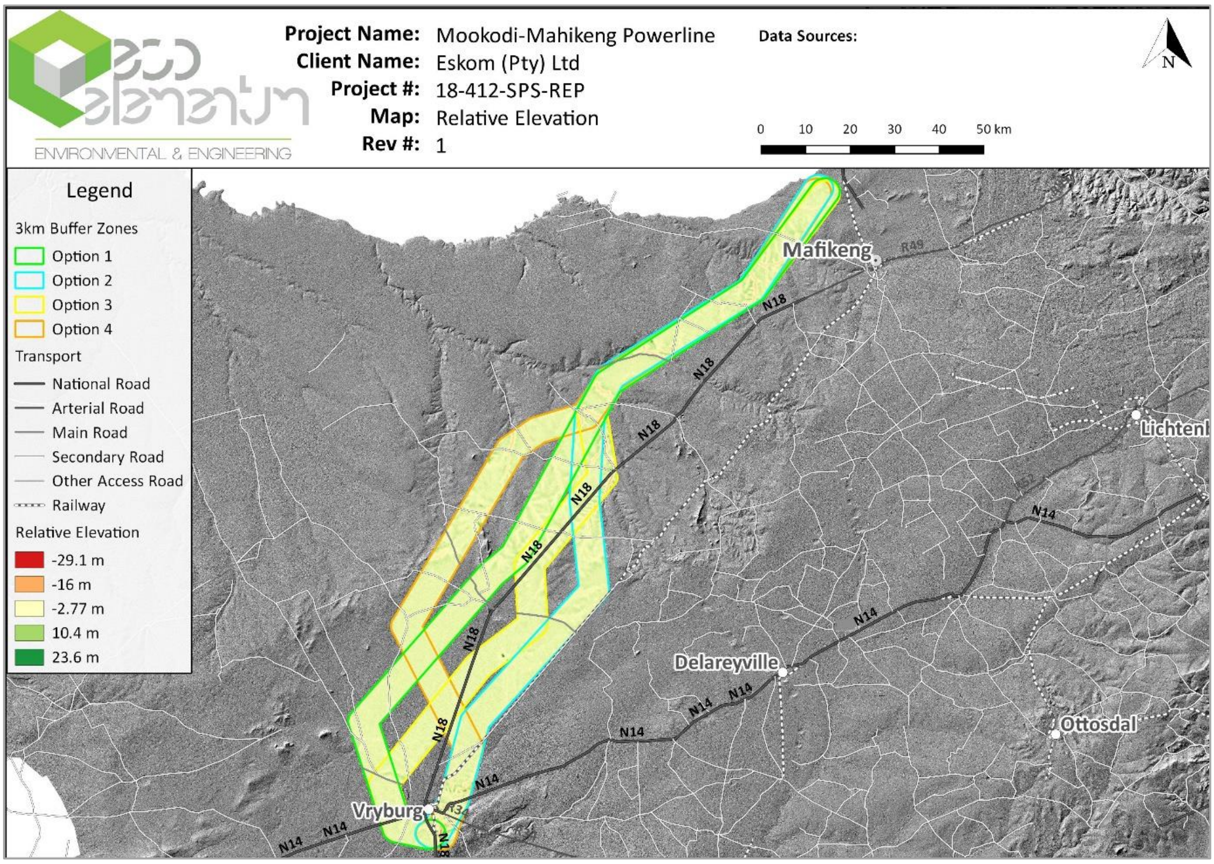

Figure 9: Relative Elevation of terrain in the 3 km buffer area surrounding the proposed Mookodi-Mahikeng Powerlines project

5.2.5 Landforms

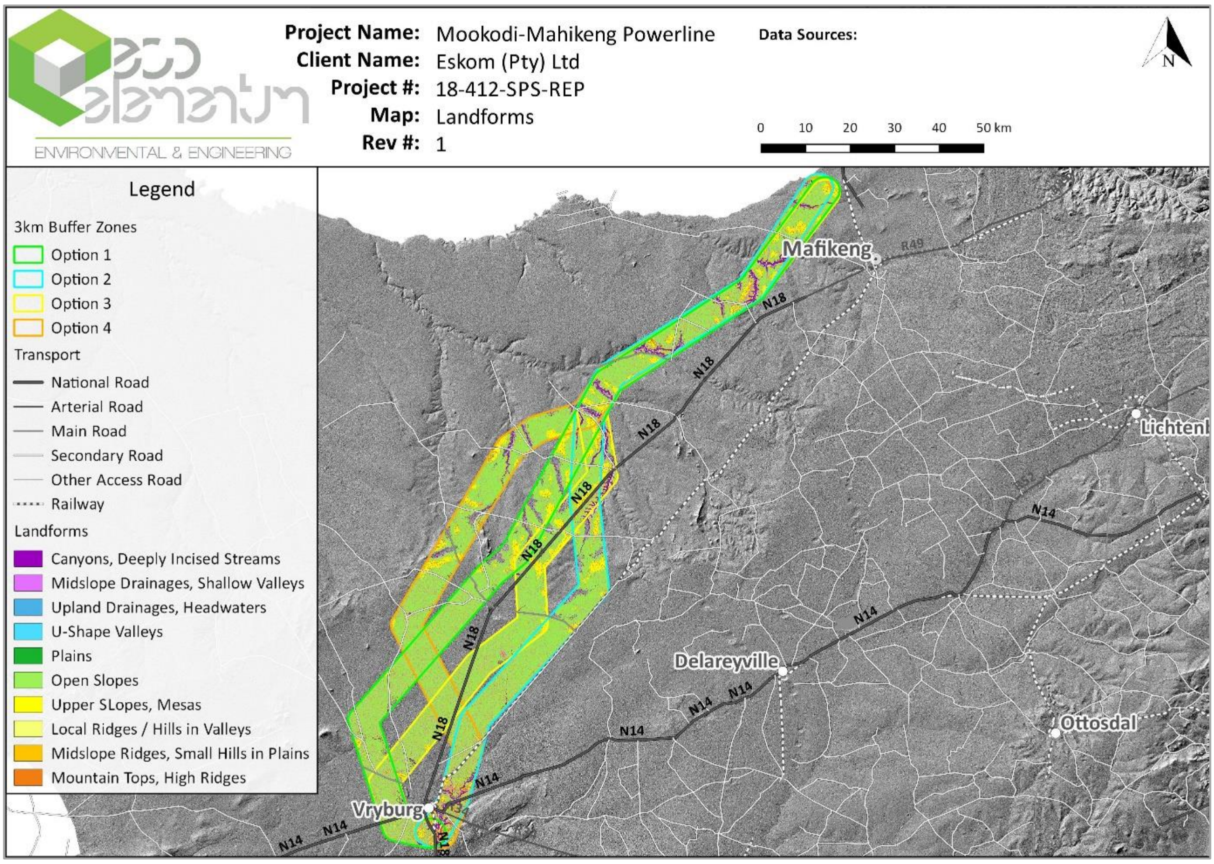

Figure 10: Landforms in a 3 km buffer area surrounding the proposed Mookodi-Mahikeng Powerlines project

5.2.6 Slope Position

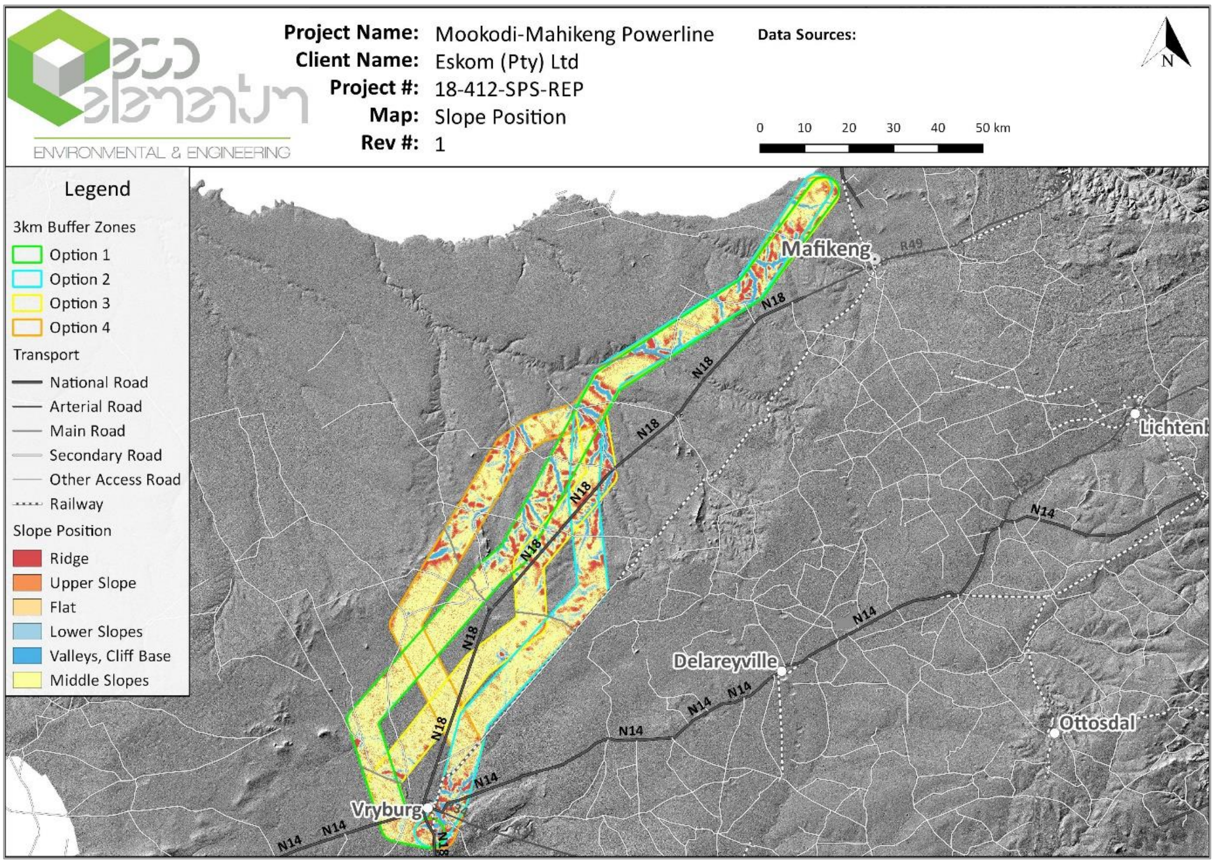

Figure 11: Slope Positions in the 3 km buffer area surrounding the proposed Mookodi-Mahikeng Powerlines project

5.3 GIS Visual Impact

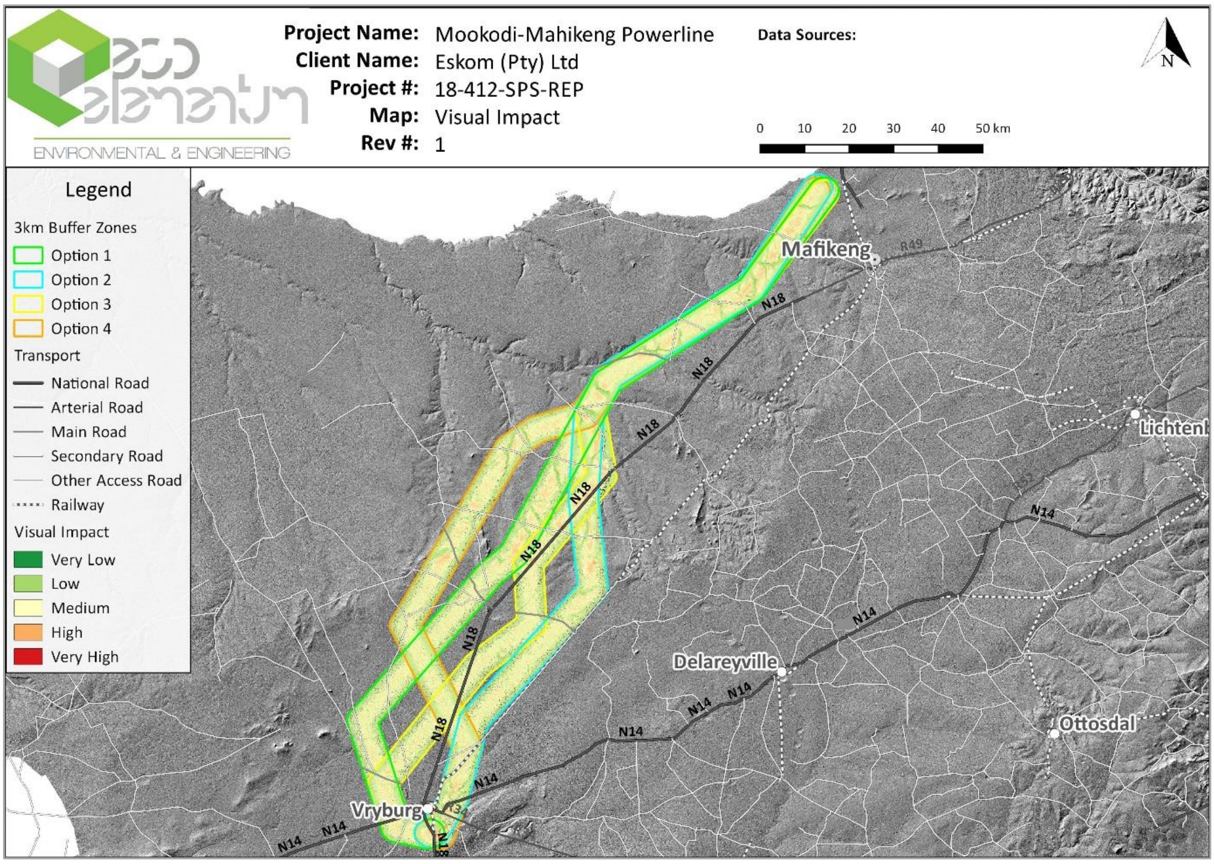

Figure 12: GIS Visual Impact of the proposed Mookodi-Mahikeng Powerlines project

The final Visual impact of the proposed infrastructure was calculated using all the datasets above then summarising all the pixel values of each corridor option to get to a final rating as shown in Table 8 below. **Option 2** is the preferred option.

Table 8: GIS Calculated Visual Impact.

Alternative	Rank	Sum of GIS Pixel Values	Mean of GIS Pixel Values	% Difference from Lowest
Option 1	2	2832702	2.709	+4.6%
Option 2	**1**	2702506	2.753	0%
Option 3	4	3034484	2.902	+11%
Option 4	3	2837609	2.732	+5%

6. VISUAL IMPACT SIGNIFICANCE RATING

6.1 VISUAL IMPACT SIGNIFICANCE RATING CRITERIA

Table 9: Criteria for Visual Impact Assessment

Intensity (Magnitude)	
The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it has a significant, moderate or insignificant, visual impacted.	
(I)nsignificant	The visual impact of the development will not have a negative effect on the surrounding environment and land users.
(M)oderate	The development will have an effect on the environment and land users, but will not be significant.
(V)ery High	The development will have a significant impact on the environment and land users.
Duration	
The lifetime of the impact, that is measure in relation to the lifetime of the proposed development.	
(T)emporary	The impact either will disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
(S)hort term	The impact will be relevant through to the end of a construction phase (1.5 – 2 years).
(M)edium term	The impact will last up to the end of the development phases, where after it will be entirely negated.
(L)ong term	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
(P)ermanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.
Spatial Scale	
Classification of the physical and spatial aspect of the impact	
(F)ootprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
(S)ite	The impact could affect the whole, or a significant portion of the site.
(R)egional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
(N)ational	The impact could have an effect that expands throughout the country (South Africa).
(I)nternational	Where the impact has international ramifications that extend beyond the boundaries of South Africa.

Probability	
This describes the likelihood of the impact actually occurring. The impact may occur for any length of time during the life cycle of the activity. The classes are rated as follows:	
(I)mprobable	The possibility of the Visual Impact occurring is none, due to the circumstances or design. The chance of this Visual Impact occurring is zero (0%).
(P)ossible	The possibility of the Visual Impact occurring is very low, due either to the circumstances or design. The chance of this Visual Impact occurring is defined as 25% or less.
(L)ikely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of the Visual Impact occurring is defined as 50%.
(H)ighly Likely	It is most likely that the Visual Impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75%.
(D)efinite	The Visual impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

Table 10: Assessment Criteria and Ranking Scale

PROBABILITY		**MAGNITUDE**	
Description Meaning	**Score**	**Description Meaning**	**Score**
Definite / don't know	5	Very high / don't know	10
Highly likely	4	High	8
Likely	3	Moderate	6
Possible	2	Low	4
Improbable	1	Insignificant	2
DURATION		**SPATIAL SCALE**	
Description Meaning	**Score**	**Description /Meaning**	**Score**
Permanent	5	International	5
Long Term	4	National	4
Medium	3	Regional	3
Short term	2	Local/Site	2
Temporary	1	Footprint	1/0

Equation 1: Significant Rating

Significant Rating (SR) = (Extent + Intensity + Duration) x Probability

Table 11: Significant Rating Scale without mitigation

SR < 30	LOW (L)	Visual Impact with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
31 > SR < 60	MEDIUM (M)	Where Visual Impact could have an influence on the decision unless it is mitigated. An impact or benefit, which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 61	HIGH (H)	Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact that could influence the decision about whether or not to proceed with the project.

Table 12: Significant Rating Scale with mitigation

SR < 30	LOW (L)	The Visual Impact is mitigated to the point where it is of limited importance.
31 > SR < 60	MEDIUM (M)	Notwithstanding successful implementation of mitigation measures to reduce negative visual impacts to acceptable levels, the negative visual impact will remain of significance. Taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR > 61	HIGH (H)	The visual impact is of major importance. Mitigation of the visual impact is not possible on a cost-effective basis. The visual impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. The visual impact is regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

6.2 Activities Assessed

The following activities were assessed individually:

- Construction Camps;
- Power Line;
- Access Roads.

Visibility is determined by a line of sight where nothing obscures the view of an object. Exposure is defined by the degree of visibility, in other words “how much” of it can be seen. This is influenced by topography and the incidence of objects such as trees and buildings that obscure the view partially or in total.

6.2.1 Construction Camps

Potential construction camps visual impact will have a LOW significance impact before mitigation and LOW significance after mitigation, as indicated in the table below. Although the construction camps will be LOW visible, the time of exposure is minimal and thus the impact on the users will remain LOW.

Table 13: Summarizing the significance of visual impacts of the Construction Camps.

Nature of impact: Potential visual impact significance of the Construction Camps		
	No Mitigation	**With Mitigation**
	Proposed	**Proposed**
Extent	2	1
Duration	1	1
Magnitude	6	4
Probability	3	3
Significance Rating (SR)	Low (27)	Low (18)
Status (positive, neutral or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources	Yes	
Can impact be mitigated	Yes	
Mitigation:	The visual impact can be minimized by the creation of a visual barrier. The construction area will be cleared as soon as construction of the infrastructure is finished.	
Cumulative Impact:	The construction camps of the proposed Mookodi-Mahikeng Powerlines project with its associated infrastructure will increase the cumulative visual impact of power line type infrastructure within the region. The construction camps of the Mookodi-Mahikeng Power line structures will contribute to a regional increase in heavy vehicles on the roads in the region, with construction activity noticeable.	

6.2.2 Powerlines

Potential Powerlines visual impact will have a HIGH significance impact before mitigation and MEDIUM significance after mitigation, as indicated in Table 14 below. Although the Powerlines will be HIGH visible, the extent and magnitude of the exposure can be mitigated and thus the impact on the users will remain MEDIUM.

Table 14: Summarizing the significance of visual impacts of the Powerlines.

Nature of impact: Potential visual impact significance of the Powerlines		
	No Mitigation	**With Mitigation**
	Proposed	**Proposed**
Extent	4	3
Duration	5	5
Magnitude	8	6
Probability	5	4
Significance Rating (SR)	High (85)	Medium (56)
Status (positive, neutral or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources	Yes	
Can impact be mitigated	Yes	
Mitigation:	The visual impact can be minimized by the creation of a visual barrier during construction. The steel of the pylons can be painted a darker colour than galvanized steel to reduce the visual impact. Placing Powerlines next to existing linear features as far as possible. Clearing of vegetation should only be done by cutting and not earth moving equipment to reduce the visual impact of the vegetation scars.	
Cumulative Impact:	The Powerlines of the proposed Mookodi-Mahikeng Power line project with its associated infrastructure will increase the cumulative visual impact of Power line type infrastructure within the region.	

6.2.3 Access Roads

Potential Access Roads visual impact will have a MEDIUM significance impact before mitigation and MEDIUM significance after mitigation, as indicated in the table below. Although the Access Roads visual impacts will be MEDIUM visible, the probability of the exposure is can be mitigated and thus the impact on the users will reduce although remain MEDIUM.

Table 15: Summarizing the significance of visual impacts of the Access Roads.

Nature of impact: Potential visual impact significance of the Access Roads		
	No Mitigation	**With Mitigation**
	Proposed	**Proposed**
Extent	3	3
Duration	4	4
Magnitude	6	6
Probability	4	3
Significance Rating (SR)	Medium (52)	Medium (39)
Status (positive, neutral or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources	Yes	
Can impact be mitigated	Yes	
Mitigation:	The visual impact can be minimized by using existing roads.	
Cumulative Impact:	The Access Roads of the Mookodi-Mahikeng Powerlines structures will contribute to a regional increase in small maintenance vehicles on the roads in the region.	

6.3 Cumulative Impacts

Cumulative landscape and visual effects (impacts) resulting from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future, may also affect the way in which the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the inter-visibility (visibility) of a range of developments and / or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effects on visual receptors within their combined visual envelopes. Inter-visibility depends upon general topography, aspects, tree cover or other visual obstruction, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The Landscape Institute, 1996).

- The cumulative visual intrusion of the proposed Mookodi-Mahikeng Power line structures will be MEDIUM as it is a power line. The site location expand several hundreds of kilometres through varying terrain and Landover types. The visual impact and impact on sense of place of the proposed project will contribute to the cumulative negative effect on the aesthetics of the study area.

To get a better understanding and quantify the cumulative impacts better, all the individual project elements were summed together and the average of each impact nature were calculated to form the cumulative significant impact rating for the complete project. The results can be seen in Table 17.

6.4 Mitigation Measures

Mitigation measures may be considered in two categories:

- Primary measures that intrinsically comprise part of the development design through an iterative process. Mitigation measures are more effective if they are implemented from project inception when alternatives are being considered.
- Secondary measures designed to specifically address the remaining negative effects of the final development proposals.

Primary measures to be implemented will mainly be measures that will minimise the visual impact by softening the visibility of the structures by “blending” with the surrounding areas. Such measures will include:

- Rehabilitation of the construction areas by re-vegetation of the sites and surrounding area;
- Painting / coating of the pylons to a darker colour than Galvanized steel;
- Building the Powerlines and pylons next to existing linear structures as far as possible;
- Clear vegetation only by cutting and not earth moving equipment; and
- Use of existing roads for access roads.

7. CONCLUSION

7.1 GIS VISUAL IMPACT RATINGS

Table 16: GIS Calculated Visual Impact.

Alternative	Rank	Sum of GIS Pixel Values	Mean of GIS Pixel Values	% Difference from Lowest
Option 1	2	2832702	2.709	+4.6%
Option 2	**1**	2702506	2.753	0%
Option 3	4	3034484	2.902	+11%
Option 4	3	2837609	2.732	+5%

The final Visual impact of the proposed infrastructure was calculated using all the datasets in the GIS Assessment section then summarising all the pixel values of each corridor option to get to a final rating as shown in Table 8 above. **Option 2** is the preferred option.

The visual impact generated in GIS cannot be guaranteed as 100% accurate. Some viewpoints, which are indicated on the viewshed as being inside of the viewshed, can be outside of the viewshed. This is due to the change of the natural environment by surrounding activities as well as natural vegetation that play a significant role and can have a positive or negative influence on the visual impact

7.2 SIGNIFICANCE IMPACT RATINGS

The construction and operation phase of the proposed Mookodi-Mahikeng Powerlines related activities and its associated infrastructure will have a MEDIUM visual impact on the natural scenic resources and the topography. However, with the correct mitigation measures the impact might decrease to a point where the visual impact can be seen as less significant although still MEDIUM. The moderating factors of the visual impact of the proposed infrastructure in close range are as follows:

- Number of human inhabitants located in the area;
- Natural topography and vegetation;
- Mitigation measures that will be implemented such as the establishment of barriers or screens;
- The size of the operation; and
- Absorption capacity of the landscape.

In light of the above-mentioned factors that reduce the impact of the facility, the visual impact is assessed as MEDIUM VISUAL IMPACT after mitigation measures have been implemented.

Table 17: The overall Assessment of the Visual Impact

Nature of impact: The overall Assessment of the Visual Impact of the area.		
	No Mitigation	**With Mitigation**
	Proposed	**Proposed**
Extent	3	2.33
Duration	3.33	3.33
Magnitude	6.67	5.33
Probability	4	3.33
Significance Rating (SR)	Medium (52)	Medium (36.67)
Status (positive, neutral or negative)	Negative	
Reversibility	No	
Irreplaceable loss of resources	Yes	
Can impact be mitigated	Yes	
Mitigation:	All mitigation as discussed in each individual project element.	
Cumulative Impact:	Cumulative of each individual project element.	

The Visual Impact due to the construction activities and associated project infrastructure can be seen as having a MEDIUM impact on the surrounding environment and inhabitants before mitigation measures are implemented. After mitigation, the visual impact can be seen as lowered although still classified as MEDIUM. Thus, mitigation measures are very important and two of the most significant mitigation measures are the rehabilitation of the area after construction has been concluded and reducing the visibility of the powerlines as much as possible. If the mitigation of the impact is not done correctly then the visual impact will become a concern. However, with the correct mitigation, the impact will be of minimal visual intrusion for the type of proposed structures.

8. REFERENCE

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Appendix 6G: Economic Impact Assessment

PROPOSED MOOKODI – MAHIKENG 400kV LINE

ECONOMIC IMPACT ASSESSMENT

Draft Report

Submitted to:

Nemai Consulting

(Environmental, Social and OHS Consultants)

Address: 147 Bram Fisher Drive, Ferndale

Report Submitted by:

Peter Baur

27 April 2018

Table of Contents

1. Introduction

1.1 Background to the Project

This report is designed to assess the economic impact of the proposed Mookodi-Mahikeng 400kV Line, which is estimated to be approximately 180km in length, crossing a multitude of private, tribal and commercial lands, all within the North West Province. There are four alternative routes proposed by Eskom, which within this report will be to be assessed from a macroeconomic perspective. The starting point of the proposed line is situated in Vryburg at the Mookodi Main Transmission Substation (MTS). The project is located within the Naledi Local Municipality, Kagisano-Molopo Local Municipality, Ratlou Local Municipality, and Mahikeng Local Municipality in the North West Province. There are four proposed alternative routes for the proposed line which will travel in a north-east direction terminating at the proposed Mahikeng substation site.

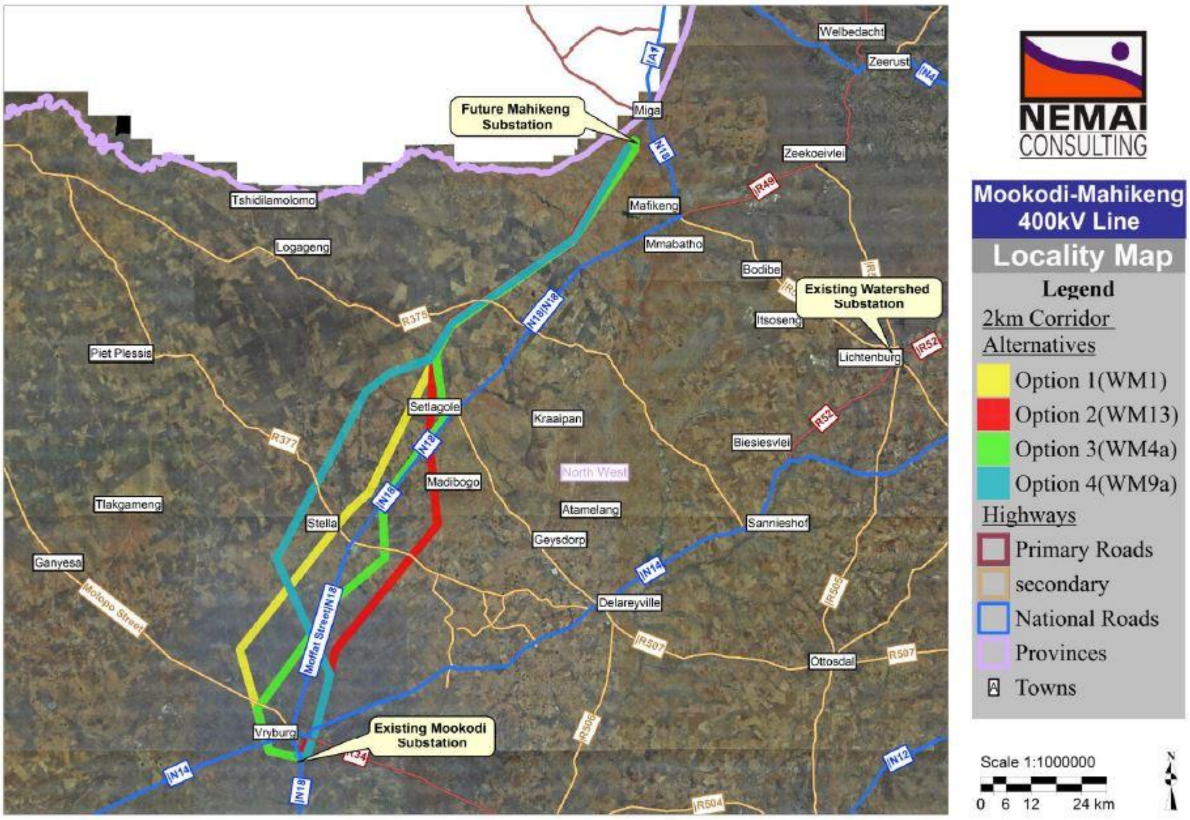

Figure 1. Locality Map, North West Province, Ngaka Modiri Molema and Naledi Regions

The Watershed substation has insufficient capacity to support the forecasted load in the Watershed MTS area, which includes the municipality of Lichtenburg and which extends to the town of Mahikeng. In order to accommodate the growing energy demand a further electricity network expansion project is considered through the establishment of a new transmission substation in Mahikeng. The proposed Mahikeng substation will be designed with an end state of 3x 500MVA 400/132kV transformers and include 2x 500MVA 400/132kV transformers initially. A 160km Pluto 400kV line will be constructed and a 180km Mookodi – Mahikeng 400kV line will also be developed. However the proposed substation and Pluto 400kV line does not fall part of the scope of work for this study.

1.2 Objective of the Study

Nemai Consulting was appointed by Eskom Holdings SOC Limited to conduct the Environmental Impact Assessment, in terms of Government Notice (GN) No. R 982 of 4 December 2014 (as amended). As a part of the Environmental Impact Assessment, a macroeconomic assessment will also be undertaken. This macroeconomic assessment will include a literature analysis, a review of documents and information provided by Eskom relating to the project, an analysis of the comments made by people affected by the proposed project, including landowners and other interested parties. An assessment of both the larger economy of South Africa will be undertaken and an assessment of the North West Province will also be explored.

1.3 Terms of Reference

This analysis will expand to include the potential secondary impacts on farming (agricultural and livestock), game farming, tourism, population and a possible impact on the social setting. From this analysis a quantitative economic impact assessment will be done, include a possible suitable cost benefit analysis. From this, the document will propose certain suggestions and recommendations on mitigation measures and proposed impacts.

1.4 Structure of the Report

The structure of this report begins with a brief macroeconomic review of the economic environment of South Africa, followed by a more detailed macroeconomic analysis of the economy of the North West Province, specifically focusing on the areas most influenced by the proposed study, namely the Ngaka Modiri Molema and Naledi Regions. There is an in depth assessment of the most critical economic fundamentals of these regions. The study then continues to cultivate an analysis of the specific macroeconomic fundamentals underlying the project. An assessment of the possible alternatives is undertaken, with emphasis on different scenario estimates on the different possible impacts that the project will have on the economy. An analysis of the findings is then presented and possible recommendations are made based on the collective research presented in this document.

2. Brief Macroeconomic review of South Africa

The trends in overall GDP and its growth of South Africa for the period 1960 to 2016 are presented in Figure 1. Figure 1 shows the trends in the overall GDP and its growth rate. South Africa achieved low economic growth during the period 2000 to 2016.

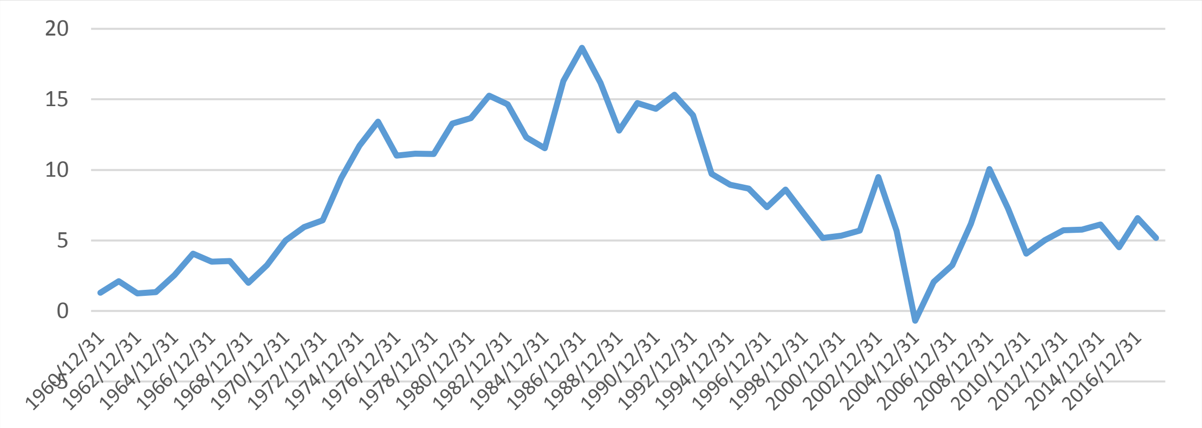

Figure 2. Economic Growth 1960-2016 (Source: StatsSA, 2017)

Figure 2 depicts the poor economic performance in terms of the historical trend in the output growth. The South African economy has recorded very low levels of economic growth, indicating negative trends over the period 2000 to 2017, with Gross Domestic Product (GDP) growth reaching a low of 0.37% in 2016.

Many of the problems associated with low growth in South Africa has impacted it has on unemployment. The unemployment levels and the distribution of income remained high while the trend in overall income inequality is unclear. The distribution of employment and inequality in the formal and informal sectors is also a major concern within South Africa. The income distribution between rural and urban sectors of the economy are a resilient concern.

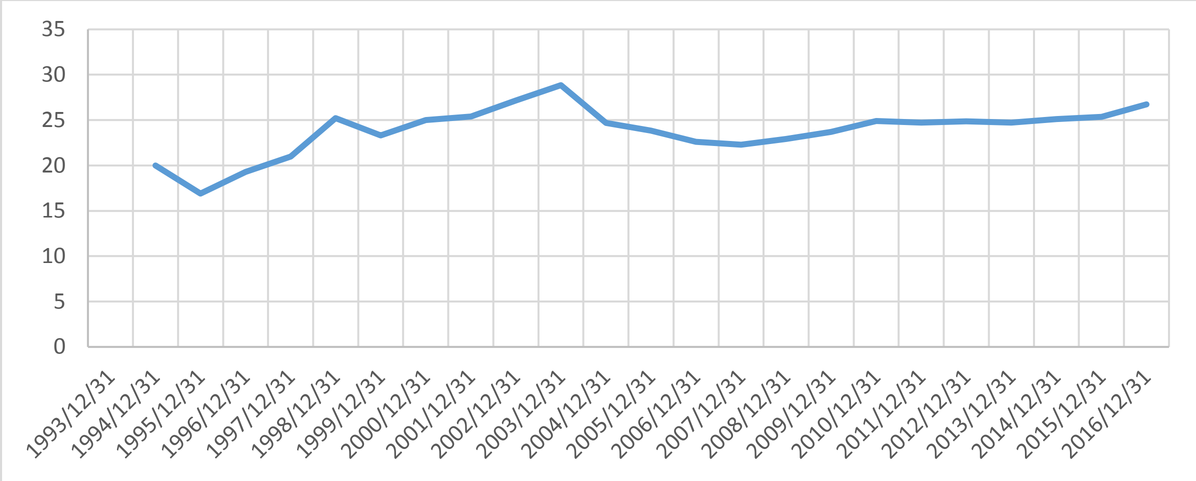

Figure 3: Official Unemployment in South Africa between 1993 and 2016 Source: (StatsSA, 2017)

The relevance of unemployment to inequality is emphasised by the rate and extent of earnings inequality. Clearly, unemployment has been found to account for a significant part of earnings inequality. However, the distribution of earnings amongst the employed as well as the proportions of people in the formal and informal sectors are also important contributors to inequality amongst the labour force as a whole (Tregenna & Tsela, 2008).

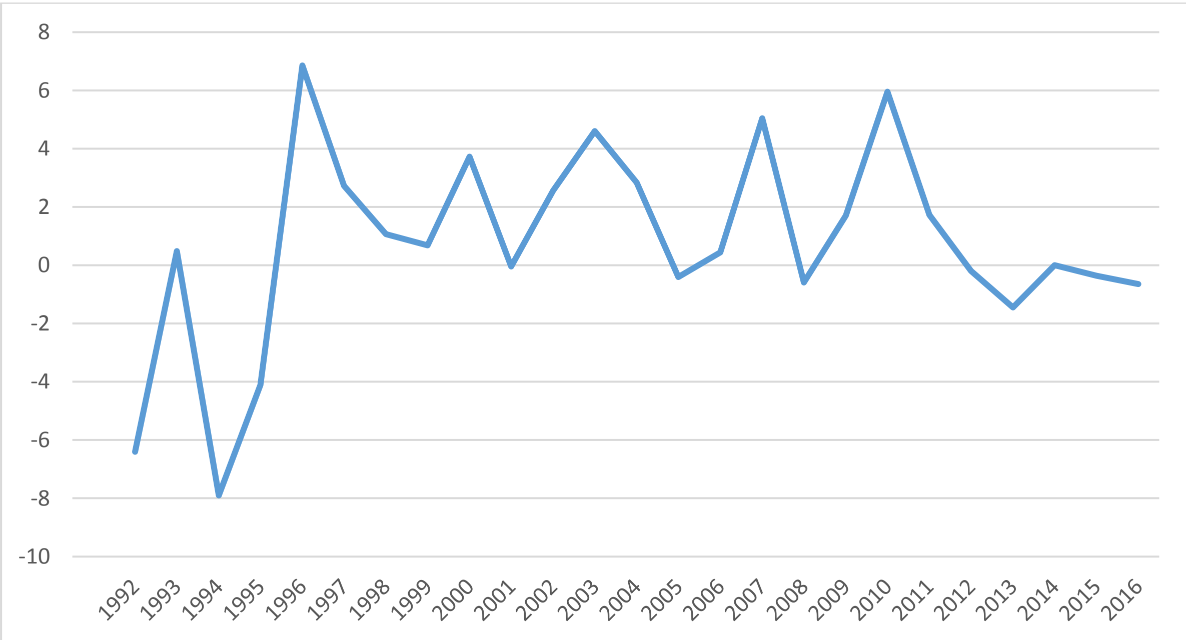

Figure 4. Change in GDP per Capita from 1992 to 2016 Source: Derived from data from StatsSA, 2017.

Figure 5 presents investment from 2010 to 2016. The change in the growth of GDP per capita is showing a decreasing trend which is adding to the problem of unemployment and inequality in South Africa.

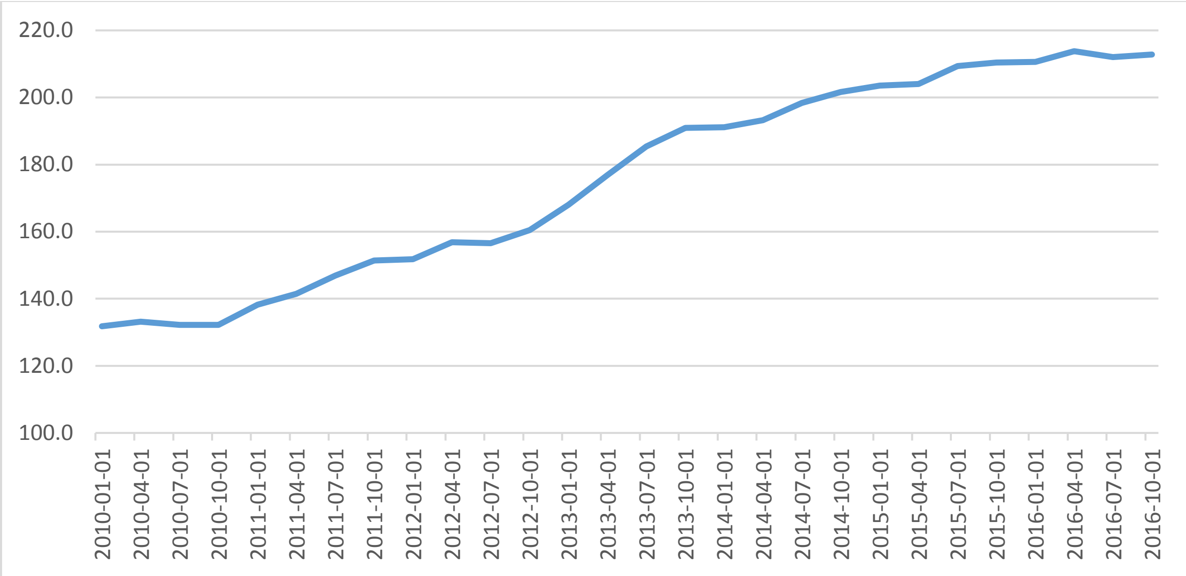

Figure 5. Capital formation, South Africa, 2010-2016 (Source: StatsSA, 2017)

Over the period 1994-2010 the South African economy was able to maintain the existing infrastructure which was mostly built before 1994, limiting the amount of investment into additional fixed capacity which was then required to meet the growing economy.

The downgrading of the South African financial sector by some of the international credit rating agencies has resulted in uncertainty for the level of investment in South Africa. The need to increase capacity in the country has become very urgent for the country at this juncture of time.

Consumer and producer price indexes are presented in Figure 5. Consumer Price Index (CPI) and Producer Price Index (PPI), using 2010 as the base year, traced an increasing projector between the years 2000 and 2015. Much of this is associated with deflation of the South Africa currency, and increasing global food prices along with additional pressure associated with increasing international oil prices.

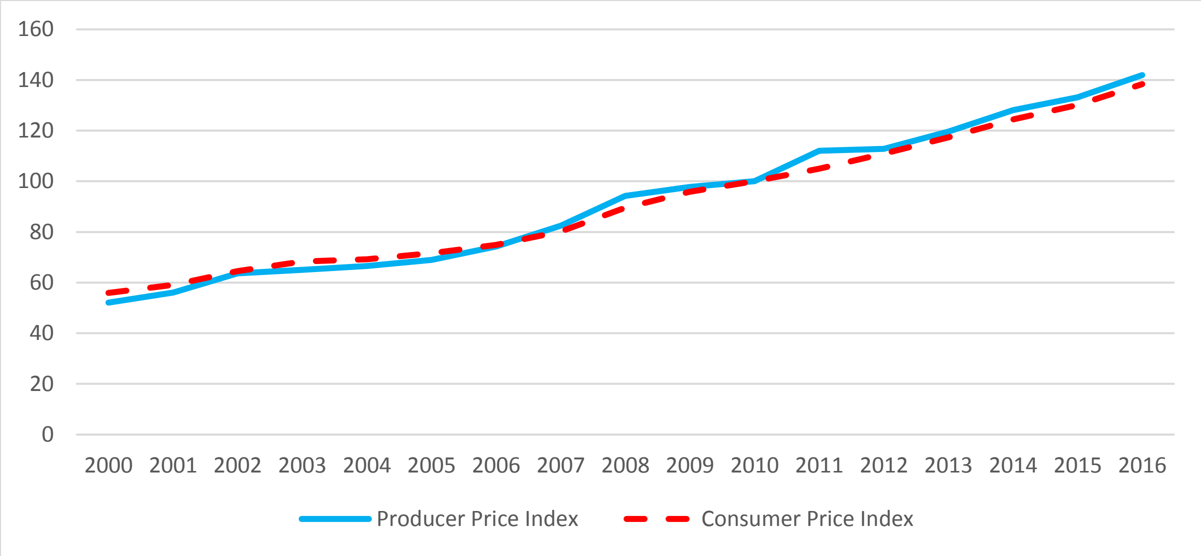

Figure 6. Inflation, (2010=100), 2000-2016 (Source: StatsSA, 2017)

3. The role of ESKOM in the development of the North West Province

This portion of the study briefly examines the role of Eskom. The importance of Eskom to expand its operation capacity and increase its network span is paramount, and central to this study. Due to the slow progress in the rural electrification programme, the need to extend the programme beyond the Kusile and Medupi power stations is a major consideration (RSA, 2013).

Eskom, technically speaking, is considered a State Owned Enterprise (SOE) under the influence of the Department of Public Enterprise (DPE). As its primary mandate, the DPE provides strategic bearing for Eskom. According to the Companies Act of 2008, Eskom is classified as a SOE which is wholly owned by Government through the chief management of the DPE. As such, Eskom is subject to the Public Finance Management Act (PFMA), 1999, and the provisions of Eskom's Memorandum of Incorporation (MOI). The importance of Eskom to the South African society and the overall economy is unquestionable.

Within South Africa, Eskom is the largest producer of electricity generating approximately 95% locally and approximately 45% within the rest of Africa (Eskom, 2011:13). Eskom is among the top 20 energy producing utilities in the world (Fourie, 2014). An important part of this responsibility is the expansion of the transmission network which includes the building and maintenance of transmission lines which are designed to transfer power as economically as possible while meeting the safety, security and reliability requirements. It is the responsibility of Eskom to ensure that transmission line development is undertaken in compliance with the environmental conditions and local regulations prevailing in the region where the lines are to be constructed. Factors which significantly influencing the design, construction and operation of these lines include the weather conditions, conductor material and configuration, insulator design, tower geometry and designs, foundations and environmental considerations (Teegala & Singal, 2015).

While energy formation governs the core function of Eskom, the utility is also active in all elements of the energy supply chain, which includes the transmission and distribution thereof to industrial, mining, commercial and residential consumers (Eskom, 2011:13).

Due to the low levels of international economic growth in the past few years, combined with a lethargic local economy, many of Eskom's key customers have been negatively affected by bringing their ability to increase, or even maintain, their electricity consumption. Economic prospects in the local and regional macro-economic landscapes of South Africa suggest that there is a growing electricity demand in the North West Province which, if properly developed and supported, can be achieved through the development of the network as proposed in this study (Eskom, 2017).

4. The regional economy of North West Province

The province of the North West is situated west of Gauteng, South Africa. The capital of the North West Province is Mahikeng. The North West Province is made of Four Districts, namely BojanLa Platinum District, Ngaoka Modiri Molema District, Dr Kenneth Kaunda District and Dr Ruth Segomotsi Mompati District. The scope of this study involves mainly the Ngaka Modiri Molema District and the Naledi Municipality within the Dr Ruth Segomotsi Mopati District.

Much of the province has shown economic growth which is in line with that of the National GDP.

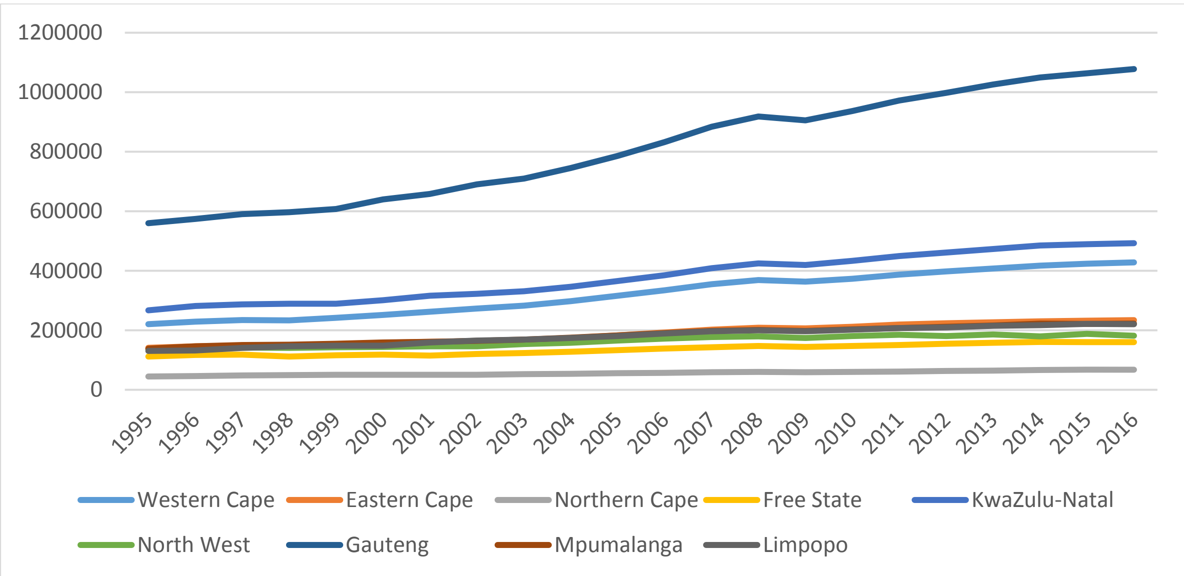

Figure 7. Regional GDP for the North West Province, 1995-2016 (Source: Quantec, 2018)

In terms of Regional Gross Domestic Product, the North West Province is the third largest province in South Africa. Gauteng is the largest province in South Africa, followed by KwaZulu Natal and then the Western Cape.

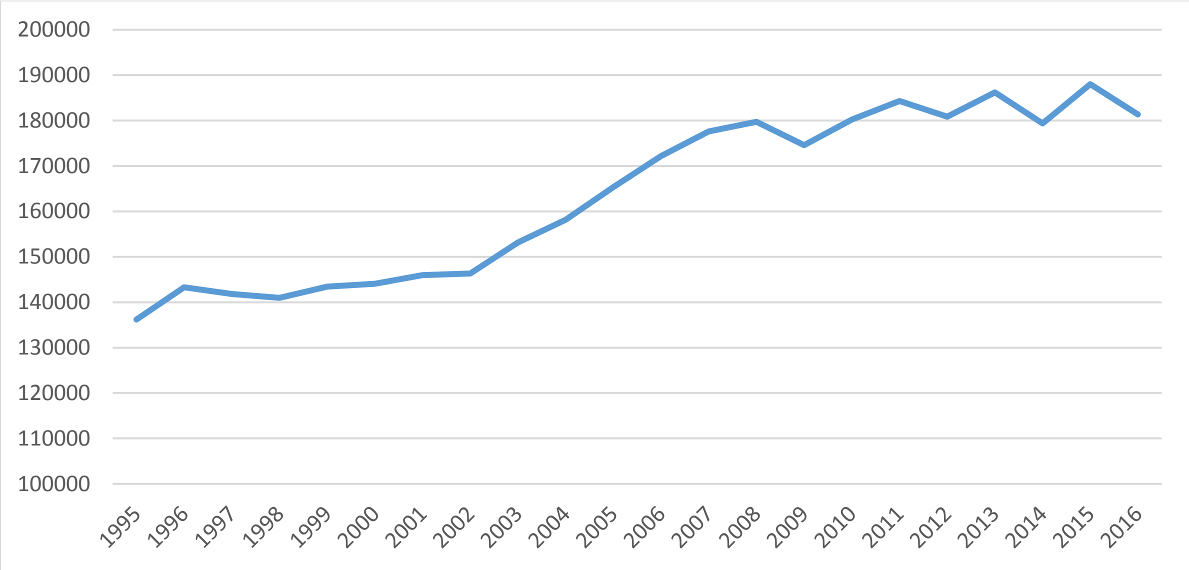

Figure 8. Regional GDP for the North West Province, 1995-2016 (Source: StatsSA, 2018)

Much of the province consists of flat areas of scattered trees and grassland. It's a largely agricultural region which is composed primarily of small agricultural holdings, well suited towards livestock, game farming, and other agricultural activities. While on the surface, agriculture plays an important role, an important part of the provincial economy consists of mining, which generates more than half of the province's Regional Gross Domestic Product (GDPR).

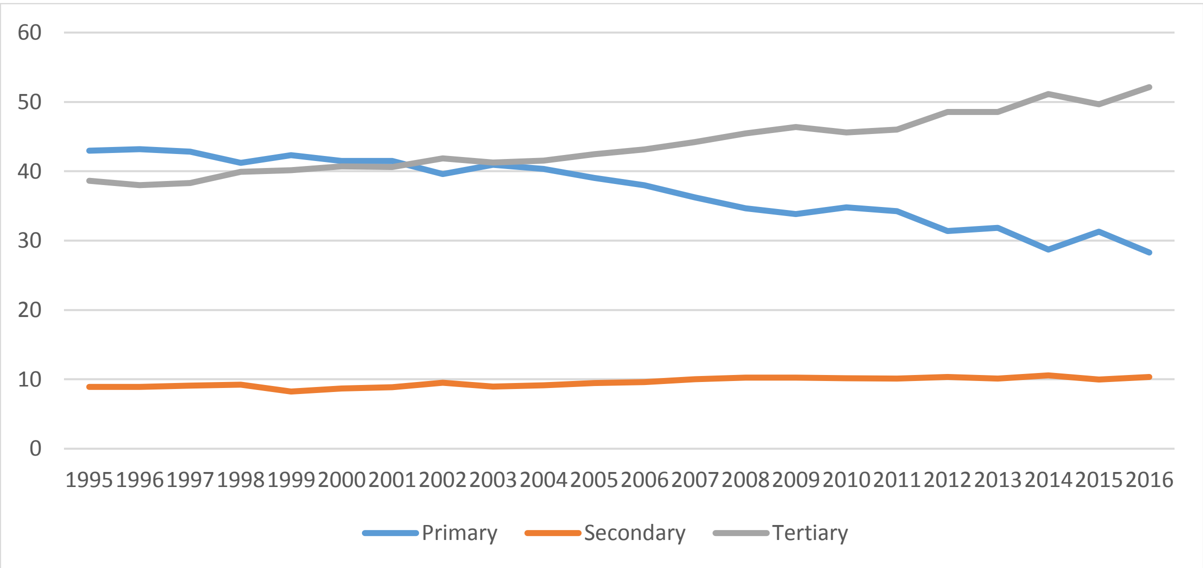

Figure 9. Regional GDP per Sector for the North West Province, 1995-2016 (Source: StatsSA, 2018)

While the secondary sector (mostly manufacturing and construction industries) contributes the least of all three sectors to the economy of the North West Province, it still has a significant impact of approximately 10% of economic activity. This accounts for a large portion of job creation within the region. The role of the primary sector, mainly consisting of agriculture, mining, fishing and forestry activities, is showing a steady decrease in economic activity between 1995 and 2016, moving from approximately 42% of the regional economy to a mere 28% of the contribution. However, the tertiary sector of the primary sector has shown a remarkable growth from 39% of the regional economic output, growing to an astonishing 52% of the contribution to the region. This implies that much of the economic activity is derived from the service sector which is most likely condensed around the main cities and towns of the province.

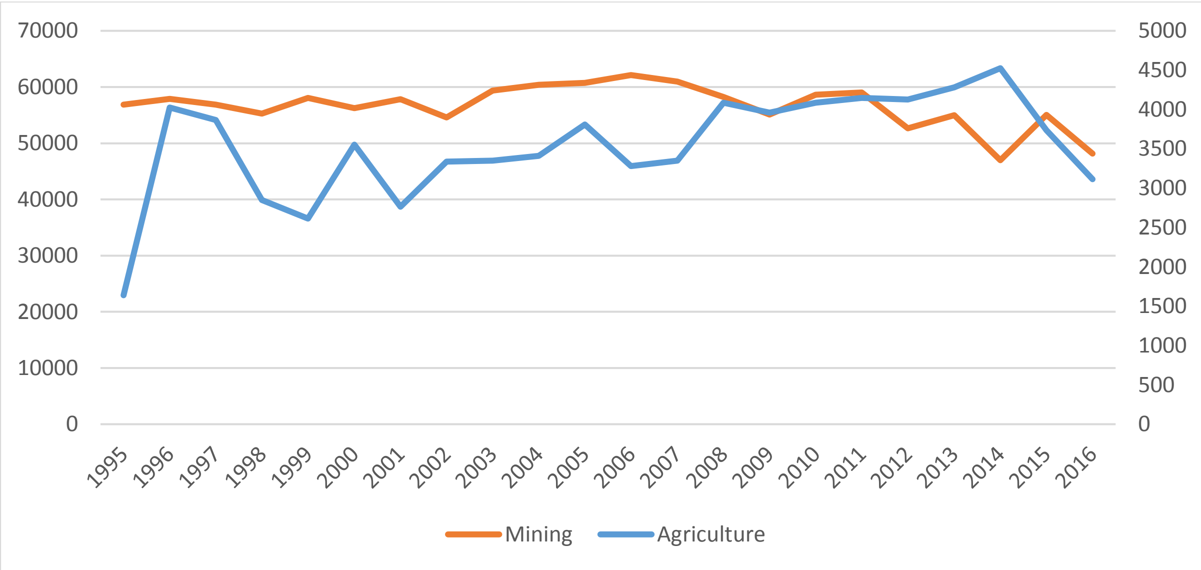

Figure 10. Contribution of Agriculture and Mining to the North West Province, 1995-2016 (Source: StatsSA, 2018)

A closer look at the role of mining and agriculture within the province shows that mining is still a significant portion of the overall contribution to the province. Output from farming is still significantly less than the mining sector, but not less important due to the issues of food security and the number of jobs created in the farming sector of the province.

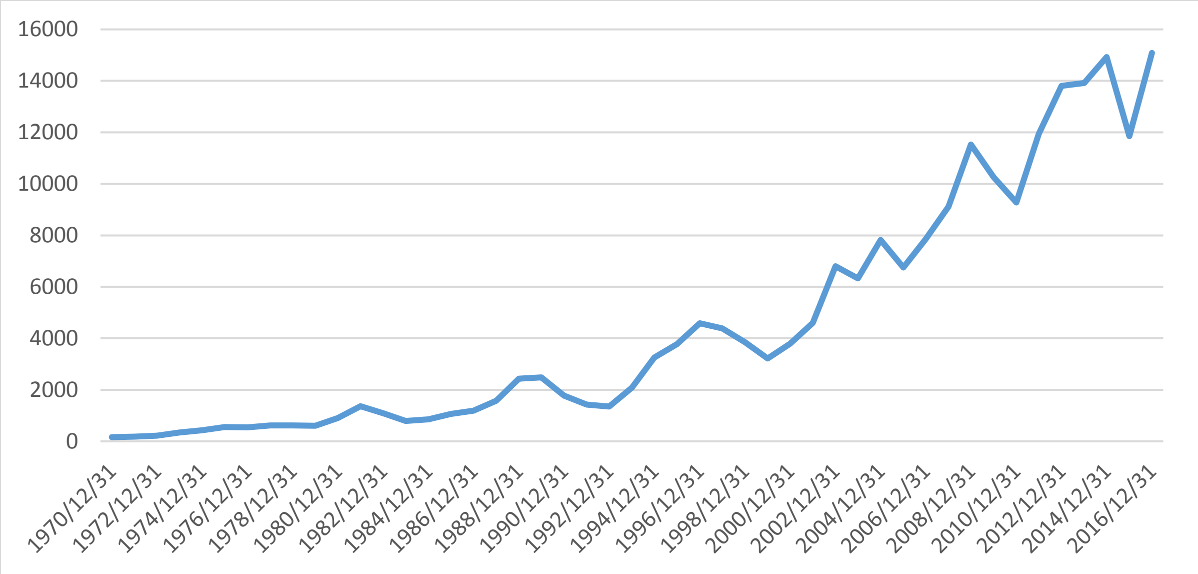

Figure 11. Investment into agriculture, farm assets and liabilities, 1970-2016 (Source: StatsSA, 2018)

Nationally, investment into the agricultural sector has shown consistent growth, especially showing large capital formation inflows from 1994 onwards. This highlights the importance of the overall agricultural sector in face of the growing South Africa economy. Elements such as the growing pressure of an increasing national population, the right to own land, and the changing global macroeconomic environment all have a significant contributing factor to total investment in farming.

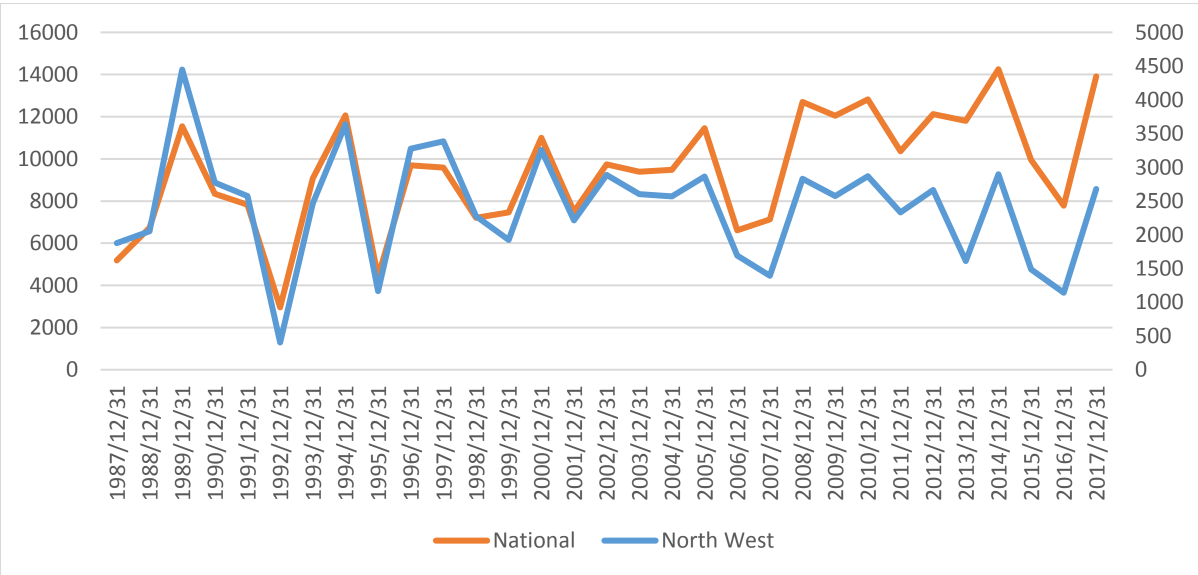

Figure 12. Comparing maize production both nationally and for the North West Province from 1987-2017 (Source: Quantec, 2018)

The output of maize production for the North West Province is very much in line with the total National maize production from 1987 2002. From approximately 2005, the maize production levels of the North West Province began to waver from national output, so while production changes are clearly seasonally dependant, the North West Province seems to show ever decreasing levels of output and production of the maize crop for those years post 2002. Much of this could be due to changing environmental conditions and the migration of skills into other regions of the economy.

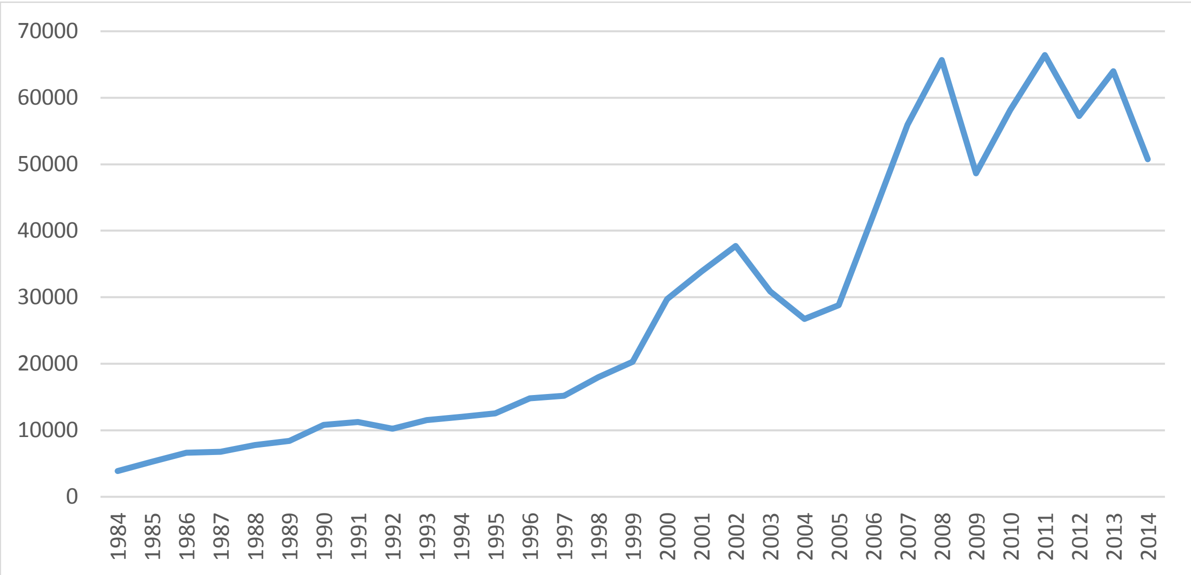

Figure 13. Mineral statistics – North West Province annual sales, employment and earnings from 1984-2016 (Source: Quantec, 2018)

The growth of the mining sector in the North West Province is paramount in this discussion, contributing somewhat to the Regional Gross Domestic Product of the province and also to the productivity of the South Africa economy. With a weakening Rand a greater reach into the international markets, the development of some of South Africa most prestigious mining companies have had a significant impact on the development and contribution to the South Africa economy.

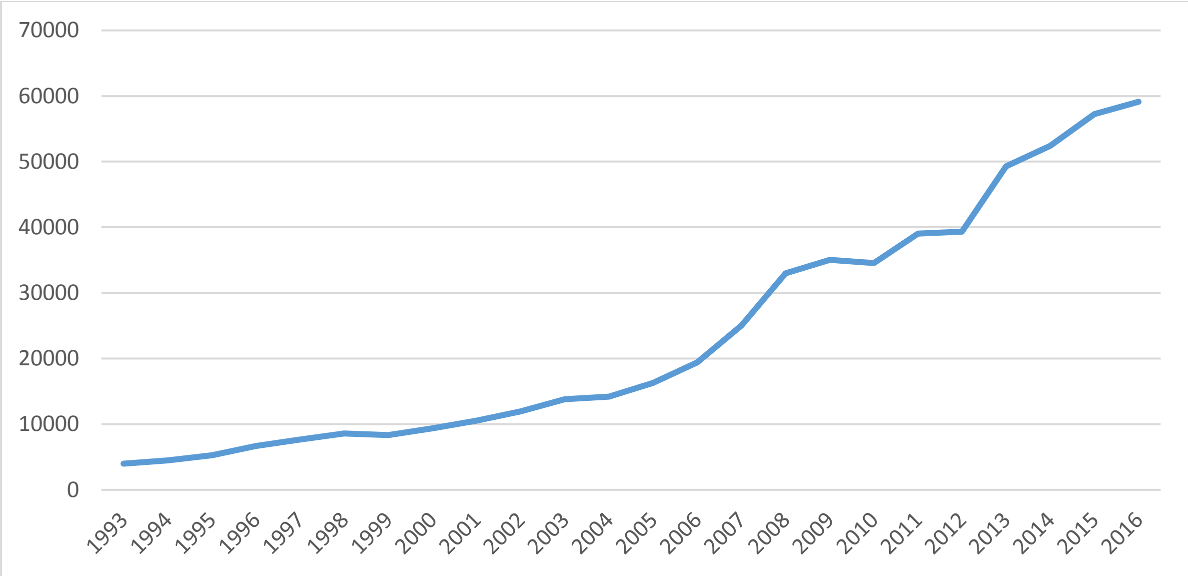

Figure 14. Total Investment into North West Province from 1993-2016 (Source: StatsSA, 2018)

The overall investment inflows into the province has grown proportionately with investment into SA as a whole. A particular growth of investment into the province was most noticeable post the 2008 financial crisis, and currently speaking, overall investment continues to grow post 2016. This investment is critical for the region, as it leads to job creation, and expands the contribution of the North West Province to the overall South African Economy.

However, the growth of tourism is quite remarkable and requires some discussion.

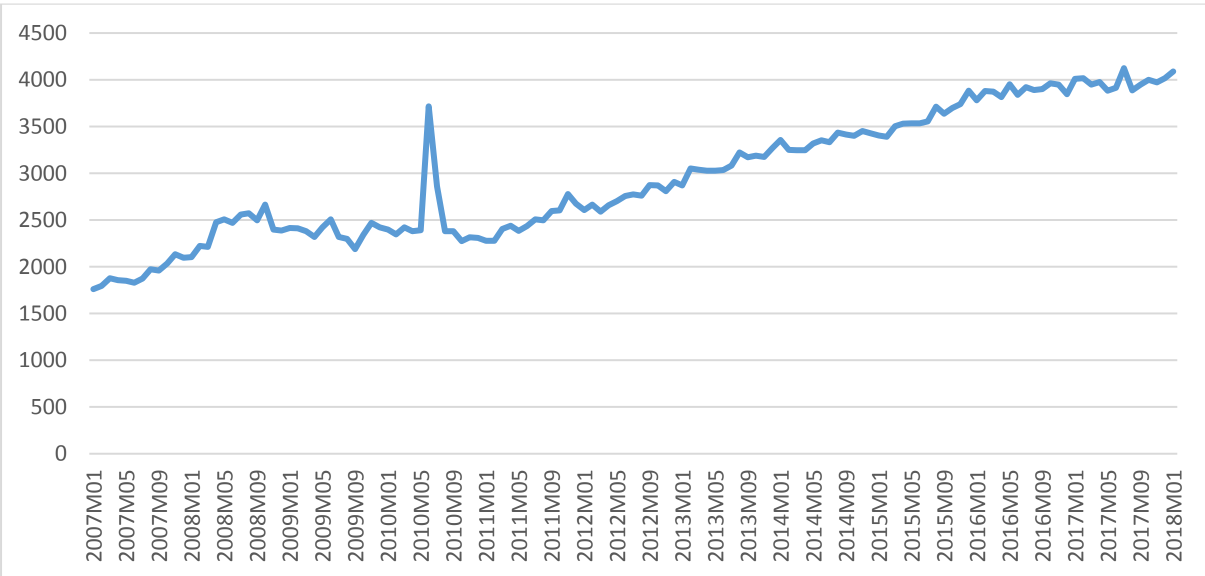

Figure 15. Income from tourist accommodation, 2007 to 2018, South Africa (Source: StatsSA, 2018)

The levels of growth in tourism for South Africa post the 2008 financial crisis is quite remarkable. The mitigating affects for the North West Province include game farming and the overall general catering and accommodation industries. Tourism is quite an important income for South Africa. Nationally speaking, in 2001 only 5 million arrivals were reported but by 2015 this had grown to 15 million (IRR, 2017). The inflow of tourism into this region will have a positive impact on the employment of the North West Province.

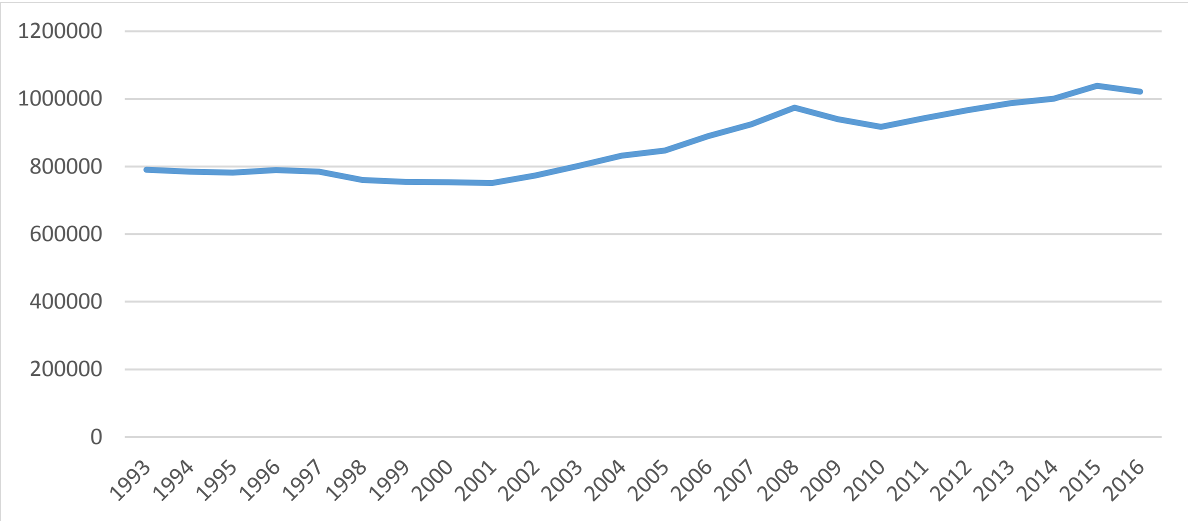

Figure 16. Total Employment 1993-2016 (Source: StatsSA, 2018)

Job creation is very low in South Africa. Official employment levels nationally sit at around 39%, and for the NWP it is estimated to be slightly lower at 37.1 %. For the Ngaka Modiri Molema area it is at 29.2% and for the Naledi area, this figure is as high as 42.6%. Across the region, the greater portion of the employed persons is greatest in the formal sector. For the reasons of the study specifically referring to the Ngaka Morodiri Molema and Naledi regions, the not economically active portion of the population is at about 48% and 43% respectively.

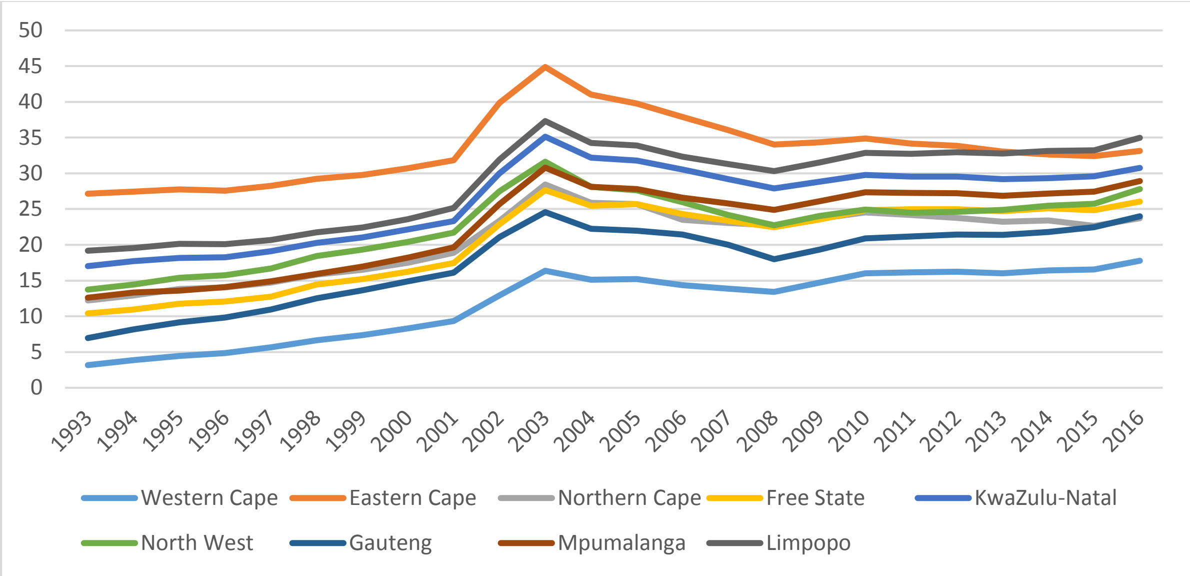

Figure 17. Comparison of unemployment rate by province, 1993 to 2016. (Source: StatsSA, 2018)

The unemployment rate in the North West Province, comparatively is situated approximately halfway between the Eastern Cape which shows the highest unemployment rate and the Western Cape which shows the lowest unemployment rate. The North West Province follows the movement with that of the rest of the national average for unemployment, and is influenced by much of what happens both locally within the province and internationally, such as the global financial crisis, international trade issues, the demand for South Africa goods and growth of the world economy. While there are underlying reasons of differences in unemployment between provinces, it is the overall construct of the North West Province and the level and development of its economic sectors which also have an influence.

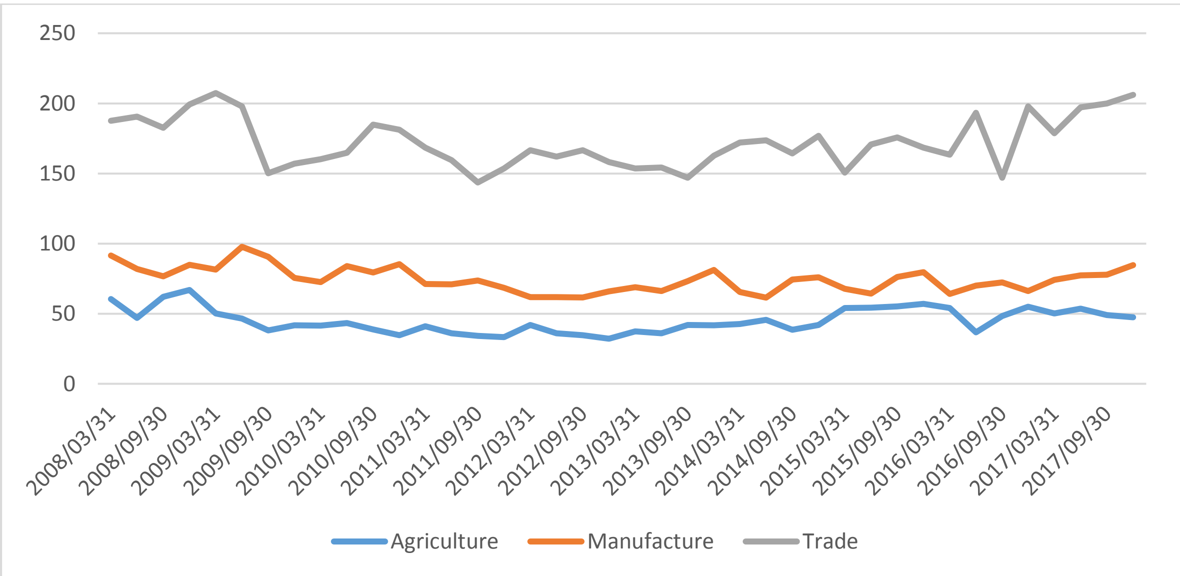

Figure 18. Employment by Sector for the North West Province, 2008 to 2017. (Source: StatsSA, 2018)

Employment by sector shows that the agricultural sector contributes towards the lowest number of job opportunities within the North West Province, with manufacturing and trade exceeding the agricultural sector by quite a significant portion.

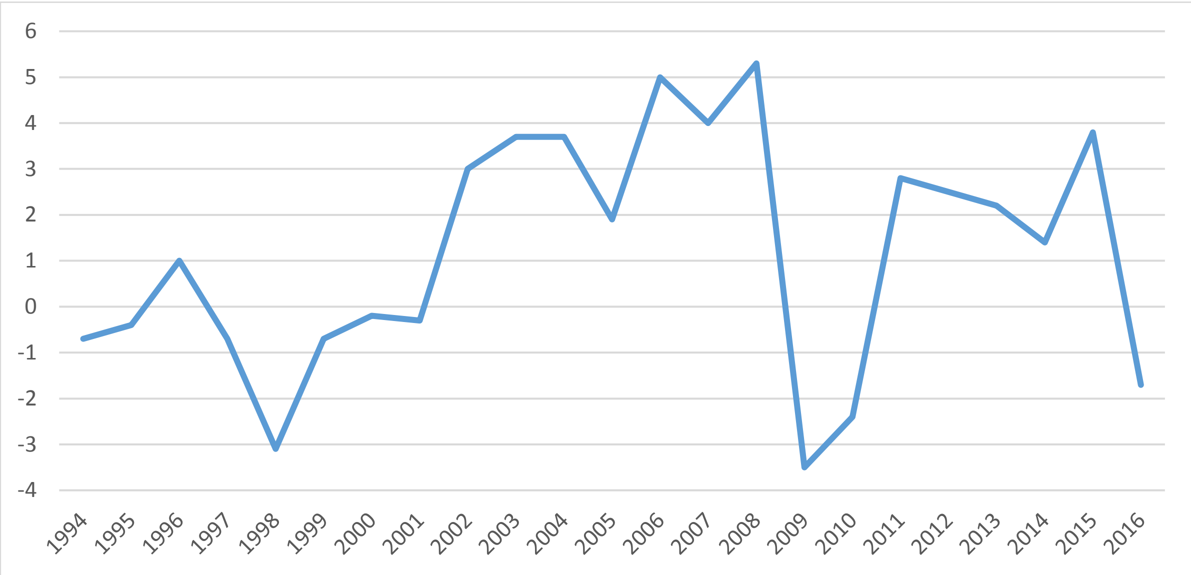

Figure 19. Percentage change in Total Employment 1994-2016 (Source: StatsSA, 2018)

A large challenge faced by the North West Province is that the change in employment is extremely erratic, shifting from periods of job growth to job losses, much of which is related to environmental factors, which would naturally influence the agricultural sector and changes in global economy which will have a remarkable effect on the mining sector, which, as mentioned earlier are the largest of the two sectors which are responsible for employment within the region.

This has an impact on household behavioural dynamics. Much of the population of the region, are related to the informal portions of the Ngaka Morodiri Molema and Naledi regions. Household savings are negative for most of the North West Province.

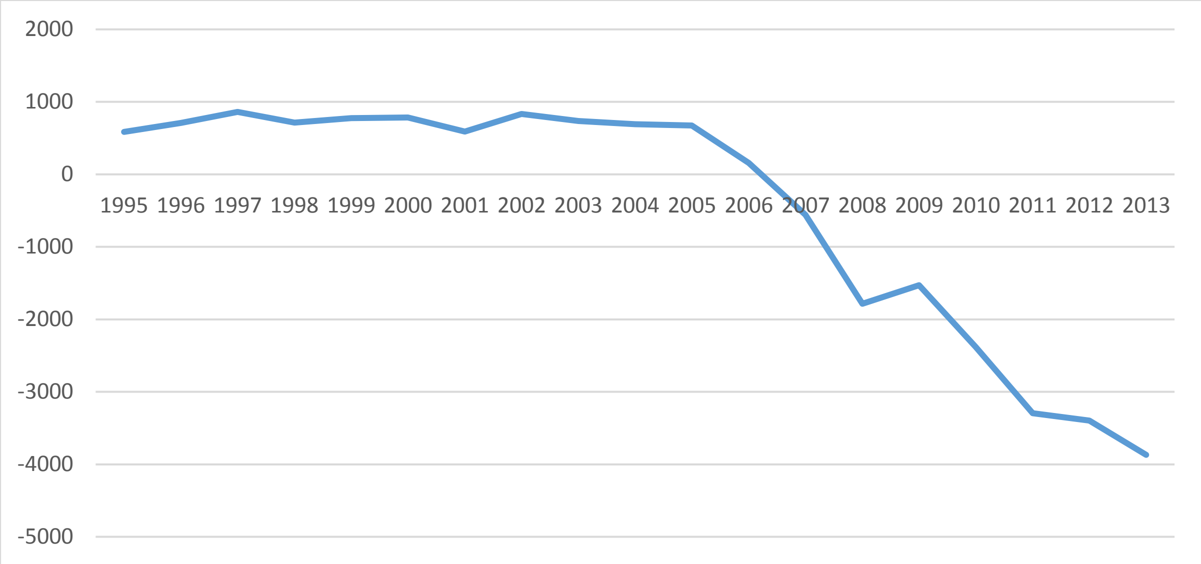

Figure 20. Average household savings 1995-2013 (Source: StatsSA, 2018)

This is a major concern as many of the households find it difficult to meet their basic needs. The number of households in the North West Province is estimated to be at about 1248765 households, and divided between the Ngaka Morodiri Molema and Naledi regions it would equate to 269975 and 20692 households for each of the regions respectively. Within the region, it is estimated that between 41% and 35% of the households within the Ngaka Morodiri Molema and Naledi regions are headed by woman, which is incidentally the demographic proportion which is subjected to the highest level of poverty and inequality.

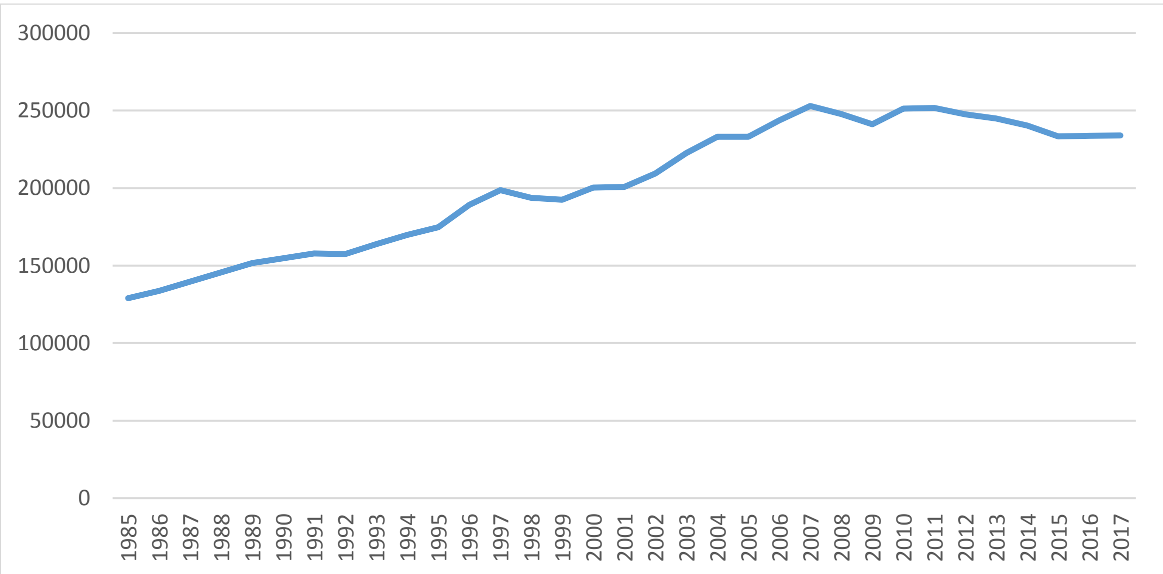

Figure 21. Electricity available for national distribution, 1985-2017 (Source: StatsSA, 2018)

Access to basic services such as electricity and water are still a rather large concern, with 7% of the North West Province population still does not having access to electricity. Neither do the Ngaka Morodiri Molema and Naledi regions, which could increase from 7% to 15.3%, respectively, with the Naledi region the worst affected.

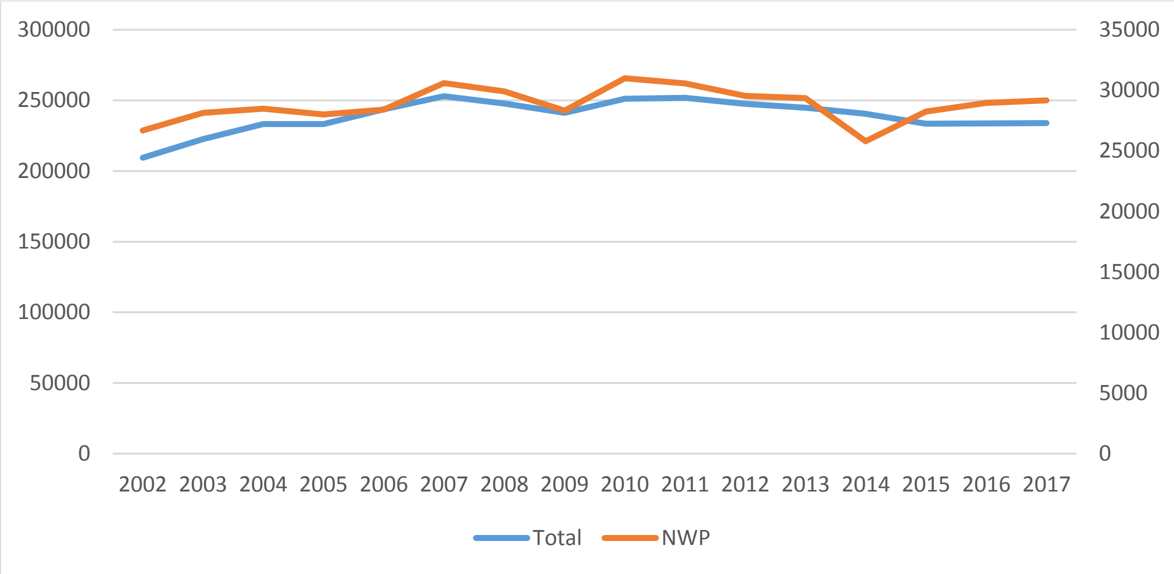

Figure 22. Comparing Eskom energy distribution nationally and for the North West Province, 2002-2017 (Source: StatsSA, 2018)

The overall population of the North West Province is 3 748 435 (less than 10 percent of the national population of 55 635654). The population density of this province is rather less densely comprised, with a mean age of 25, and the majority, 97.5% of the people within the Ngaka Morodiri Molema and Naledi regions, born in South Africa. Annual household income for the Ngaka Morodiri Molema and Naledi regions is between R14600 and R29000. This region is also subjected to only 32.6% and 37% of the Ngaka Morodiri Molema and Naledi regions populations respectively having acquired a matric qualification or higher (Wazimap, 2011).

5. Macroeconomic impact assessment analysis of the proposed Mookodi – Mahikeng 400 kV line for the North West Province

The existing electricity network structure in the North West Province is being upgraded so as to better cope with the rising demands of an increasing economy, growing population and the shifting structural nature of industrialisation, as South Africa approaches the era of the fourth industrial revolution. It is therefore critical to ensure an adequate electricity supply is maintained in order to cater for the future demands of the existing Watershed substation area, including Lichtenburg, which extends to the Mahikeng town. This will bolster economic growth of the region and support employment opportunities. This in turn will help alleviate some of the socio-economic challenges associated with high levels of poverty and inequality. It is highly likely that the proposed project will have a positive economic impact for the receiving area.

However, for certain affected landowners across whose land the intended powerlines will cross, the impacts are perceived as negative by the landowners, as the proposed development of the network encroaches on existing agricultural, farming, residential or manufacturing land. The public participation programme has drawn attention to the concerns of certain landowners but it must be noted that the negotiation process for the purchasing of servitude rights for the proposed powerline has yet to start.

This portion of the report will examine issues of concern during different phases of the project, namely; the construction phase and the operations phase[1].

5.1 Possible Impacts associated with the construction phase

Impacts associated with the construction phase of the project are usually of a short time period. The movements of machinery and labour are temporary in nature, but could have long term effects on the surrounding environment, especially within the 55m servitude lane where the majority of the construction and implementation will be happening. The 55m servitude is cleared of all objects that may interfere with the laying of the network, including natural and manmade features.

The following impacts are anticipated during the construction of the proposed transmission line:

5.1.1 Impact on job opportunities

The construction of transmission lines does not usually create a large number of job opportunities. Due to the social character of the population within the study area, and specifically along the 180km corridor designated for this project, including Vryburg and Lichtenburg, job opportunities could be accessible for those living in or near the corridor. This should still be viewed as a social benefit as the limited number of job opportunities, despite been temporary in nature, could still have some positive economic impact on the communities. Thus from the perspective that additional incomes will induce local spending which in turn will have a positive spill over via the multiplier effect. The instance of cash remittances to other areas will also occur, as some of the specialised labour will be brought into the area. The proposed project could further result in capacity building through skill transfer via on-site training and additional skills development opportunities.

[1] Some of the arguments raised in this section have been identified in a report by Envirolution Consulting, in a report subitted in 2008.

5.1.2 Influx of Jobseekers

Due to the nature of unemployment and the low levels of skills available in this area, there will be a significant influx of jobseekers to the construction areas. Cumulative impacts in this regard include conflict between outsiders and locals (characteristic of the insider outsider hypothesis), additional pressure on infrastructure and services and the continued migration of outsiders remaining in the area after the project has been completed.

Another study demonstrated that the construction of power transmission lines indicates a moderate creator of employment, with approximately 30 to 80 unskilled workers and 5 to 10 semiskilled workers which can be sourced, other than the skilled teams utilised by the contractor (MasterQ Research, 2010). A number of points need to be mentioned within this section, and this includes, amongst others, accommodation facilities, migration and proximity movement of workers, infrastructure disturbances, health and safety, access to farms and possible theft and damage to areas outside the 55m corridor, etc.

Projects of this nature occasionally involve the development of accommodation sites which house the temporary construction workers. This could impact on the daily living and movement patterns of local inhabitants and land owners in the area, with movement patterns having an impact in the area on those living in close proximity to construction activities. Cumulative impacts include misbehaviour of some construction workers at the construction site and possible mismanagement which could impact on safety and security concerns, social conflict and environmental problems.

Construction related activities, such as the increase in construction vehicle activity on the local roads, and possibly on the new roads which will be built to access the sight. What is particularly important is to note, that construction work, which is undertaken on private property could also have a negative impact on those property owners' daily living and movement concerns. These impacts could also include possibly impact on the noise pollution during construction activities, particularly where construction takes place in close proximity to dwellings situated in low ambient noise areas, such as those areas located within agricultural land. It should be noted that the noise generated from this project will only be temporarily generated and if construction activities adhere to all relevant legislation in this regard, and limit construction activities to normal working hours, the impact is anticipated to be minimal.

The proposed routes that may need to be crossed or those routes that are in close proximity to existing infrastructure such as roads and railway lines may impact on, during the construction phase, which may be temporary. In this regard the impact may also hinder business or social activities at or during the time of the project.

Resettlement in specific areas, especially in the high-density informal sectors or in areas where informal settlers have erected dwellings within vacant servitudes, are highly likely. Only once the preferred route alignment has been determined, will the real significance and intensity of this impact be established. The intensity of the impact on agricultural activities would depends largely on the type of activities undertaken on the properties as well as the location of the transmission line on each of these properties. Irrigation equipment could also be negatively affected and the severity of this impact would therefore need to be further assessed.

Health related impacts during the construction phase of the proposed project is possible. Inadequate accommodation facilities for jobseekers and workers could also result in health risks due to environmental pollution. Safety and security impacts include construction related risks and accidents, vehicle accidents, the perceived increase in crime as a result of outsiders being in the area and the possible increased risks of veldt fires.

5.2 Operational Phase Social impacts

The operational phase of transmission lines is a long term process, and the impacts usually associated with this phase are therefore associated with the maintenance undertaken during the operational phase, which is infrequent, yet may have some short-term impacts.

These intermittent impacts will periodically occur during the operational stages of the proposed project. There are a limited number of job opportunities for local business or job opportunities for local labourers with the exception of the clearing of the servitude and ongoing general maintenance activities. An inflow of workers during the operational phase is expected to be extremely limited, which would only be during maintenance work undertaken on the lines. The range of any negative impacts during maintenance will depend on the number of specialists or specialised teams who would have to access private property during these times. The visual impact which again impacts on the sense of place and possibly on the daily living and movement patterns of residents.

The improvement in the electricity supply would result in positive economic spin-offs for both the Ngaka Modiri Molema and Naledi Regions and the province as a whole. Increased investor confidence in the North West Province may benefit through the capital deepening, and encourage investment into the region.

While Eskom compensates property owners based on market value of the land that is required for the construction and establishment of the transmission lines, it is not expected that the property owners would suffer a financial losses associated with the construction of the transmission lines.

However, the concept of 'Property Value' is increasingly interesting as there are most likely two different sets of possible impacts, one in the short run, where property value is most likely to decrease, and one in the medium to long term, where property values will remain unchanged or increase in line with property prices elsewhere. However, the fall in the value of property is related with how access to the servitude will be structured. This would be either through sterilisation, where the land is completely fenced off and not available for local economic activities, or alternatively the land which lies directly under the pylon, and activity is only disrupted during times of maintenance.

Agricultural holdings are smaller in size and the actual tower position, its size and servitude across such a property could have additional impacts on these property values. This impact will be mitigated through the outcome of the negotiation process. Another concern here is the planned future developments of the land, such potential traffic at the local airport (runway), and the potential impact on the farms where, as per a comment from a local resident, 'they would like to increase and intensify the existing land use activities in the future'.

5.3 Land Use

The installation of the infrastructure is planned for long term use. Towers and other structures may limit development or change of land use within the servitude after construction is complete. However, based on the level of the negotiations between the land owner and Eskom, normal activities in the area may continue below the powerlines. In the formalization process, the installed transmission lines will require appropriate registration of servitude, whereby no other land use may be allowed.

Although there is some variation between land uses in the alternative corridors, the area is primarily used for agriculture, livestock, game-farming and residential. It is assumed that the compensation of landowners will mitigate this impact. The greatest concern relates to the area lost to the tower footprints and the narrow strip required for tower dressing, no significant disturbance to agricultural land is envisaged. The sterilisation of such land and the erection of fencing could be a major concern to land owners, as Eskom does not permit houses to be built within the servitude of overhead powerlines.

5.4 Roads and Traffic

The powerlines will cross over number of farms, railway line and local and provincial roads. For example, near Setlagole, the powerline crosses the N18. The powerline will not impact on normal traffic during the operation time frame with the exception of minor maintenance activities along the roads.

5.5 Visual Impacts

Visual and aesthetic impacts will result from the construction activities of excavation, erection of towers and transporting of materials. In most areas the construction activities will however be of short duration. Once in place the powerline will have an aesthetic/visual impact.

5.6 Heritage

The risk of archaeological features such as graves and old infrastructure such as farmsteads and bridges which exist and could result in the removal or damage of these resources during construction of excavations, access roads or during the establishment of residential sites. Considering the limited footprint presented by overhead powerlines and associated towers this potential is considered to have a low impact. However, concerns have been raised about the existence of ancient indigenous fauna and flora (specifically the locally occurring Camel Thorn trees) which needs to be protected and preserved, and thus must be a priority consideration during the construction and maintenance process.

5.7 Noise, air, health and safety.

The movement of machinery and vehicles will constitute an additional source of noise to the study area. However, this will be limited to the period of construction and mitigation can involve the use of equipment fitted with noise abatement technology (where possible) and the restriction of construction to certain days and times. Dust will be generated during construction activities. Other potential sources of air pollution would include exhaust fumes from machinery such as tractors, vehicles, trucks, cranes, loaders, generators and other motorised machinery.

6. Examining key microeconomic considerations of affected parties within the proposed routes

The impact of the development of the transmission lines will have implications on the numerous microeconomic concerns faced by the individuals situated within the region that is affected by the development of the 400kV powerlines that will connect Watershed B Substation to Mookodi and Pluto, respectively.

Please note that the specifics of this study does not allow that each and every major concern be addressed. From a microeconomic perspective, certain key points were extracted from the participation process, and addressed in such a way as to provide additional qualitative information relating to the project concerned.

Microeconomic Consideration	Possible Impact
Local participation, certain individuals wish to be a part of the construction process.	Local participation on a project is critical as the benefits of investment into the local region should be encouraged, and the benefits will be best realised if locals are allowed to participate as it may add value to the local community.
The loss of valuable grazing land. Especially if a fence is installed on both sides of the powerline.	Negotiations around the use of land after the transmission cables are installed must be structured so as to allow access to the land within the 55m servitude, in order to minimise impact. Previous studies have shown that the placing of power transmission lines on agricultural land does not usually impact farming activities. This is as both dry land agriculture and certain types of irrigated agriculture (crop cultivation and grazing) can continue underneath power lines (MasterQ Research, 2010).
The use the N18 should be reconsidered as many respondents urge for this idea.	Eskom undertook and investigation of An alternative along the N18 was investigated but was far less feasible according to the Multi-criteria Decision-Making Model (MCDM).
Leasing the farm and intention to build a game lodge with an airstrip.	The concept of how the project may affect leasing of a farm is a question of the legalities underling the arrangement between land owner and lease, but the nature of farming activity is important. The issue of future ambitions is very difficult to quantify. However after construction of the transmission lines, future developments can be done around the new development.
The damage to grazing land.	Two effects, namely the short run and the long run effects of the transmission. Short run

Microeconomic Consideration	Possible Impact
	issues deal with construction and land recovery post transmission line instillation. The long term effects depends on how access to the 55m servitude is decided, and the potential for future developments within the servitude corridor. The critical issue of land sterilisation must be carefully dealt with here. Previous studies have shown that if the transmission power lines impact on the agricultural productivity of land along the various corridor routes it may therefore also affect output of the agricultural and forestry industries and the viability of specific operations along the route, which in turn will impact on employment (MasterQ Research, 2010).
Possible fencing off of the powerline	Two effects, namely the short run and the long run effects of the transmission. Short run issues deal with construction and land recovery post transmission line instillation. The long term effects depends on how access to the 55m servitude is decided, and the potential for future developments within the servitude corridor. The critical issue of land sterilisation must be carefully dealt with here.
Fragmentation of the small property	Two effects, namely the short run and the long run effects of the transmission. Short run issues deal with construction and land recovery post transmission line instillation. The long term effects depends on how access to the 55m servitude is decided, and the potential for future developments within the

Microeconomic Consideration	Possible Impact
	servitude corridor. The critical issue of land sterilisation must be carefully dealt with here.
The housekeeping of the construction domain after the powerline is installed	The long term effects depends on how access to the 55m servitude is decided, and the potential for future developments within the servitude corridor. The critical issue of land sterilisation must be carefully dealt with here.
The magnificent Camel Thorn trees over 100 years old are an outstanding feature of this farm.	This is a question of heritage, and the impact would extend to beyond the negotiation process, and should be consider in this case.
Concerned that the fertility of my stud cattle will be affected by the proposed project.	The powerline is expected to have minimal effect on animals grazing underneath the powerline. A study was undertaken by Eskom (2006) which assessed the impact of EMF from powerlines and the results were inconclusive which indicated that there is no evidence that EMF has a definite impact on cattle fertility.
The security of the farm owners and workers as unfamiliar workers will obtain access.	Short run issues deal with construction. Here Eskom and its expertise in the matter will need to be addressed.
Concerned about my farms property value decreasing due to the proposed powerlines.	Eskom is offering compensation for devaluation of property. However, in the long run the real effect may be insignificant. Depending on visual aspects such as topography) to residential settlements or lifestyle estates, or where lines cross smallholdings/agricultural properties where value is derived from a natural setting. There are also strong indications from previous research that any property value impacts are cumulative for the construction of multiple lines in servitude, especially where smaller

Microeconomic Consideration	Possible Impact
	agricultural, smallholdings and residential properties are concerned (MasterQ Research, 2010).
Game farming and specialist game farming with accommodation for hunters and tourists. The concern is that the instillation of power transmission lines will affect the scenery and the experience for the tourist/client may be negatively affected.	This may have long term consequences, and if fences are erected, then entire areas of the farm may become unusable, and this is a large concern for this study. Maintenance of the transmission lines would also become a concern, for the safety of the workers running maintenance from both hunters and wildlife. This would interrupt business activities unlike the way in which regular agricultural or livestock farming activities would be influenced. Although there is no historic evidence that transmission power lines are a residential development inhibitor it is possible that the type of developments may change as a result of the location of the power line, and any residential developments that will derive their value from a rural character, farming environment or natural beauty may be affected (MasterQ Research, 2010).
Future plans for open cast mining or other mining activity is a concern for some of the land owners.	Once the land is zoned for the transmission lines, the prospects of a future established opencast mine should be dealt with at the time in the future when an open cast mine is established, and does not fall within the constraints of the existing report. Another study showed that if the corridor crosses any areas where improvements in fixed capital goods or improvements such as land rezoning, land subdivision, infrastructure, installations or buildings are found these may

Microeconomic Consideration	Possible Impact
	have to be removed or relocated. This requirement may in turn neutralise other fixed capital improvements (MasterQ Research, 2010).

7 Considering the Future Value Scenario

In the research article by Teegala and Singal (2015), it was mentioned that a typical transmission line project's total life includes the planning and design stage, implementation stage, operation stage and replacement stage. Many energy utilities follow a standard cost management process, it reflects the investment cost only to a certain extent i.e. the design and construction phase of the project. Even though this phase has a major share of the total line investment, but cost of line losses, faults, repair times, operation and management costs must also be considered in evaluating the total life cycle costing of the project.

It is from this perspective that, in order to evaluate the cost of transmission lines, macro-economic factors which depend on the country's economy should be considered including possible changes from time to time. Net present value (NPV) analysis is a widely accepted form for evaluation which helps to analyse alternatives for capital cost estimation. Net Present Value can be defined as the present value of cash flows. The analysis is conducted for a pre-determined time span and discounted to the present cash flows with a discount rate. Net Present Value (NPV) is calculated by using the following formula:

$$NPV = \sum_{n=1}^{t} \frac{CFn}{(1+i)^n} - I_p$$

Where n is the operating lifetime, i is the discount rate and *CFn* is the cash flow in the nth year, and I is the initial cost of the investment or capital cost. The capital investment *(I)* for a new transmission line consists of the cost of developing and building the structures, conductors, civil works, engineering, administration and management.

The uncertainties associated with predicting changes in future interest and inflation rates should be taken cognisance of when applying Net Present Value analysis when undertaking this form of analysis. Net Present Value uses the concept of time value of money which states that value of money at present and future is not the same.

$$FV = PV(1+i)^n$$

$$PV = FV(1+i)^{-n}$$

Where, PV is the present value of money, FV is the future value of money, i is the discount rate and n is estimated life of the project. The value $(1+ i)^{-n}$ and $(1+ i)^{n}$ are expressed as the present value factor and future value factor respectively.

The factors influencing the costs include local regulations, land rights and land purchasing, land, construction material and labour cost, etc. Out of these, the land rights are going to be highly variable and site specific.

$$I_p = A_t \; x \; CL$$

$$A_t = W \; x \; 10^3 m^2/km$$

I_p is the total cost of land, A_t is the total area in m^2 for the required Route and *CL* is the per unit land cost in R/m^2 or R/hectare. The value of per unit land cost is dependent on the local real estate market conditions and thus, is highly dynamic in nature. The total area per kilometre for the required Route width W, and can be calculated by multiplying the Route width W with by the length of the corridor.

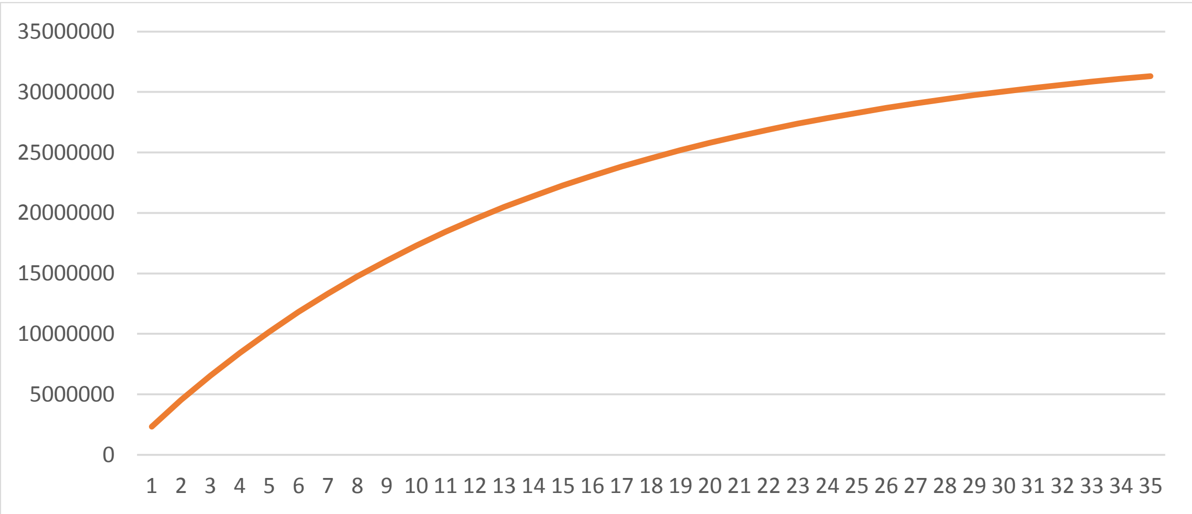

Figure 23. Estimated Net Present Value of a 400kV Transmission Line over a 35 Year Span. (Source: Estimated data derived from Teegala & Singal, 2015)

The use of a break-even analysis is defined as the cost at which the investment for the overhead transmission line becomes equal. Alternatively, it can be shown that breakeven point can be determined by considering the cost of land as reference used for construction of these lines (Teegala & Singal, 2015). It is from this perspective that a forward breakeven analysis procedure should be treated with caution and that the final outcome of this is an estimate only. As the difference in capital cost for each route of the project chosen is going to be large, mainly due to the economic, social, geographic, demographic and environmental variables, which are subject to exponential increases, with respect to the useful life, within each of the respective routes.

Land value becomes a central concern as how the land is used will greatly influence the value of that land. Determining the value of agricultural, livestock and game farming land is usually a function of the return to that land given how the land will be used. Land may be valued or taxed differently depending on its use. For example, prices may vary depending on whether the land is available for growing annual cash crops or for other farming activities, such as trees which take a long time before harvest, or if the land is going to be used for collateral or sold for development. Other questions that are important to a South African context is, is the land heritage or tribal land context, in which case there will be additional factors applied to determine the value of that land (Cowart, 2017).

In a study by Osano, Rouget, Turpie, Thuiller and Balmford (2011), livestock and crop production are the two main land uses that could conflict with conservation (game farming). Estimating the foregone profit from limiting livestock production involves quantifying potential losses that could be incurred from stock reduction. In this study it was estimated that the cost of partial loss of benefits of landownership to landowners, of retaining areas, for other use by calculating the difference between the predicted current land price (i.e. with natural vegetation retained) and the predicted land price if all remaining natural habitat were to be fully converted to agriculture, minus the estimated costs of the transformed land, which is, economically spoken, the opportunity cost (Osano, et al., 2011).

$$Opportunity\ Cost = \left[\frac{NPV}{Area}\right] - Conversion\ Cost$$

$$NPV = (LVF - LVP)$$

Area refers to the farmland portion consisting of natural vegetation; LVF refers to the estimated price of the farm if it is 100% transformed, and LVP refers to the estimated price of farm at the present level of transformation. Choosing a discount rate is important to accurately reflect the opportunity cost (Osano, et al., 2011). In other words, it is important that the analysis should consider the asking price with the potential income generated by the farm (Coleman, 2015) while much of the capital costs in the present day power transmission systems are due to the cost of equipment and construction process (Teegala & Singal, 2015).

8. Strategy applied to consider an Optimal Route

When deciding the best route, certain key fundamental considerations were addressed, and these include within the Multi-criteria Decision-Making Model, namely; topography and slope, water bodies, land use and infrastructure, other powerlines, urban residential areas, biodiversity and heritage (BOSA, 2017).

8.1 Assessment Criteria

The assessment was designed using several categories, namely, a technical, an environmental, a social and strategic categories. The technical category relates to the impact of a specific route alignment with regard to achieving the technical goals of the project while reducing cost and increasing ease of both construction and maintenance activities. The environmental category explores the need to select a route that minimises the risk to ecosystem functioning and environmental integrity. The Social category investigates the impact of route alignment on people by specifically avoiding residential areas, areas where assets and livelihoods may be affected (e.g. the loss of agricultural land for tower structures, the impact on tourism activities in game farm areas) and the need for compensation. Finally, the strategic category investigates aspect relates to proximity to growth areas (BOSA, 2017).

The weightings used in the selection process include: 25% for technical, 35% environmental. 35% social and 5% for strategic. The selection criteria is shown in the table below which is a summary of the selection criteria proposed in this study. It must be noted that due to the limitations in data and available information, standard economic analysis tools (e.g., production cost models) capture only a portion of transmission-related benefits, and therefore, much of the estimates made in this study are based on assumptions and proportions.

Table 1. Summary of selection criteria used in this study, 2018 looking at routes WM1, WM4, WM9 and WM13.

Route	**WM1**	**WM4**	**WM9**	**WM13***
Technical (0.25)	18.48	25.62	18.48	25.38
Environmental (0.35)	18.05	16.84	13.79	47.41
Social (0.35)	16.51	18.49	28.09	32.16
Strategic (0.05)	20	20	20	20
Overall	54.3	62.6	63.8	99.8
Length (km)	185	186	184	175
Agriculture (% land used)*	30	30	40	30

Livestock (% land used)*	30	20	30	35
Game Farming (% land used)*	10	10	10	20
Residential (% land used)*	30	40	20	15
Manufacturing (% land used)*[2]	0	0	0	0
Units LOD	206	493	181	496

(Source of data: Estimates based on site visit (2018), Google Earth (2018), BOSA, (2017), Land Owners Database, (2018))

8.2 Property Value Profile

Land cost per hectare depends much on the province as it does on the use of the land. According to estimates based on the HSRC, using information derived through the restitution process, is that the cost of land for the North West Province (between 2009 and 2014) is estimated to range on average from R2159 to R2754 per hector (IRR, 2017). According to Coleman (2015) in a report estimated that averages for arable land sold for R6 000/ha in 2001 and later those prices rose to R50 000/ha in 2013. Grazing land prices increased during the same period from R50/ha five decades ago to R800/ha in 2001 and R5 000/ha in 2013 (Coleman, 2015).

Table 2. Economic impact, synopsis and impact value, short term and long term[3].

Impact[4]	Brief Synopsis
Impact on rural Agricultural and residential values	Value of land will decrease in the short run. In the long run, if there are benefits from additional investment, there will be long term benefits.

[2] The values donated in this table with a * are indicative of estimates made when visiting the region. A more detailed and accurate measure of the nature of the business is important to develop a more accurate estimate. The values do not include estimates of future ambitions by land owners as to what the future use of the land will be.

[3] Note: the value of the estimates is based on a 1-5 scale for both positive and negative sides of the spectrum with 1 representing a lower value (either positive or negative) and 5 indicating a stronger value (either positive or negative). For example, a short term effect could be estimated as having a strong negative impact, however, a slightly positive long term effect.

[4] Some of the core impacts correlate with economic impacts identified by MasterQ Research (2010).

Impact[4]	Brief Synopsis
Forfeit of Development opportunities due to project activity	Once the land is zoned for transmission lines, further development thereof is not possible.
Sterilisation of land	This will impact mostly on mobility of within the land and have different impacts on different types of land use.
Loss and removal of capital goods and improvements	This will be moderate in that the area is largely under-developed. Been mostly rural agricultural, there is potential impact in long term development.
Impact on output and employment	There will be short term gains, but with the added benefit of attracting additional investment into the region, this will have a long term potential benefit.
Economic Injections as a result of the activity	This will be of a short term nature, with employment mostly influencing short term low skilled workers, with possible spill over into the local communities. Specialised high payed workers will be brought into the area, and mush of that income will have a remittance effect. Skill transfer will positively affect the area.
Economic Sustainability	The fundamental effect of the project is to reduce inequality by increasing future growth and possible prospects in the region.
Impact on rural Tourism Accommodation Game Farming	The development of transmission lines will have its greatest negative effect on tourism, spill over to accommodation and related industries. Greatest impact in the short run, with little improvement of those properties improving in the long run.

The main economic features along the proposed routes include mainly agricultural farming, leaning more towards livestock and game farming. Land sterilisation due to the nature of the farming activity will be influenced by the impact of the development of the line transmissions. Due to a lower intensity of development along all routes proposed on this project, property value and capital goods impacts, loss of agricultural and forestry land, and production and forfeit of development opportunities is expected, for much of the route, to be moderate. Yet, in the case of Game farming and tourism, along all routes, the negative impact could be quite high. All corridor routes are similar in this respect. However, several course deviations have been recommended to avoid areas of high economic importance.

8.2 Assessment Schemata

The process used in the analysis of the economic impact is in line with the Regulation 31(2) (l) of the NEMA (Act 107 of 1998), where each potential impact is identified and is clearly described including whether the potential impact will have a positive or negative outcome on the economy and is assessed in terms of the following factors: The extent of the impact (spatial scale) i.e. Will the impact affect the national, regional or local environment, or only that of the site. The duration (temporal scale) i.e. the estimated time that the impact will last. The magnitude (severity) i.e. is the impact mostly positive or negative. The probability (likelihood of occurring) i.e. estimate the likelihood that the impact will occur (Urban-Econ Development Economists, 2016).

For the purpose of this study, the impact assessment is based on sound validated scientific information which has been gathered, analysed and assessed. Professional judgement in the context of the specific project and site conditions has been applied to this so as to enable a scientific approach for the determination of an economic value linked to each factor.

The following ranking scales are applied in this context.

Probability (weighting)	**Duration**
0 – Improbable 0.25 – Low probability 0.5 – Medium probability 0.75 – Highly probable 1 – Definite	1 – Immediate 2 – Short term (0-5 years) 3 – Medium term (5-15 years) 4 – Long-term (ceases with the operational life) 5 – Permanent
Magnitude	**Extent**

-1 – Negative +1 – Positive	0 – None 1 – Site only 2 – Local 3 – Regional 4 – National 5 – International

The assessment will be based on the criteria listed in table 2. The significance of the impact will be equal to the combined effects of the duration, extent and magnitude, multiplied by the probability. The probability will be estimated from each of the individual routes, given information derived from table 1.

Significance for each route = (Duration x Extent x Magnitude) x weighting[5]

The maximum value should determine achieved would indicate the most favourable route given the formula. Appendix 1 shows the calculations for each scenario given the different options. A greater positive value will reflect a greater positive economic impact. However, a negative impact will show a negative economic outcome and the greater the negative value will imply the greater the negative impact.

8.3 Findings of Assessment

Scenario	**WM1 (Option 1)**	**WM13 (Option 2)**	**WM4 (Option 3)**	**WM9 (Option 4)**
1. Emphasis on Game Farming and Tourism	0.615542522	0.927859238	0.831524927	0.625073314
2. Emphasis on Agriculture	0.61346443	0.933765182	0.823689994	0.629080393
3. Emphasis on Livestock Farming	0.626828998	0.923342557	0.808057554	0.641770891
4. Excluding BOSA	0.628442797	0.898569915	0.841366525	0.631620763
5. Emphasis on Equal Agricultural	0.615980944	0.935599827	0.811650065	0.636769164
6. Simulating a Negative Impact[6]	-0.410361681	-0.618572825	-0.554349951	-0.416715543

[5] Formula for assessment is based on but not limited to a study on the Proposed 134 kV Powerline in the Nelson Mandela Bay Municipality (2016).

[6] The negative simulation is calculated by increasing the impact duration on future developments but for a larger area of the region. This could be useful when simulating a negative economic environment induced through other macroeconomic factors, exogenous to the model. In this case it may be possible to mitigate the outcome, but an interesting finding is that the negative impact for option four is also very large.

Six possible scenarios have been developed putting emphasis on different elements of this model for each of the possible scenarios. Scenario one examines the economic outcome on each of the possible routes by focusing on the importance of game farming, Scenario two and three emphasise agriculture and livestock farming respectively. Scenario 4 excludes the potential considerations used by Eskom in the BOSA study when developing possible route alternatives. Scenario five examines the economic impact with equal emphasis on each of the different farming sectors. Scenario 6 simulates an overall negative impact on all the routes proposed.

From this estimate based on 5 possible scenarios, it is clear that Option 2 (Route WM13) is, based on this analysis, the recommended route given the analysis presented above. However, it must be stressed that the scenarios presented above reflect the principal of caeteris paribus ("other things held constant"). There are many factors which could result in a negative impact of this project. This is simulated in scenario 6, where the impact of Option 2 (Route WM13) shows the greatest negative economic impact. Route 3 would be the second best option based on the criteria presented in this study.

9. Conclusion, and Recommendations

Given the economic environment of South Africa, and the socioeconomic structure of the North West Province, the need to extend the electricity network is paramount and is in line with the agenda of the IDP (IDP, 2012). In order to ensure sustainability of the economy, promote a sustainable future, it is advisable that the Government, through Eskom, continue on a path of expansion and development.

From the findings of this research, the implementation of the proposed Mookodi-Mahikeng 400kV Line is necessary. However, here are some points of consideration that needs to be mentioned regarding the externalities associated with this project.

- The impact on tourism will be most likely felt through the visual influence of the powerlines. This impact will most likely be negatively felt by the game farms, where people who visit such farms wish to enjoy the experience of untouched nature. This negative impact will spill over to jobs through a multiplier process, possibly influencing hotels, resorts and accommodation. Alternatives such as underground tunnelling or even making use of main roads should be re-considered. The long term impact of this should not be underestimated as the impact will influence local, and possibly regional and national levels.
- In some cases, land near or under powerlines could be used productively, especially in the case of livestock and agriculture. The 'sterilisation' of land is a very important point which should be dealt with in such a way as not to harm farming activities, block the movement

of wildlife and people, and not interfere with existing efficiency. The concept of Pareto efficiency suggests that if you can improve the life of just one person, without harming anybody else, then this should be dealt with accordingly. It would be important that when the lines are constructed, that they are constructed in a way that minimises any form of disruption to local activity.

- The 'compensation' must be dealt with in a transparent fashion and must take into consideration the long term effect as per the real implications to land owners.
- The gap between the environment and the economy is extremely narrow. The environment is a large part of the local economy, and any decision relating to the environment will have long term effects on the economy.
- The benefits of skill transfers, remittances of incomes, local economic development are all benefits which will occur due to the project. With great likely hood, the investment into the project will have both short term befits and long term effects.
- Any development strategy of this project should bear in mind that while there is the greatest positive economic impact shown in this study using possible positive outcomes, the possible negative outcomes are also quite stark and should be considered as a whole in this analysis. From this perspective, the negative concerns identified in the study should be carefully mitigated so as to minimise the risk and possible long term consequences.

The national economy can only benefit from such an investment, and this will most likely be felt on an international level as there is scope of international investment into the North West Province. However, the negative influence as raised by the local residents should and must be taken into consideration, and such concerns need to be mitigated in such a way as not to harm the economy on even the most microeconomic of levels. This study has been developed by developing its assumptions on the current economic environment. If these current environment should change, then the findings of this report should be reassessed.

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Appendix Tables: Possible Scenario Simulations

Scenario 1: Emphasis on Game Farming

Route	WM1	WM4	WM9	WM13	Weighting	WM1	WM4	WM9	WM13
Overall BOSA	54.3	62.6	63.8	99.8	0.1	5.43	6.26	6.38	9.98
Length (km)	185	186	184	175	0.05	9.25	9.3	9.2	8.75
Agriculture (% land used)*	30	30	40	30	0.2	6	6	8	6
Livestock (% land used)*	30	20	30	35	0.15	4.5	3	4.5	5.25
Game Farming (% land used)*	10	10	10	20	0.35	3.5	3.5	3.5	7
Residential (% land used)*	30	40	20	15	0.1	3	4	2	1.5
Manufacturing (% land used)*[1]	0	0	0	0	0	0	0	0	0
Units LOD	206	493	181	496	0.05	10.3	24.65	9.05	24.8
					1	41.98	56.71	42.63	63.28
						0.205180841	0.27717498	0.20835777	0.30928641

	Duration	Extent	Magnitude	
Impact on rural Agricultural and residential values	5	3	-1	-15
Future development opportunities due to project activity	3	2.5	-1	-7.5
Impact on rural Tourism Accommodation Game Farming	5	1	-1	-5
Sterilisation of land	5	1	-1	-5
Loss and removal of capital goods and improvements	2	1.5	-1	-3
Impact on output and employment	4	3.5	1	14
Economic Injections as a result of the activity	5	2.5	1	12.5
Sustainability	4	3	1	12
Total score for current estimates				3

Total impact on each route

WM1	WM4	WM9	WM13
0.615543	0.831525	0.625073	0.927859

Scenario 2: Emphasis on Agriculture

Route	WM1	WM4	WM9	WM13	Weighting	WM1	WM4	WM9	WM13
Overall BOSA	54.3	62.6	63.8	99.8	0.15	8.145	9.39	9.57	14.97
Length (km)	185	186	184	175	0.05	9.25	9.3	9.2	8.75
Agriculture (% land used)*	30	30	40	30	0.2	6	6	8	6
Livestock (% land used)*	30	20	30	35	0.15	4.5	3	4.5	5.25
Game Farming (% land used)*	10	10	10	20	0.3	3	3	3	6
Residential (% land used)*	30	40	20	15	0.1	3	4	2	1.5
Manufacturing (% land used)*[1]	0	0	0	0	0	0	0	0	0
Units LOD	206	493	181	496	0.05	10.3	24.65	9.05	24.8
					1	44.195	59.34	45.32	67.27
						0.204488143	0.27456333	0.20969346	0.31125506

	Duration	Extent	Magnitude	
Impact on rural Agricultural and residential values	5	2	-1	-10
Future development opportunities due to project activity	3	2.5	-1	-7.5
Impact on rural Tourism Accommodation Game Farming	5	2	-1	-10
Sterilisation of land	5	1	-1	-5
Loss and removal of capital goods and improvements	2	1.5	-1	-3
Impact on output and employment	4	3.5	1	14
Economic Injections as a result of the activity	5	2.5	1	12.5
Sustainability	4	3	1	12
Total score for current estimates				3

Total impact on each route

WM1	WM4	WM9	WM13
0.613464	0.82369	0.62908	0.933765

Scenario 3: Emphasis on Livestock Farming

Route	WM1	WM4	WM9	WM13	Weighting		WM1	WM4	WM9	WM13
Overall BOSA	54.3	62.6	63.8	99.8	0.15		8.145	9.39	9.57	14.97
Length (km)	185	186	184	175	0.05		9.25	9.3	9.2	8.75
Agriculture (% land used)*	30	30	40	30	0.2		6	6	8	6
Livestock (% land used)*	30	20	30	35	0.3		9	6	9	10.5
Game Farming (% land used)*	10	10	10	20	0.15		1.5	1.5	1.5	3
Residential (% land used)*	30	40	20	15	0.1		3	4	2	1.5
Manufacturing (% land used)*[1]	0	0	0	0	0		0	0	0	0
Units LOD	206	493	181	496	0.05		10.3	24.65	9.05	24.8
					1		47.195	60.84	48.32	69.52
							0.208942999	0.26935252	0.21392363	0.30778085

	Duration	Extent	Magnitude	
Impact on rural Agricultural and residential values	5	2	-1	-10
Future development opportunities due to project activity	3	2.5	-1	-7.5
Impact on rural Tourism Accommodation Game Farming	5	2	-1	-10
Sterilisation of land	5	1	-1	-5
Loss and removal of capital goods and improvements	2	1.5	-1	-3
Impact on output and employment	4	3.5	1	14
Economic Injections as a result of the activity	5	2.5	1	12.5
Sustainability	4	3	1	12
Total score for current estimates				3

Total impact on each route

WM1	WM4	WM9	WM13
0.626829	0.808058	0.641771	0.923343

Scenario 4: Excluding BOSA

Route	WM1	WM4	WM9	WM13	Weighting		WM1	WM4	WM9	WM13
Overall BOSA	54.3	62.6	63.8	99.8	0		0	0	0	0
Length (km)	185	186	184	175	0.05		9.25	9.3	9.2	8.75
Agriculture (% land used)*	30	30	40	30	0.25		7.5	7.5	10	7.5
Livestock (% land used)*	30	20	30	35	0.2		6	4	6	7
Game Farming (% land used)*	10	10	10	20	0.35		3.5	3.5	3.5	7
Residential (% land used)*	30	40	20	15	0.1		3	4	2	1.5
Manufacturing (% land used)*[1]	0	0	0	0	0		0	0	0	0
Units LOD	206	493	181	496	0.05		10.3	24.65	9.05	24.8
					1		39.55	52.95	39.75	56.55
							0.209480932	0.28045551	0.21054025	0.29952331

	Duration	Extent	Magnitude	
Impact on rural Agricultural and residential values	5	2	-1	-10
Future development opportunities due to project activity	3	2.5	-1	-7.5
Impact on rural Tourism Accommodation Game Farming	5	2	-1	-10
Sterilisation of land	5	1	-1	-5
Loss and removal of capital goods and improvements	2	1.5	-1	-3
Impact on output and employment	4	3.5	1	14
Economic Injections as a result of the activity	5	2.5	1	12.5
Sustainability	4	3	1	12
Total score for current estimates				3

Total impact on each route

WM1	WM4	WM9	WM13
0.628443	0.841367	0.631621	0.89857

Scenario 5: Equal Agriculture

Route	WM1	WM4	WM9	WM13	Weighting		WM1	WM4	WM9	WM13
Overall BOSA	54.3	62.6	63.8	99.8	0.2		10.86	12.52	12.76	19.96
Length (km)	185	186	184	175	0.05		9.25	9.3	9.2	8.75
Agriculture (% land used)*	30	30	40	30	0.2		6	6	8	6
Livestock (% land used)*	30	20	30	35	0.2		6	4	6	7
Game Farming (% land used)*	10	10	10	20	0.2		2	2	2	4
Residential (% land used)*	30	40	20	15	0.1		3	4	2	1.5
Manufacturing (% land used)*[1]	0	0	0	0	0		0	0	0	0
Units LOD	206	493	181	496	0.05		10.3	24.65	9.05	24.8
					1		47.41	62.47	49.01	72.01
							0.205326981	0.27055002	0.21225639	0.31186661

	Duration	Extent	Magnitude	
Impact on rural Agricultural and residential values	5	2	-1	-10
Future development opportunities due to project activity	3	2.5	-1	-7.5
Impact on rural Tourism Accommodation Game Farming	5	2	-1	-10
Sterilisation of land	5	1	-1	-5
Loss and removal of capital goods and improvements	2	1.5	-1	-3
Impact on output and employment	4	3.5	1	14
Economic Injections as a result of the activity	5	2.5	1	12.5
Sustainability	4	3	1	12
Total score for current estimates				3

Total impact on each route

WM1	WM4	WM9	WM13
0.615981	0.81165	0.636769	0.9356

Scenario 6: Simulating a possible negative impact

Route	WM1	WM4	WM9	WM13	Weighting		WM1	WM4	WM9	WM13
Overall BOSA	54.3	62.6	63.8	99.8	0.1		5.43	6.26	6.38	9.98
Length (km)	185	186	184	175	0.05		9.25	9.3	9.2	8.75
Agriculture (% land used)*	30	30	40	30	0.2		6	6	8	6
Livestock (% land used)*	30	20	30	35	0.15		4.5	3	4.5	5.25
Game Farming (% land used)*	10	10	10	20	0.35		3.5	3.5	3.5	7
Residential (% land used)*	30	40	20	15	0.1		3	4	2	1.5
Manufacturing (% land used)*[1]	0	0	0	0	0		0	0	0	0
Units LOD	206	493	181	496	0.05		10.3	24.65	9.05	24.8
					1		41.98	56.71	42.63	63.28
							0.205180841	0.27717498	0.20835777	0.30928641

	Duration	Extent	Magnitude	
Impact on rural Agricultural and residential values	5	3	-1	-15
Future development opportunities due to project activity	5	2.5	-1	-12.5
Impact on rural Tourism Accommodation Game Farming	5	1	-1	-5
Sterilisation of land	5	1	-1	-5
Loss and removal of capital goods and improvements	2	1.5	-1	-3
Impact on output and employment	4	3.5	1	14
Economic Injections as a result of the activity	5	2.5	1	12.5
Sustainability	4	3	1	12
Total score for current estimates				-2

Total impact on each route

WM1	WM4	WM9	WM13
-0.410362	-0.55435	-0.41672	-0.61857

Appendix 6H: Social Impact Assessment

PROPOSED MOOKODI-MAHIKENG 400KV POWERLINE, NORTH WEST PROVINCE

Social Impact Assessment

May 2018

Final

Prepared for: Eskom Holdings (SOC) Ltd

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Title and Approval Page

Project Name:	Proposed Mookodi-Mahikeng 400kV powerline
Report Title:	Social Impact Assessment
Authority Reference:	14/12/16/3/3/2/1056
Report Status	Final

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Amendments Page

Date:	Nature of Amendment	Amendment Number:
15 April 2018	Draft	00
31 May 2018	Final	01

Executive Summary

Eskom Holdings SOC Ltd proposed the construction of the Mookodi-Mahikeng 400kV powerline in the North West Province in order to increase the supply and assurance of supply to Mahikeng and Lichtenburg. The project consists of an approximately 180-kilometre-long 400kV powerline, the extension of the existing Mookodi Substation and construction of the new Mahikeng Substation.

Nemai Consulting was appointed to carry out the Social Impact Assessment (SIA) which is a specialist study to the Environmental Impact Assessment for the project.

The project is located mainly inside the Naledi, Ratlou and Mahikeng Local Municipalities.

Project Alternatives

Four route alternatives were provided for analysis. Each route option was considered with a two-kilometre-wide corridor, which allows final placement of the route to take place once final design has been completed. A No-Go option was also considered by the study.

Route Option 1 (WM1) is approximately 186 kilometres in length. The route runs to the south and west of Vryburg and heads in a northeasterly direction, passing to the west of Stella. It then runs parallel to N18, and on to the Mahikeng Substation.

Route Option 2 (WM13) is approximately 176km in length. It travels from the starting point at the Mookodi substation, to the east of Vryburg, and travels in a northeast direction, passing Stella to the east and Setlagole to the west. This route crosses the N18 twice, once near Vryburg and for the second time near Setlagole.

Route Option 3 (WMV4a) is approximately 187km in length. It passes Vryburg to the south and the west. It then travels in a northwest direction towards Stella. The route crosses the N18 to pass Stella to the east and re-crosses the N18 after Stella, to continue along the N18 to the west. The power line then follows the N18 until Setlagole, where it turns to the northwest.

Route Option 4 (WM9a) is approximately 185km in length. The route passes to the east of Vryburg, crossing the N18, the R34 and the N14. The route then crosses back over the N18 to run parallel to the road to the west. It passes Stella and Setlagole to the west.

Methodology

The following activities were conducted as part of the SIA: defining the study area; detailing the project scope; a situation analysis describing the social status of the study area, engagement with stakeholders through public participation process; an impact assessment and recommended mitigation measures to reduce the identified impacts. The report concludes with an alternative analysis which makes recommendations with regards the preferred alternative from a social perspective.

Situation Analysis

The land use in the area is predominantly agricultural. Crops are planted along some of the route of the proposed alternative options, with large areas being given over to grazing. Commercial agriculture dominates in the southern and central sections of the powerline route, traditional agriculture and rural dwelling patterns dominate the final third of the route, to the north.

All of the route options impact upon farm building and dwellings, smallholdings, irrigation pivots, commercial and industrial entities to differing extents. The site for the proposed Mahikeng Substation is located near the village of Lokgalong where scattered dwellings occupy the area proposed for the substation.

The study area is made up a population of 66 781, living within 18 572 households. In general, the rural households in the study area are impoverished and have low access to services such as water and sanitation. The urban households are relatively more wealthy and have been access to water, housing and employment opportunities.

Stakeholder Engagement

Stakeholder engagement was carried out using two approaches. First using public participation process during the EIA and later as part of this SIA during site visits to the proposed locations. Stakeholders involved in the engagement were landowners, community groups, the respective Local Municipalities as well as the Traditional Authorities. During this engagement the following social and economic issues were identified: noise; land acquisition; security issues; traffic; land capability; land use; and direct local economic benefits derived from the project.

Identification of Activities, Aspect and Impacts

Impact assessment started with the identification of the high risk project activities and the social aspects of the project which create impacts.

The social impacts of the proposed development were divided into categories and were identified as follows:

Impacts owing to and extended and more secure electricity supply;

Impacts due to land acquisition and the establishment of servitude rights;

- Partial loss of livelihood on the part of landowners
- Reduced access to productive land
- Development constraints within the sub places

Impacts Due to Scheme Operations;

- Economic growth and induced impacts
- Opportunity for local business.
- Employment of local people
- Skills development
- Safety concerns

Impacts occurring at the construction phase;

- Security Concerns
- Damage to property or equipment
- Damage or wear to access roads
- Improvement of access in the project area
- Proximity to construction work and associated inconvenience and dangers.
- Employment of local people
- Sourcing of equipment, machinery and services locally
- Noise
- Pollution of remaining waste material
- Safety concerns (road safety)
- Dust
- Influx of workers
- Employment of local people
- Temporary road closures
- Increased traffic
- Loss of vegetation
- Improved access to amenities

<u>Mitigation Measures</u>

Relevant and appropriate mitigation measures are proposed in the report and the implementation of these mitigation measures is expected to reduce the social impacts of the project to lower levels.

The manifest benefits to the region of a more secure and extended electricity supply were covered by the study.

The final routing of the 400kV powerline and the selection of the proposed Mahikeng substation site are considered to be the primary mitigation measures of the project. The routing and the selection of the site should be carried out so as to avoid impacting upon existing development as far as possible. Where not possible, the suggested mitigation measures provide for the compensation of any losses that may be encountered during the pre-construction, construction, operation and decommissioning phase of the project.

Local labour and business stand to benefit from the economic stimulus of construction of the proposed project. As a result, mitigation measure encourages active participation of the local community.

Disturbances that may occur during construction phase can be successfully mitigated through contractor agreements and discussions with the directly affected parties which are in close proximity to the project and through regular monitoring throughout the construction phase.

Discussion of Alternatives

The ‘No Go’ option, where the project was not to go ahead was not supported owing to the benefits to be derived from the project and there being no social fatal flaws evident from the study.

The alternative route selection was based on selecting a route which would create the least number of impacts, which would have the lowest long term effect on the development of rural towns and with a consideration of the length of the route.

Route option 2 was considered to be the preferred option. This option has the advantage of being the shortest of the four routes under consideration. It impacts upon relatively few farm buildings and the lowest number of irrigation pivots. However, it impinges upon the most smallholdings and commercial enterprises, passing as it does to the east of Vryburg. This route crosses the N18 twice as well as railway line and avoids the centre of Setlagole.

Summary and Conclusion

This study assesses the social impacts which would be created as a result of the proposed project. As expected, development and construction creates both positive and negative impacts and whilst the positive impacts are accepted, the negative impacts can be successfully mitigated through route selection and careful tower placement within the selected route corridor.

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List of Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ASGISA	Accelerated and Shared Growth-South Africa
DEA	Department of Environmental Affairs
DFA	Development Facilitation Act (Act 67 of 1995)
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMPr	Environmental Management Programme
HIV	Human Immunodeficiency Virus
ISO	International Standards Organisation
kV	Kilovolt
LM	Local Municipality
MP	Main Place
NDP	National Development Plan
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NSDS	National Skills Development Strategy
NU	Non-Urban
PAJA	Promotion of Administrative Justice Act (Act No. 3 of 2000)
PGDS	Provincial Growth and Development Strategy
PSEDS	Provincial Spatial Economic Development Strategy
SEIA	Socio-Economic Impact Assessment
SIA	Social Impact Assessment
SMME	Small, Medium or Micro Enterprise

1 INTRODUCTION

Eskom Holdings SoC Limited has proposed the Mookodi Mahikeng 400kV Powerline, located the North West Province, to improve the security of electrical supply to Mahikeng and eventually to Lichtenburg and the surrounding area. The proposed Mookodi-Mahikeng 400kV Powerline Project is one of the several projects underway to alleviate constraint problems which are together referred to as the Watershed Strengthening Scheme.

The powerline is proposed to run from the Mookodi Sub-Station, which is located near Vryburg, to the Mahikeng Sub-station, located in Mahikeng. The approximate length of the line is 180 kilometres.

Vryburg is located to the south west of Mahikeng with the towns being connected along the N18 route. Stella and Setlagole lie along the N18 between Vryburg and Mahikeng.

Nemai Consulting was appointed as the independent Environmental Assessment Practitioner by Eskom Holdings (SOC) Ltd to undertake the Environmental Authorisation process for the development of the proposed Mookodi Mahikeng 400kV Powerline.

One of the specialist studies required by the Environmental Impact Assessment (EIA) is a Social Impact Assessment. This report fulfils the requirements of the Social Impact Assessment and its recommendations will be included into the EIA.

1.1 Terms of Reference

The terms of reference for the study are as follows:

- Determine the specific social, land utilisation and acquisition implications of the project.
- Collect baseline data on the current social environment.
- Gather an understanding of the social landscape of the project area through the following actions:
  - Attend and review minutes of public and individual stakeholder meetings; and
  - Review of the formally submitted commented for the project.
- Assess the social impacts of the project, both positive and negative;
- Suggest suitable mitigation measures to address the identified impacts; and
- Provide recommendations on the preferred route alternative from a social perspective.

1.2 Structure of the report

The remainder of the report is structured as follows:

Section 2: Legislation – A description of the statutory and regulatory requirements that inform this report.

Section 3: Project Description – This section provides an introduction and motivation to the project. It includes a description of the study area.

Section 4: Methodology – Outline the methodology used to determine the social impacts of the proposed project.

Section 5: Situational Analysis – A desktop analysis of the baseline situation in the study area. The section includes a discussion on the findings that resulted from community engagement, site visits and stakeholder participation.

Section 6: Identification of Activities - Aspects and Impacts – The identification of the project activities and an investigation into what aspects of these activities will result in social impacts.

Section 7: Analysis of Alternatives – Decision making with regards the preferred project alternatives from a social perspective.

2 LEGISLATION

Legislation, policy, plans and strategy provide an important framework and governance of the SEIA. This section provides a summary of the acts, policy, plans and strategy which were considered by this study.

2.1 Constitution of the Republic of South Africa (Act 108 of 1996)

As contained in the Constitution the rights of all South Africans are protected as outlined in Chapter 2: The Bill of Rights. These rights form the basis of democracy in South Africa. The Constitution (including the Bill of Rights) binds the Legislature, the Executive, the Judiciary and all organs of state and is the overriding legislation of South Africa.

While all items in the Bill of Rights are considered to be of equal importance, key items in the Bill of Rights that have a bearing on social rights and issues in this project include (but are not necessarily limited to):

- Life: Everyone has the right to life;
- Human Dignity: Everyone has inherent dignity and the right to have their dignity respected and protected;
- Equality: Everyone is equal before the law and has the right to equal protection and benefit from the law;
- Freedom of religion, belief and opinion: Everyone has the right of freedom of conscience, religion, thought, belief and opinion;
- Environment: Everyone has the right to an environment that is not harmful to their health or well-being, and to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development;
- Property: No person may be deprived of property except in terms of the law of general application, and no law may permit arbitrary deprivation of property. Property may be expropriated only in terms of the law of general application for a public purpose or in the public interest. The public interest includes South Africa's commitment to land reform and to reforms to bring about equitable access to all South Africa's natural resources. Property is not limited to land;
- Health care, food, water and social security: Everyone has the right to have access to health care services, including reproductive health care, sufficient food and water and social security, including, if they are unable to support themselves and their dependents, appropriate social assistance;

- Language and culture: Everyone has the right to use the language and participate in the cultural life of their choice, but no one exercising these rights may do so in a manner inconsistent with any provision of the Bill of Rights;
- Cultural, religious and linguistic communities: Persons belonging to cultural, religious or linguistic communities may not be denied the right, with other members of the that community to enjoy their culture, practice their religion and use their language, and to form, join and maintain cultural, religious and linguistic associations and other organs of civil society. These rights must be exercised in a manner that is consistent with any provision in the Bill of Rights;
- Access to information: Everyone has the right of access to any information held by the state and any information that is held by another person and that is required for the exercise or protection of any rights; and,
- Just administrative action: Everyone has the right to administrative action that is lawful, reasonable and procedurally fair. Everyone whose rights have been adversely affected by administrative action has the right to be given written reasons. This right has been given effect via the Promotion of Administrative Justice Act ((PAJA) Act 3 of 2000).

2.2 National Environmental Management (Act 107 of 1998)

The National Environmental Management Act (NEMA) and the principles contained therein have a significant influence on the need to identify and assess socio-economic impacts. The NEMA principles are based on the basic rights as set out in Chapter 2 (Bill of Rights) of the Constitution.

According to Barber (2007:16) the following NEMA principles have an important impact on social issues:

- Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably;
- Development must be socially, environmentally and economically sustainable;
- Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option;
- Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons;
- Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures

may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination;

- The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured;
- Decisions must take into account the interests, needs and values of all interested and affected parties, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge;
- Community well-being and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means;
- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in light of such consideration and assessment;
- The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected;
- Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law;
- The environment is held in public trust for the people. The beneficial use of environmental resources must serve the public interest and the environment must be protected as the peoples' common heritage; and
- The vital role of women and youth in environmental management and development must be recognised and their full participation therein must be promoted.

2.3 Development Facilitation Act (Act 67 of 1995)

The Development Facilitation Act (DFA) outlines various principles concerning land development in Section 3 of the Act. Some of the relevant principles are briefly highlighted below (Babour, 2007). These principles include (but are not limited to:

- Promoting the integration of the social, economic, institutional and physical aspects of land development;
- Promoting integrated land development in rural and urban areas in support of each other;
- Promoting the availability of residential and employment opportunities in close proximity to or integrated with each other;

- Optimising the use of existing resources including such resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;
- Promoting a diverse combination of land uses, also at the level of individual erven or subdivisions of land;
- Discouraging the phenomenon of "urban sprawl" in urban areas and contributing to the development of more compact towns and cities;
- Contributing to the correction of the historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure in excess of current needs;
- Encouraging environmentally sustainable land development practices and processes;
- Promoting land development which is within the fiscal, institutional and administrative means of the Republic;
- Promoting the establishment of viable communities; and
- Promoting sustained protection of the environment.

2.4 Restitution of Land Rights Act 22 Of 1994

The aim of the Restitution of Land Rights Act 22 of 1994 is as follows:

- To provide for the restitution of rights in land in respect of which persons or communities were dispossessed under or for the purpose of furthering the objects of any racially based discriminatory law;
- To establish a Commission on Restitution of Land Rights and a Land Claims Court; and
- To provide for matters connected therewith.

2.5 National Development Plan (2011)

The National Development Plan (NDP) of 2010 proposes to “invigorate and expand economic opportunity through infrastructure, more innovation, private investment and entrepreneurialism.

The Plan aims to ensure that all South Africans attain a decent standard of living through the elimination of poverty and reduction of inequality. The core elements of a decent standard of living identified in the Plan are:

- Housing, water, electricity and sanitation;
- Safe and reliable public transport;
- Quality education and skills development;
- Safety and security;

- Quality health care;
- Social protection;
- Employment;
- Recreation and leisure;
- Clean environment; and
- Adequate nutrition.

2.6 North West Provincial Development Plan

The North West Provincial Development Plan (PDP) is based on the National Development Plan (NDP) and it has aligned its objectives and priorities with the NDP vision for 2030. The NDP aims to eliminate poverty and reduce inequality by 2030. The NDP offers a long term perspective. It defines a desired destination and identifies the role different sectors of society needs to play in reaching that goal. According to the plan, South Africa can realise these goals by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the state, and promoting leadership and partnerships throughout society.

The PDP has identified eight of the priorities identified in the NDP as key focus areas for the North West. The selected focus areas represent the main challenge areas hampering growth in the province. Particular focus will be placed on both the rural economy (due to the predominant rural character of the province) as well as on the upgrading, the provisioning and the maintenance of economic infrastructure as the precondition of overall economic growth and development and for its significant potential to sustain employment. The province will also prioritise the transformation of human settlements (mainly due to the challenges presented by housing and living conditions in mining communities) and the eradication of corruption. All of the above will be done while building and establishing a capable and developmental state. The chosen development priorities through which the North West intends to align itself to the NDP are:

- Economy and employment;
- Economic infrastructure;
- An integrated and inclusive rural economy;
- Human settlement and spatial transformation;
- Improving education, training and innovation;
- Building a capable and developmental state;
- Fighting corruption; and
- Transforming society and uniting the province

2.7 Provincial Growth and Development Strategy 2011

There are seven strategic objectives highlighted in the PGDS namely:

1. Job creation;
2. Human resource development;
3. Human and community development;
4. Strategic infrastructure;
5. Environmental sustainability;
6. Governance and policy; and
7. Spatial equity.

The document identifies unemployment, poverty and inequality as structural constraints to the Province's growth.

2.8 North West Province Economic Planning and Sector Development.

To facilitate economic research and planning processes that will stimulate integrated economic growth for North West Province through trade and industry development as well as through investment promotion.

The Programme aims to achieve the following:

a) To champion inclusive economic growth for North West Province through research, the development and review of economic development plans and strategies;
b) To exercise oversight that will inform a coordinated economic policy and strategy implementation;
c) To ensure economic and enterprise policy alignment across all spheres of government in line with the Provincial Development Plan.
d) To facilitate and coordinate the development and promotion of key economic sectors to stimulate economic growth.

2.9 International Organisation for Standardization, ISO 14001:2004

The International Organisation for Standardization (ISO) is used for identifying impacts. The ISO 14001: 2004 – Environmental Management Systems definitions for aspect, activity and impact are used in keeping with best practice.

ISO 14001:2004 specifies requirements for an environmental management system to enable an organization to develop and implement a policy and objectives and information about significant environmental aspects. It applies to those environmental aspects that the organization identifies as those which it can control and those which it can influence.

3 PROJECT DESCRIPTION

The proposed Mookodi-Mahikeng 400kV Power Line is the recommended augmentation option for the upgrade and assurance of the electrical supply to the Mahikeng/Lichtenburg area. The project is located in an area that is occupied by existing settlements, dwellings and farms. Ownership patterns in the project area include ownership by private individuals, municipalities and traditional authorities. The project area is rural, with small population centres surrounded by farmlands.

The proposed Mookodi-Mahikeng 400kV Power Line consists of the following infrastructure:

- A 180km transmission line;
- The new Mahikeng Substation, designed for 3 x 500MVA 400/132kV transformers;

The power line travels in a north-east direction from the Mookodi Substation near Vryburg, towards Mahikeng, ending at the Mahikeng substation. The project has proposed a number of route alternatives; each route alternative consists of a two-kilometre-wide corridor. The final placing of the power line within the corridor will be carried out once the final design has been completed. The final placing will also allow the project flexibility to avoid impacts identified by the environmental assessment process as well as to adjust to on-site conditions closer to the construction date. The final corridor will be fifty-seven meters wide.

3.1 Location

The proposed Mookodi- Mahijkeng 400kV powerline is located in the North West Province. The power line corridor passes through the following local municipalities:

- Naledi Local Municipality – all route alternatives;
- Ratlou Local Municipality – all route alternatives;
- Mafikeng Local Municipality – all route alternatives; and
- Kagisano-Molopo Local Municipality – small sections of route alternatives 1 and 4.

Figure 3 below provides a map of the various route alternatives proposed by the project and includes the boundaries of the local municipalities listed above.

Each local municipality is divided into wards. Wards are political sub-divisions with each ward represented by an elected ward councillor. The project corridor passes through various wards within each municipality. The directly affected Wards are illustrated, in **Figure 3,** which overlays the various route alternatives of the power line.

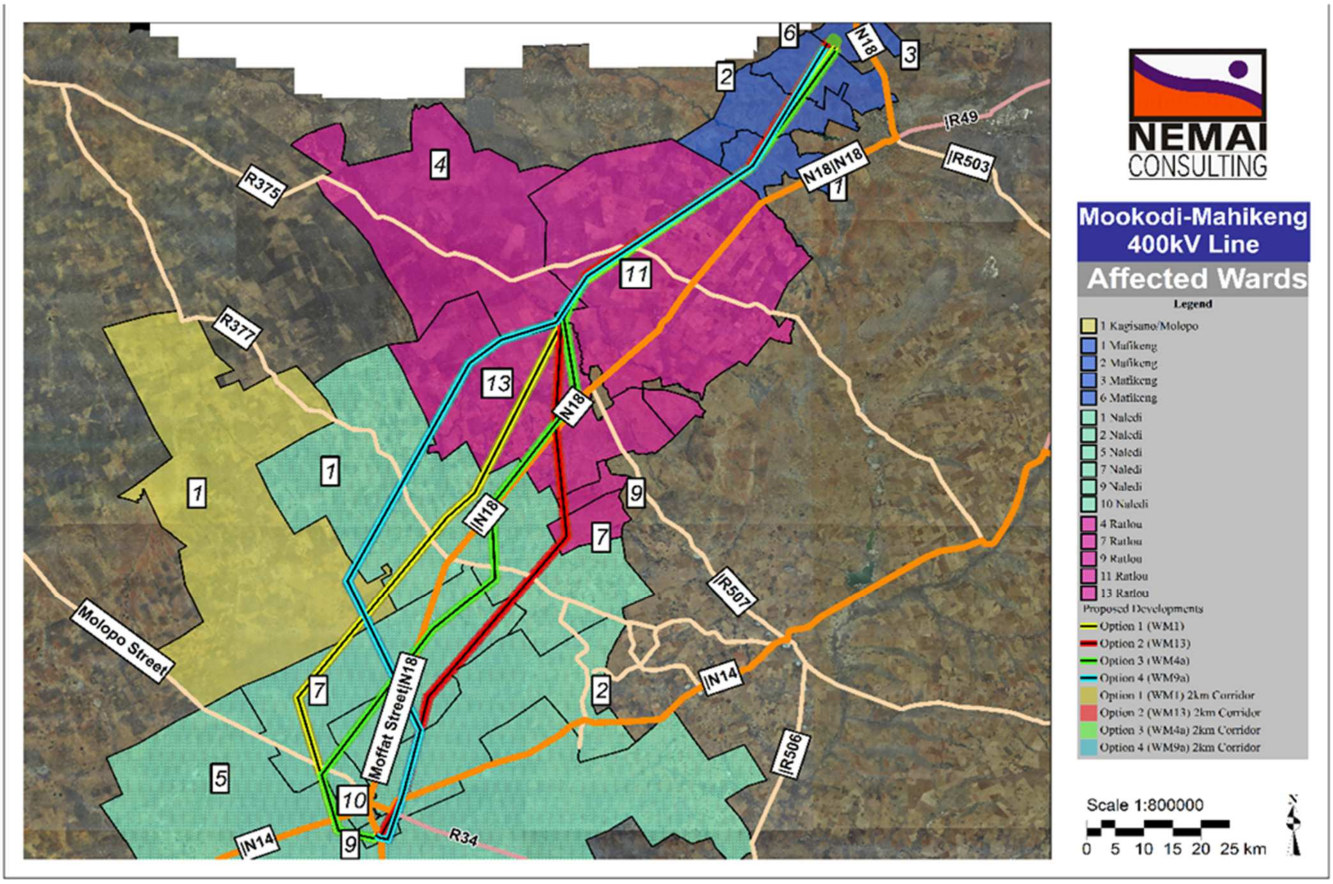


Figure 1: Map of the affected Municipal Wards within project area

The directly affected Main Places within the Wards and Local Municipalities for the proposed 400kV Mookodi-Mahikeng power line are listed in the table below. Main Places are the major subdivision of municipalities used by Statistics South Africa in their Census 2011.

Table 1: Affected Local Municipalities, Wards and Places

Local Municipality	Wards	Main Places
Naledi	1, 2, 5, 7, 9 and 10	Naledi NU, Stella Huhudi and Vryburg
Kagisano-Molopo	1	Kagisano NU
Ratlou	4, 7, 9, 11 and 13	Ratlou NU, Setlagole, Disaneng and Madibogo Pan.
Mahikeng	1, 2, 3 and 6	Madibe-Magelelo , Masutlhe , Modimola , Lekung , Tlapeng , Lokgalong , Miga and Mafikeng NU

The main places indicated in the table above are those taken from Census 2011. Their boundaries do not necessarily coincide with the ward boundaries, but the names have been used in this report to identify local features within the project study area.

The main settlements bordering the project study area are described in the table below

Table 2: Main Settlements Bordering the Project Study Area

Local Municipality	Settlement/Town Name	Description
Naledi	Vryburg	Regional economic node and population centre
Naledi	Stella	Secondary economic node, small population centre
Ratlou	Setlagole	Secondary economic node, large population centre
Mahikeng	Masutlhe	Small sized, rural, population centre
Mahikeng	Lekgalong	Small sized, rural, population centre
Mahikeng	Mogosane	Small sized, rural, population centre
Mahikeng	Modimola	Small sized, rural, population centre
Mahikeng	Madibe-Magelelo	Small sized, rural, population centre
Mahikeng	Madibe-Makgabane	Small sized, rural, population centre

3.2 Description of Route Alternatives

The proposed route alternatives for the project were selected using a Multi-Criteria Decision-Making Model Process (MCDM) conducted by Aurecon South Africa (Pty) Ltd against the criteria identified below.

- Social impacts
- Visual impacts; and
- Heritage impact.

Nemai Consulting conducted further screening of alternatives and removed one other route alternative since it was within the critically endangered Western Highveld Sandy Grassland biome.

As a result, the following four feasible alternative routes are considered by this report as feasible alternatives for the proposed powerline:

1. Option 1 (WM1);
2. Option 2 (WM13);
3. Option 4 (WM4a); and
4. Option 4 (WM9a).

The four route alternatives are discussed in more detail below. Each of the routes begin at the Mookodi Substation and end at the Mahikeng Substation. All of the differences between the route alternatives are limited to the first two thirds of the route. The final third of all routes follow the same corridor in a stretch that starts north of the R387 road crossing and ends at the Mahikeng Substation. This section of route travels through traditional authority land and is populated by low density settlements and rural homesteads. This section also passes the Mahikeng International Airport, approximately four kilometres distant.

3.2.1 Option 1 (WM1)

Option 1 (WM1) is approximately 186 kilometres in length. The route runs to the south and west of Vryburg and heads in a northeastly direction, passing to the west of Stella. It then runs parallel to N18, to the west. This route has several major road crossings: of the N14, the R378, the R377, the R376 and the R375. From this point on, the all route alternatives join where they run in a northeast direction to end in Mahikeng, at the proposed future substation site. **Figure 2** below provides a map showing route option 1 (WM1).

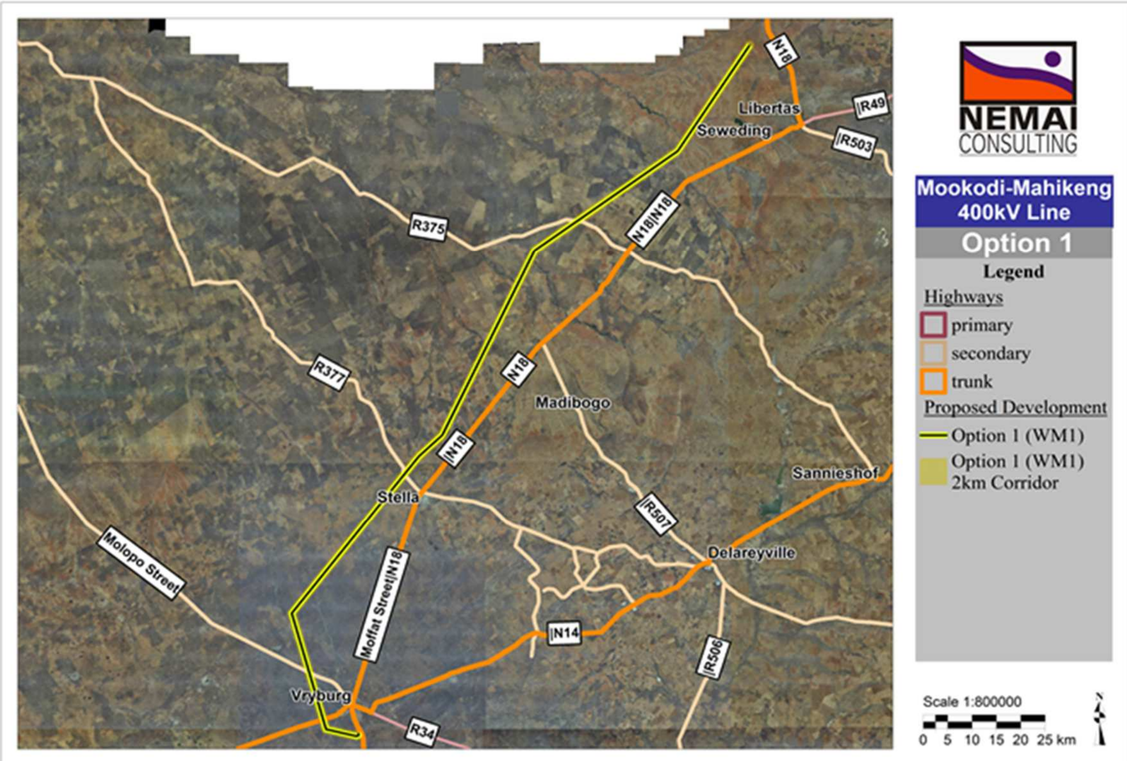


Figure 2: Route Alternative Option 1

3.2.2 Option 2 (WM13)

Option 2 (WM13) is approximately 176km in length. From the starting point at the Mookodi substation in Vryburg, the line passes to the east of Vryburg, and travels in a northeast direction, passing Stella to the east and Setlagole to the west. This route crosses the N18 twice, once near Vryburg and for the second time near Setlagole. The route also crosses the R34, the N14, the R377, the R376 and the R375. The route alternative then passes along the same common route towards the north east towards the site of the proposed Mahikeng Substation. A map showing this alternative is shown below as **Figure 3**.

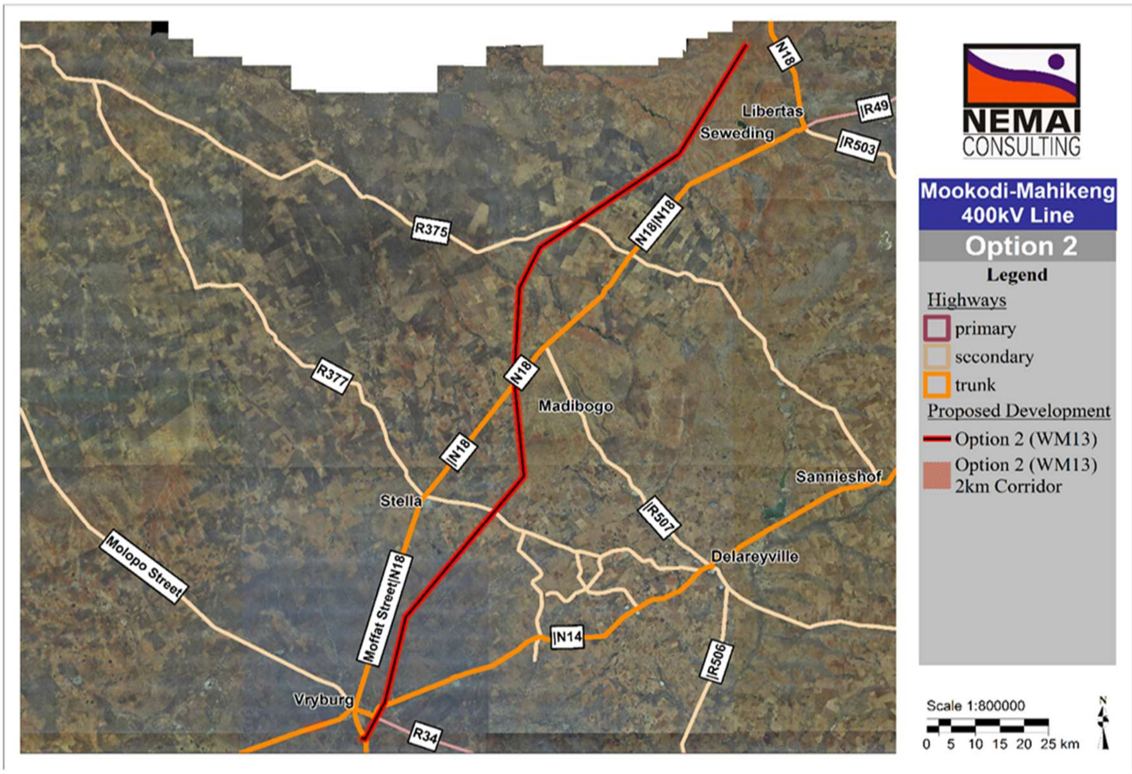


Figure 3: Route Alternative Option 2

3.2.3 Option 3 (WM4a)

Option 3 (WM4a) is approximately 187km in length and is similar to Option 1. The alternative starts from the Mookodi Substation and passes Vryburg to the south and the west. It then travels in a northwest direction towards Stella. The route crosses the N18 to pass Stella to the east and re-crosses the N18 after Stella, to continue along the N18 to the west. The power line then follows the N18 until Setlagole, where it turns to the northwest. This route then joins the common northern section for all of the route alternatives, until it reaches the site of the Mahikeng Substation. This route crosses the N14, the R378, the N18 twice, the R377, the R376 and the R375. The route alternative is shown in **Figure 4** below.

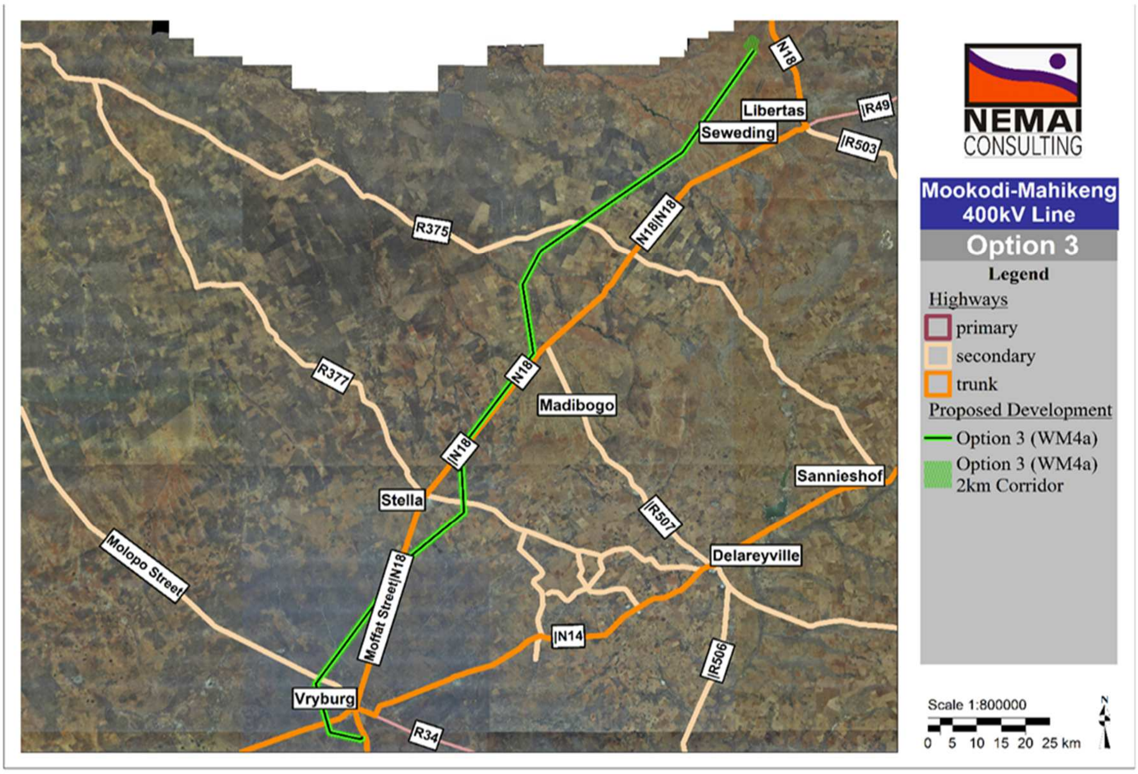


Figure 4: Route Alternative Option 3

3.2.4 Option 4 (WM9a)

Route Alternative Option 4 (WM9a) is approximately 185km in length, and is a hybrid of Option 2 in its southern portion and Option 1 in the central section. The route alternative passes to the east of Vryburg, crossing the N18, the R34 and the N14. The route then crosses back over the N18 to run parallel to the road to the west. It passes Stella and Setlagole to the west when it joins the common route to the north east, ending at the site of the Mahikeng Substation. This route crosses the N18 twice, the R34, the N14, the R377 and R376 and the R375.The route alternative can be seen in the map shown in **Figure 5** below.

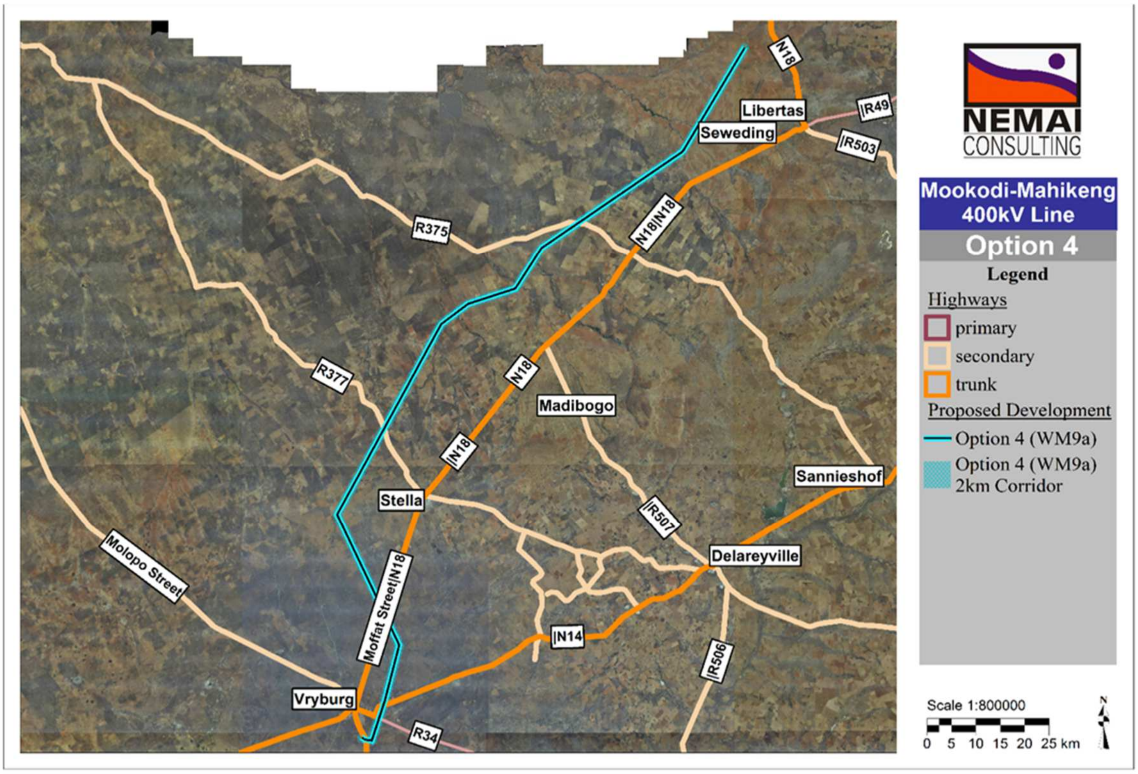


Figure 5: Route Alternative Option 4

3.2.5 No-Go alternative

The final alternative considered during this social impact assessment is the No-Go alternative. In this alternative, the social impacts of not going ahead with the proposed development have been considered.

The 'No-go' alternative would mean that the area where the proposed Mookodi-Mahikeng 400kV powerline is to be built would not change in any way and the environment conditions would generally stay the same within the site.

This would imply that the anticipated load growth within the area of Mahikeng and the resulting need for further enhancement of capacity in the area would not be met. There would be no further network expansion if the powerline and other related projects are not built. The projected impacts on the society and communities would not prevail as the conditions would still remain generally the same.

3.3 Description of the Study Area

The study area for this social impact assessment is defined by the impact area of the project. As the distance from the centre of the powerline increases, so the social impact decreases. This can be seen in examples such as the direct impact on people who love under the proposed route and would have to be relocated, rather than those who live a safe distance from the powerline and would not have to be relocated. This example is similar to others with regards to the economic impact of the disruption due to the powerline servitude.

Impacts such as the visual impact and the impact of the more constant provision of electricity are more weakly dependent upon distance, but these impacts are the subject of other areas of investigation, rather than the social impact assessment.

As a result of this analysis the study area can be defined.

The regional study area is the area within which social impacts can conceivably be felt. For this scale of project, the regional study area is defined as being the municipalities through which the powerline runs.

The project study area is defined as the footprint of the possible impact. In this case, each individual line has a two-kilometre-wide servitude, with the powerline notionally running down the centre of this servitude. The servitudes of all of the powerline routes together thus form the project study area.

4 METHODOLOGY

Social Impact Assessment is an interactive process by its nature which relies on both desktop research as well as from site visits and input from the community stakeholders. This tool assists the community to be part of the environmental decision-making process, and empower communities to participate in decisions that will affect their livelihoods (DEAT, 2006).

The Australian Government Department of the Environment and Heritage (2005:5) states that Socio-economic Impact Assessment is a useful tool to help understand the potential range of impacts of a proposed change, and the likely responses of those impacted on if the change occurs. This, in a rather different but similar context, applies to the role that an SIA performs.

An SIA is used during the EIA process to identify and evaluate potential social impacts of a proposed development. The SIA further recognises the important relationship between the social and biophysical environment.

The SIA is aimed at minimising adverse impacts of the proposed development while also aiming to maximise the beneficial impacts. The SIA sets out the social baseline, predicts impacts and makes recommendations for mitigation. The SIA holds relationships with other impact assessment fields. Although the core of SIA is relatively discrete, it overlaps other impact assessment studies and evaluation studies, sharing techniques, expertise, literature and so on (Barrow, 2000)

4.1 SOURCING OF INFORMATION AND DATA ANALYSIS

The SIA sets out the social baseline of the study area, predicts social impacts and makes recommendations for mitigation of negative social impacts and measures which can be taken to enhance the positive social impacts. The social baseline study is based on both primary and secondary data. Primary data was collected directly from traditional leaders, community members and private farmers. Secondary data was accessed through South African Databases, available reports and articles, internet searches and are referenced in the text and in the reference section of this report.

The profile of the baseline conditions includes describing the current status quo of the community, including information on a number of social and economic issues such as:

- Demographic factors;
- Socio-economic factors such as income and population data;
- Access to services;
- Institutional environment;
- Social Organisation (Institutional Context); and
- Statutory and Regulatory Environment.

4.1.1 Primary Data

4.1.1.1 Public Participation

Affected landowners and members of the public were given an opportunity to comment on the project during the public participation process carried out during the Scoping and EIA phases of the project. Comments and responses used during this process have been included into this report and have formed one of the bases the analysis of the social impacts considered in this report.

Further primary data was collected for the purposes of the study, these were collected using the following approaches:

- ***Rapid Rural Assessment***: A survey was conducted to capture visual observations on the social dynamics, community proceedings, community resources and infrastructure.
- ***Stakeholder Consultations***: Consultations with the affected village representatives/Authorities along each project component to discuss the proposed project and to gather their concerns and feedback on the project.
- ***Focus Group Discussions***: focus group discussions with the affected farmers who reside in close proximity and/or within the range or servitude of the project were conducted.
- ***Key Informant Interviews***: Informal discussions with the IAP's to help inform the baseline were conducted during site visits and as well as during the coping phase. These included community members and authority members

4.1.2 Secondary Data

An assessment of the scoping phase was conducted to provide an understanding of the project details, location and possible impacts.

The required information was collected using different sources, these included Statistics South Africa Census data and a thorough review of relevant municipal, district and other literature.

The discussion of the demographics and the development profile of the municipality is carried out using Census 2011 data produced by Statistics South Africa.

The Census 2011 data is the most comprehensive dataset available for the subject areas, and it is currently the best data at hand. The ward and municipal data have been extracted using the project Geographic Information System, and the data for the affected areas will be presented in tables and figures throughout the report.

4.1.3 Geographic Information System

A Geographic Information System (GIS) was used to conduct an analysis of the area. The use of GIS brings together the demographic and social data to enable a thorough analysis of the project area.

4.2 IMPACT ASSESSMENT

An impact assessment should be designed as a bridge that integrates the science of environmental analysis with the policies of resource management (Barrow, 1997). Furthermore, an impact assessment allows for an estimate of the significance of the identified social impacts to those who will be affected. In addition, the response of the affected parties to such impacts also needs to be clarified (Centre for Good Governance, 2006). All impacts will be analysed with regard to their nature, extent, magnitude, duration, probability and significance (Barbour, 2007). Section 7 lists the definitions that apply to the impact assessment.

The determined impacts are clustered around a common-issue and are assessed before and after mitigation. The identification of the social impacts associated with the project is issues-based, with the main headings referring to a common theme addressing several related impacts. Under each of these issues the specific impacts and potential mitigation strategies are discussed for pre-construction, construction, operation and decommissioning phases.

4.3 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations underlie this social impact assessment:

- It is assumed that information obtained during the public participation phase provide a comprehensive account of the community structure and community concerns for the project;
- The study was done with the information available to the specialist at the time of executing the study, within the available time frames and budget. The sources consulted are not exhaustive and additional information which might strengthen arguments, contradict information in this report and/or identify additional information which might exist. However, the specialist did take an evidence-based approach in the compilation of this report and did not intentionally exclude information relevant to the assessment;
- It is assumed that no relocation of families or people will take place for this project; and
- The feasibility stage of the project presents four alternative routes which are to be narrowed to one on the basis of the route with less impact and effects on the locality, the assumed impacts and effects may later change during the detailed design phase of the project.

5 SITUATIONAL ANALYSIS

The social status quo within the project study area is an important input to the impact study of the proposed project. Here the status quo is described using data obtained from Statistics South Africa's Census 2011 as well as by observations made during site visits to the project area.

5.1 Land Use and Infrastructure

The powerline runs through areas of different land use. The predominant land use is agricultural, either commercial farming or subsistence farming.

Land use in the project study area is divided into two categories; the southern and central sections of the project study area are characterised by commercial agriculture and small dense population centres. The northern section of the project study area passes through land controlled by the traditional authority and includes subsistence agriculture and larger, lower density population centres.

5.1.1 Northern Section of the Project Study Area

The northern portion of the study area consists of the land under traditional management and starts nineteen kilometres after the R375 road (along the N18) and continues onto the Mahikeng Substation.

The table below provides detail on the settlements which will be directly affected by the power line route.

Table 3: Villages Directly Impacted by the Project

Local Municipality	Settlement/Town Name	Route Option	Co-ordinates in the Vicinity of Impact
Mahikeng	Motsumorwane	All Routes	S 25 48 57 E25 28 15
Mahikeng	Lokgalong	All Routes	S 25 47 43 E 25 29 15
Mahikeng	Mogosane	All Routes	S 25 45 00 E 25 31 53
Mahikeng	Modimola	All Routes	S 25 51 33 E 25 26 20
Mahikeng	Madibe-Magelelo	All Routes	S 25 54 52 E 25 23 34

The settlements are low density rural villages and as such the path of the powerline should be able to pass through the area without impacting upon individual dwellings. Mitigation measures should this not be the case will be provided in later sections.

Subsistence farming takes place along the northern sections of the powerline, in areas controlled by traditional authorities. Crops in this area include maize and sorghum. Grazing of cattle and goats also occurs in these agricultural areas.

The proposed Mahikeng Substation site is located in an area south west of Miga. The site is very sparsely inhabited and undeveloped. An access road bisects the proposed Mahikeng substation and is utilised as access to the surrounding settlements of Lokgalong and Miga as well as the N18. **Figure 6** below provides an image for the approximate location of the substation site.

Figure 6: Land Use near Miga at the Proposed Substation Site

At the proposed site of the Mahikeng Substation there are scattered rural dwellings that have been recently erected. Evidence on site points to this outshoot of Lokgalong growing over time with additional structures being erected. Estimates at the time of the site visits indicate a slow growth rate of approximately six structures per year.

Figure 7: Houses in the Vicinity of the Proposed Mahikeng Substation

Figure 7 above shows some of the houses in the vicinity of the proposed substation.

Figure 8: Land Use in Lokgalong

Figure 9: Land Use in Lokgalong

Figure 10: Land Use in Lokgalong

Lokgalong is a settlement on the outskirts of Mahikeng which extends into the two-kilometre corridor of all of the powerline alternative routes. This settlement is typical of those along the proposed powerline and have limited access to piped water and flushing toilets.

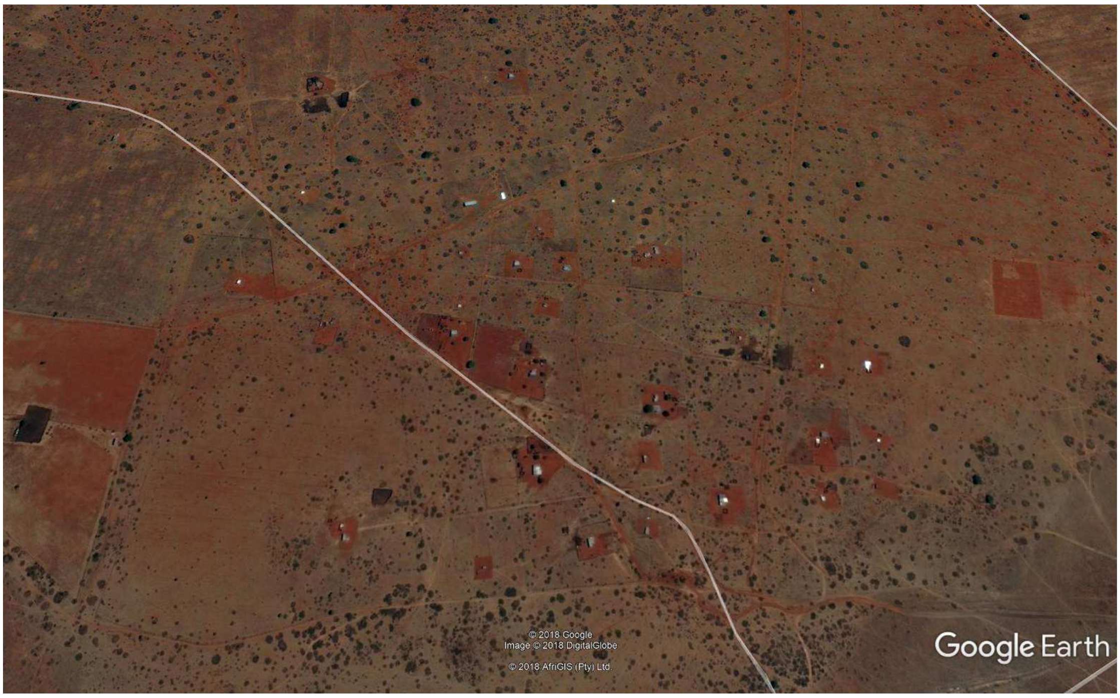


Figure 11: Impacted Structures in Lokgalong [S 25 44 40, E 25 30 48]

Thus, all of the corridors will impact to some extent on private dwellings, undeveloped agricultural lands, community water supply and a graveyard. The figures numbered **Figures 12** and **13** show the status quo of the development within Lokgalong.

Figure 12: Maize Planting in Lokgalong

The most rural parts of the project use communal or public standpipes as their main source of water supply. These standpipes are found across Lokgalong, Modimola, Setlagole and other affected areas. These are the main sources of water for the community members who cannot afford to purchase water tanks and boreholes.

Figure 13: Agricultural Fields in Masutlhe

The powerline will cut across existing gravel roads which will be used as access roads during the construction phase of the project, see **Figure 14**. As a result, these roads are likely to be more damaged during the construction phase.

Figure 14: Access Roads in Lokgalong

Figure 15: Land Use in Masutlhe

In the northern length of the project study area, heritage features such as graves are evident in each community. Features such as gravesites hold significance to the family and to society and should not be impacted upon by the proposed project. **Figure 15** above shows and example of a graveyard in Masutlhe. The powerline will pass these grave sites in the vicinity of route Option 1. The closest corridor is approximately 148m to this grave, with the corridor for route Option 2 being the furthest away and at nine hundred meters

Figure 16: Land Use in Modimola

To the south of Masutlhe, is the village of Modimola village which is located across all four alternative corridors. The village includes a main access gravel road which the powerlines will cross. By careful placement of the powerline pylons, direct impacts upon residents of the village can be avoided. **Figure 16** above provides an image of the site conditions within Modimola.

Further to the south are the villages of Motsumowane and Modimola. These are both rural settlements with layout and infrastructure provision similar to that at Lokgalong. The northern sections of all of the routes of the proposed powerlines pass through structures inside these villages. This is shown in the two figures below.

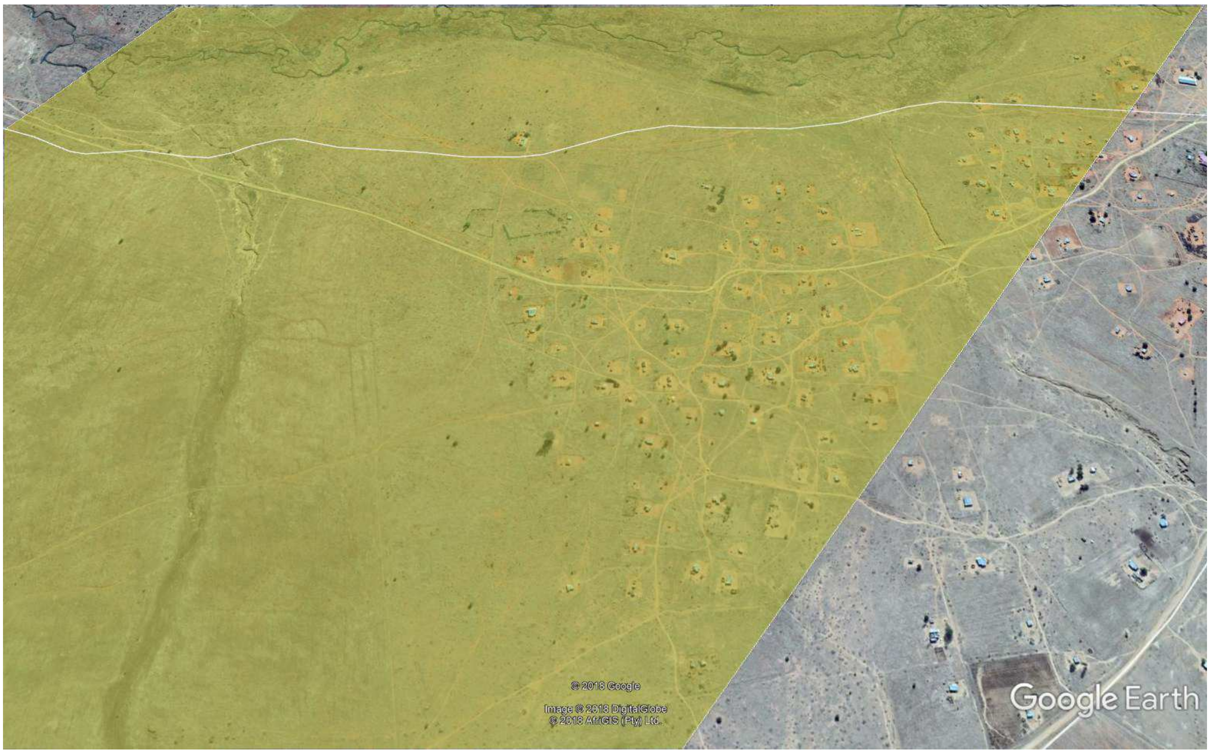


Figure 17: Impacted Structures in Motsumorwane [S25 52 21, E 25 25 49]

Figure 18: Impacted Structures in Modimola [S 25 51 59, E 25 42 43]

Figure 19: Land Use in Madibe-Magelelo

In the community of Madibe-Magelelo there is a low level of infrastructure provision. The internal gravel roads are narrow, rutted and with no storm water drainage. Agricultural activities are subsistence in nature with cattle being the main source of income. Kraals in this area are kept close to the homesteads. Residents were concerned about an influx of workers being a security threat to their cattle and property, an aspect that would have to be managed by the project. **Figure 19** above shows a typical view from inside the settlement of Madibe-Magelela.

Figure 20: Dwellings Impacted in Madibe-Magelelo [S 25 55 07. E 25 22 50]

The powerline in this portion of the project makes its way across the existing dwellings and the small river on the outskirts of the settlement see **Figure 20** above.

5.1.2 Southern and Central Sections of the Project Study Area

Commercial agriculture takes place in the southern and central portions of the proposed powerline. The farming in this area is a mixture of grazing, non-irrigated crops and crops that are irrigated using centre pivots. Crops include sorghum, sunflower and maize.

Sensitive infrastructure in these areas include dwellings, farm buildings, water infrastructure, farming infrastructure such as centre pivots and access roads.

Features such as water supply infrastructure have a high social and economic impact. There is a myriad of examples of this type of infrastructure in the project study area, and these include windmills, reservoirs, rivers and storage dams. Disruption of this type of infrastructure will leave the affected communities vulnerable to water shortages. Hence such impacts should be prevented.

Figure 21: Land Use in Setlagole

Figure 22: Land Use in Setlagole

Figure 23: Land Use in Setlagole

From Madibe-Magelelo southwards the land use changes into commercial agricultural land. Route Option 3 runs close by the village of Setlagole which a rural, low density settlement with the second largest population in the project study area. Agriculture in this area includes game and cattle grazing, crop production; including maize, sorghum, beans and sunflower. Images of the landscape in the vicinity of Setlagole are shown in **Figures 21, 22** and **23**.

Figure 24: Land Use in Stella

Figure 25: Gravel Road in the Vicinity of Stella

Stella is located along the N18 and all of the powerline routes pass either to the east or the west of the town. The town itself is not directly impacted by the proposed project, however, smallholdings to the west of the town are impacted by route alternative 1. **Figure 25** provides an image of the outskirts of Stella town. Land use in the vicinity of Stella is generally commercial farmland, with there being numerous farm buildings and farm infrastructure that is impacted upon by the proposed powerline routes. Typical agricultural production includes cattle raising with some crop production. Most local roads are gravel, a typical such road is shown in **Figure 25**.

Figure 26: Boereplaas Holiday Resort near Vryburg

The most active economic hub impacted upon by the proposed powerline routes is the town of the Vryburg, at the southern end of the route. Commercial, residential and smallholdings are all impacted by the proposed powerline routes. There is at least one tourist destination which is impacted upon by the powerline, that of the Boereplaas Holiday Resort. Impacts during construction and possibly during operations will affect this business which is dependent upon tourism for its success. The entrance to the resort is shown in **Figure 26**. Smaller powerlines and communication towers are present within this property.

Figure 27: Land Use in Vryburg NU

Figure 28: Land Use in Vryburg NU

At the southern end of the proposed powerline, near the Mookodi Substation, Vryburg economic infrastructure extends to the west and east of the town. To the east are Mam's Truck Inn, on the R34, which is affected by Option 2 as well as other residential properties along the R34. These are shown in **Figure 27** and **Figure 28**. There are two existing powerlines from the Mookodi substation which travel to the east. Portions of one of these routes can be used to avoid impacting upon existing properties in the area.

Figure 29: Existing Mookodi Substation

Figure 29 shows the existing substation entrance. Mookodi substation will be the starting point of the Mookodi-Mahikeng 400kV powerline project. The substation is located in Vryburg outside the Huhudi settlement.

Along the southern and central sections of the powerline there are numerous farm dwellings and similar structures that fall within the powerline servitude of all of the route alternatives. These impacts are detailed and listed in **Appendix 1: Census of Proposed Powerline Impacts**. There are four tables in the Appendix:

- Table 1: Farm Dwellings Directly Impacted by the Project – All Routes;
- Table 2: Farm Dwellings Directly Impacted by the Project – Route Option 1;
- Table 3: Farm Dwellings Directly Impacted by the Project – Route Option 2

- Table 4: Farm Dwellings Directly Impacted by the Project – Route Option 3; and
- Table 5: Farm Dwellings Directly Impacted by the Project – Route Option 4.

5.1.3 Airports and Aerodromes

A noteworthy feature of the study area is the number of airports and aerodromes. There are at least three aerodromes of varying size in the vicinity of the study area. This does not include the private airstrips that may exist in the area but are unregistered. These are:

1. Mahikeng Airport – this is owned by North West Department: of Community Safety and Transport Management and managed by the Mahikeng Airport Management Company and is located to the west of Mahikeng. The runway lies parallel to the powerline and is 4 500m from the edge of the closest powerline corridor;
2. Vryburg Aerodrome – located to the south of Vryburg. The distance from the end of the runway to the Mookodi Substation in 2 800m. The runway is orientated towards the Mookodi Substation and its associated powerlines;
3. Mahikeng North Aerodrome – located to the north east of Mahikeng, this is small aerodrome, located 6 800 from the edge of the corridor for the Mahikeng Substation. The runway is orientated parallel to the powerline.

The International Civil Aviation Organization's Convention on International Civil Aviation, Volume I: Aerodrome Design and Operations, designates surfaces around which obstacles should not intrude. In the case of the Vryburg Aerodrome, the Mookodi Substation and towers, being 2 700 m from end of the runway, could fall within the footprint of the inner horizontal surface, which has a height of 45m above the ground.

Given the typical tower heights of Eskom pylons is 28m (for a 518H tower), the powerline and its infrastructure should not impact upon the aerodrome operations.

5.1.4 Summary of Impacts for Route Alternatives

The northern section of the proposed power line does not have any route alternatives, hence the available mitigations in this area are to position the towers within the corridor. Impacted communities in the northern area are: Lokgalong, Motsumorwane, Modimola and Madibe-Magelelo.

This situation can be contrasted to that in southern and central area of the powerline, where choice of route alternative can make a difference on the number of impacts. It should not be forgotten that the towers can also be positioned within the corridor of the chosen route alternative.

The table below provides a breakdown of the number of impacts for the various route alternatives.

Table 4: Summary of Impacts, Southern and Central Area, Along Each Route Alternative

Nature of Impact	Route Option 1 [WM1]	Route Option 2 [WM13]	Route Option 3 [WM4a]	Route Option 4 [WM9a]
Farm Buildings / Dwellings	32	28	24	34
Irrigation Pivots	5	1	7	1
Smallholdings (buildings/dwellings)	22	19	7	19
Commercial/Institutional	2	12	3	12
Other – Tourism, Hatchery and Rail	0	1	2	2

5.2 Study Area Overview

The section below provides a more detailed description of the social environment of the study area and further illustrates the livelihoods of the study area.

The proposed project is located within various Municipalities which are namely Ratlou LM, Naledi LM, Mahikeng LM and Kagisano Molapo LM. See **Figure 2** for a map of the municipalities through which the route alternatives will travel. **Figure 3** shows the wards in which the powerline will be passing through.

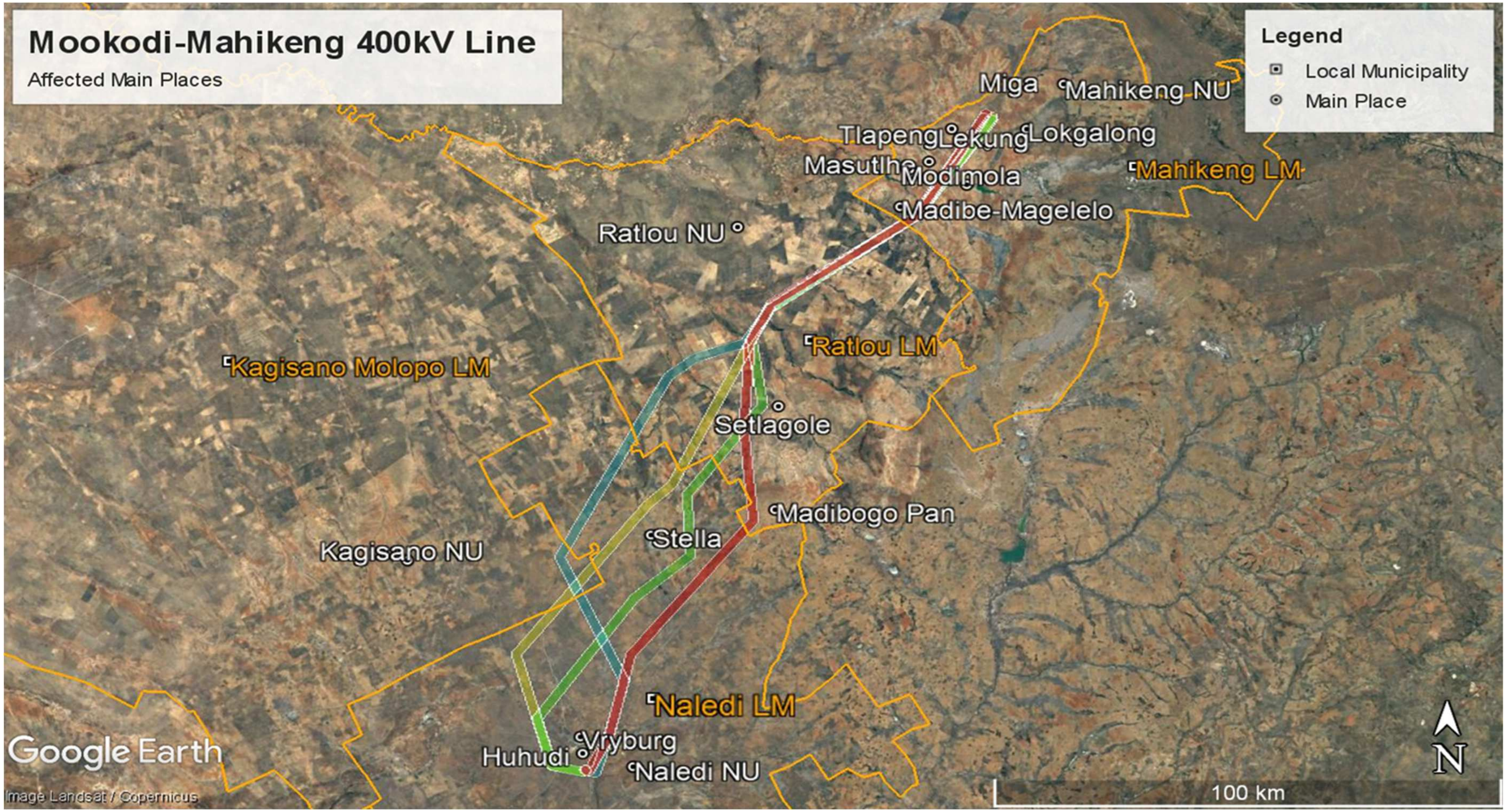


Figure 30: Affected Project Area

5.2.1 Population Data

The population of the project study area has been as determined using Statistics South Africa's Census 2011 data. The bar graph below shows the population of each of the affected main places in the project study area.

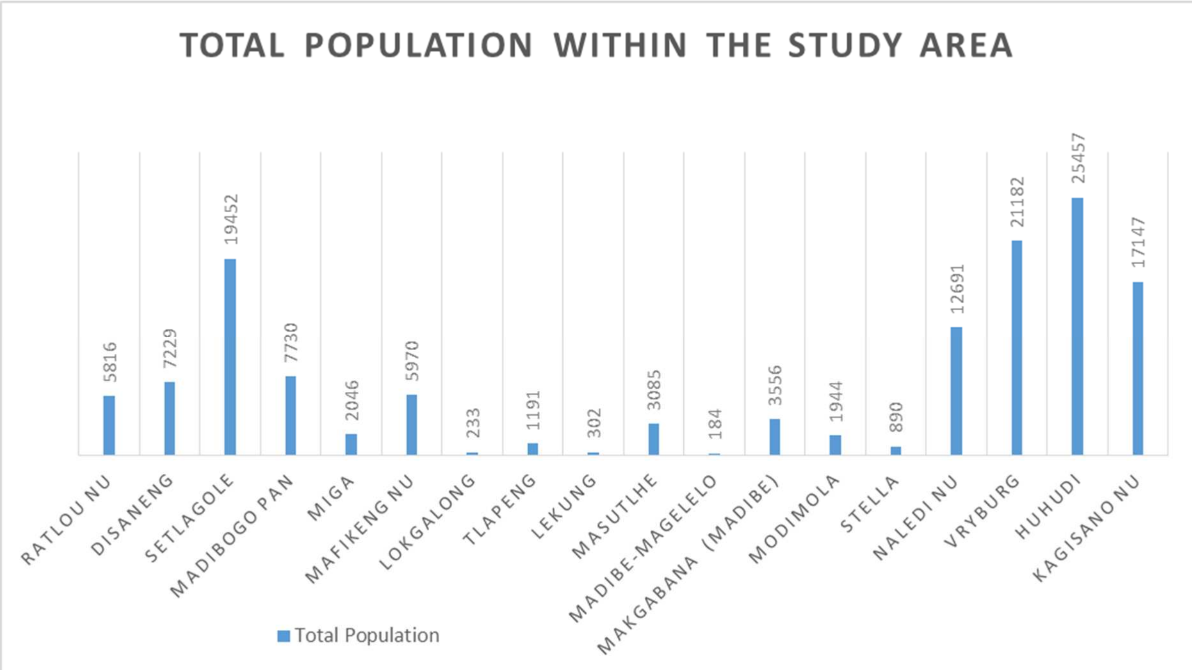


Figure 31: Total Population within the Project Areas

Huhudi is closest residential area to the existing Mookodi substation which is also the starting point of the powerline project. Huhudi has the largest population size in the project study area. All of the high population areas are not impacted by any of the proposed route alternatives.

The effects of population growth can be seen in the villages of Lokgalong, Setlagole, Lekung, Modimola and Disaneng were new areas of settlement are emerging

Masutlhe, Madibe Magelelo, Lokgalong, Lekung, Disaneng, Stella, Ratlou NU, Modimola and Tlapeng are the most rural of the affected main places in the project. This makes them vulnerable to the impacts of the project and it is of outmost importance to mitigate these impacts.

5.2.2 Household Population

The number of households in project study area is related to the population size, but shows the number of family units that are impacted by the project.

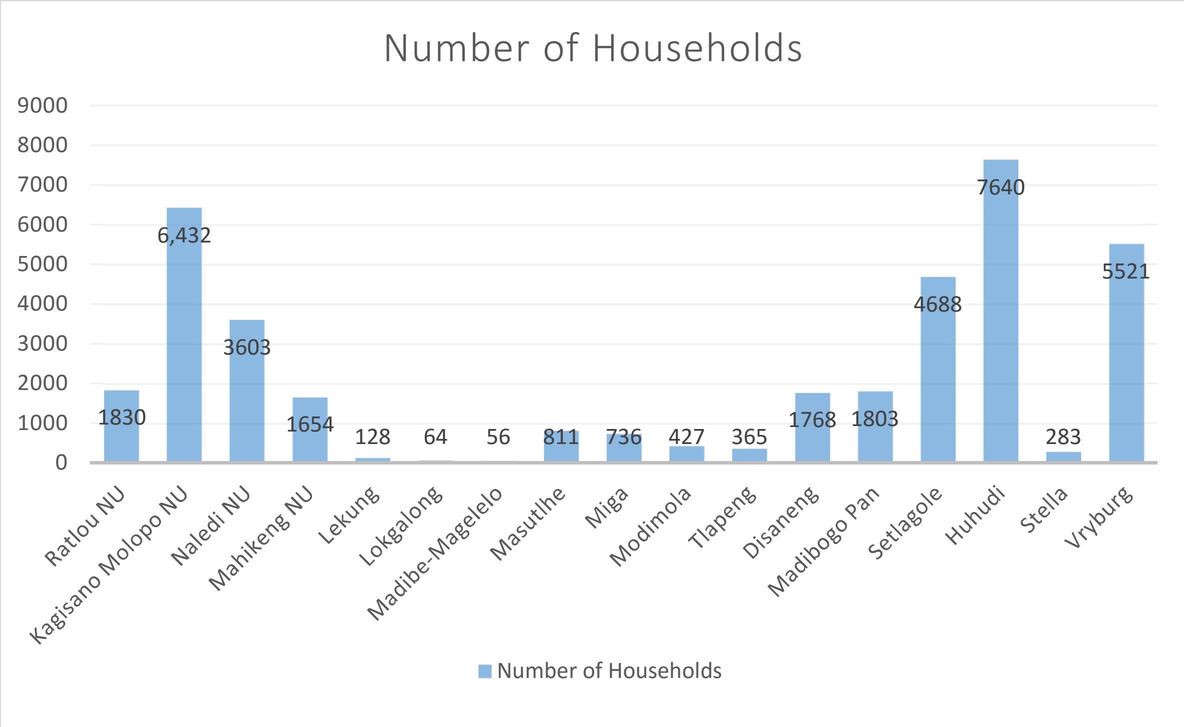


Figure 32: Household Data of the Affected Areas

The statistics presented on **Figure 32** show a range of households within the different main places. Huhudi has the largest number of households and is located next to Vryburg.

5.2.3 Dwelling Type

The characteristics of the dwellings in which households live and their access to various services and facilities provide an important indication of the well-being of household members. It is widely recognised that shelter satisfies a basic human need for physical security and comfort.

According to the Statistics South Africa household classification, the following definitions apply to formal and informal housing:

- **Formal dwelling**, refers to a structure built according to approved plans, i.e. house on a separate stand, flat or apartment, townhouse, room in backyard, rooms or flat let elsewhere. Contrasted with informal dwelling and traditional dwelling; and
- **Informal dwelling**, is a makeshift structure not erected according to approved architectural plans, for example shacks or shanties in informal settlements or in backyards.

The chart below shows the dwelling types located within the study area. The dwellings were listed taking into consideration the location, authorities and the lifestyle of the residing people. The dwelling types are categorised as being Formal (Brick/concrete house), Traditional and informal. See **Figure 33** for the results.

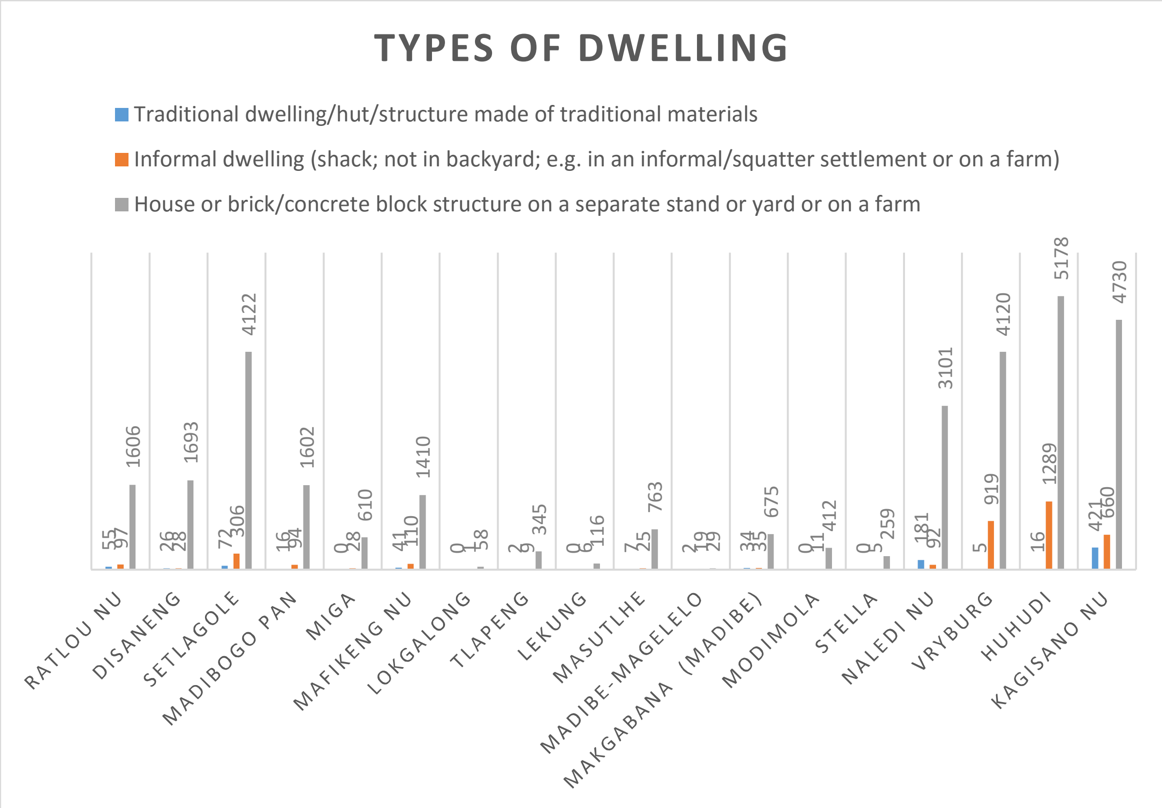


Figure 33: Types of Dwellings

It is evident that the vast majority of the inhabitants of the study area live in formal and brick dwellings. There are areas where informal/ Non-Urban settlements exist, notably Huhudi, Vryburg, Kagisano NU and Setlagole.

5.2.4 Access to Piped Water

Understanding the water supply at a household level provides insight into the municipal level of service of a community as well on the standard of living. The graph below, which summarises Statistics South Africa's Census 2011 data, shows the use of the various water supply standards within each of the sub-places.

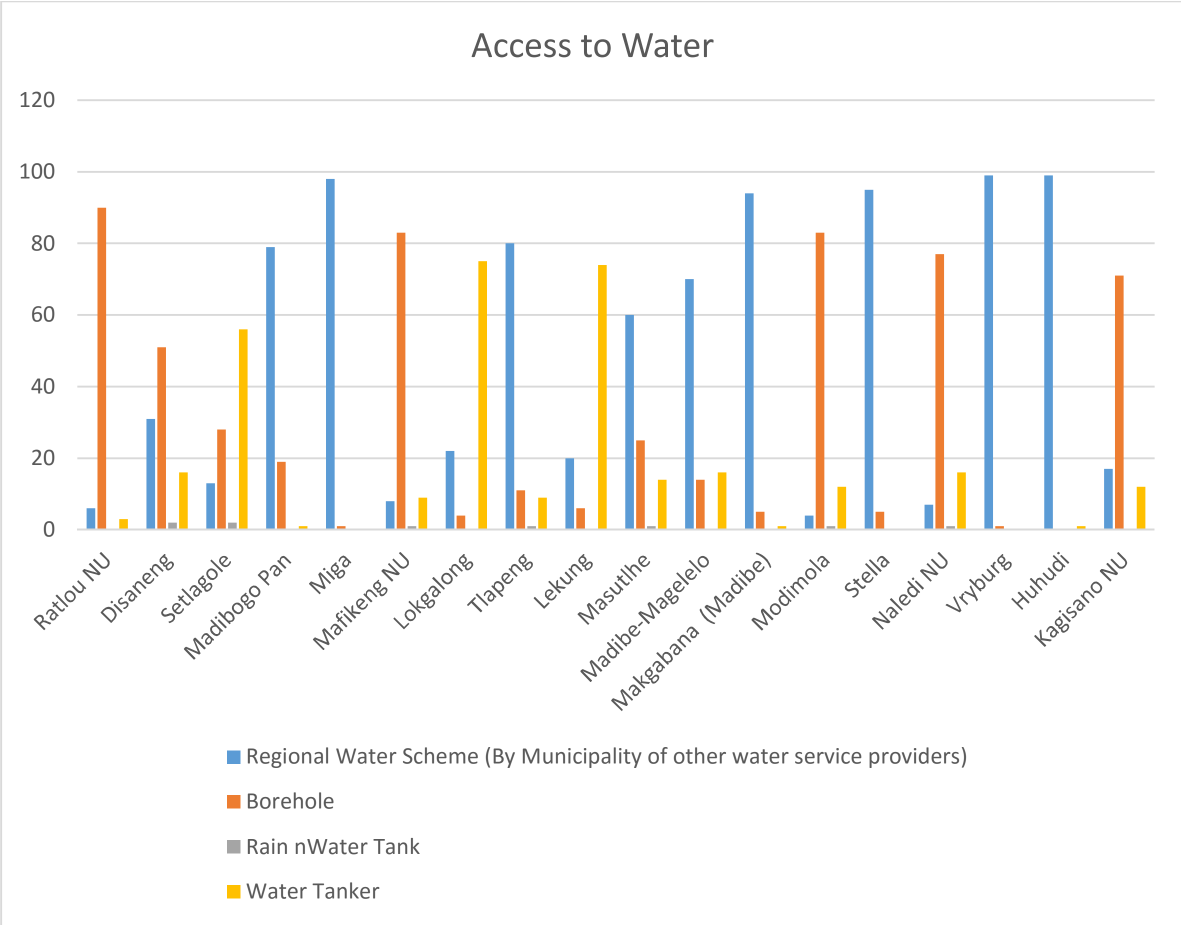


Figure 34: Access to Water

The majority of the supply area is dominated by a piped water supply inside homes through the use of Regional/Local water schemes administered by the municipalities. The second most used water supply in the affected area is the use of borehole water supply. The third most common water supply is via water tankers. These places experience water supply challenges and the most rural parts of the project have less access to piped water. Lokgalong receives 75% of its water through water tankers whilst Lekung receives 74% of its water from this source. This phenomenon was visible throughout these areas during the sites visits where water supply is a common source of complaint.

5.2.5 Sanitation

Access to sanitation services is also an indicator of the standard of living amongst the population in the sub-places. The graph below, which summarises Statistics South Africa's Census 2011 data, shows the use of the various sanitation standards within each of the sub-places.

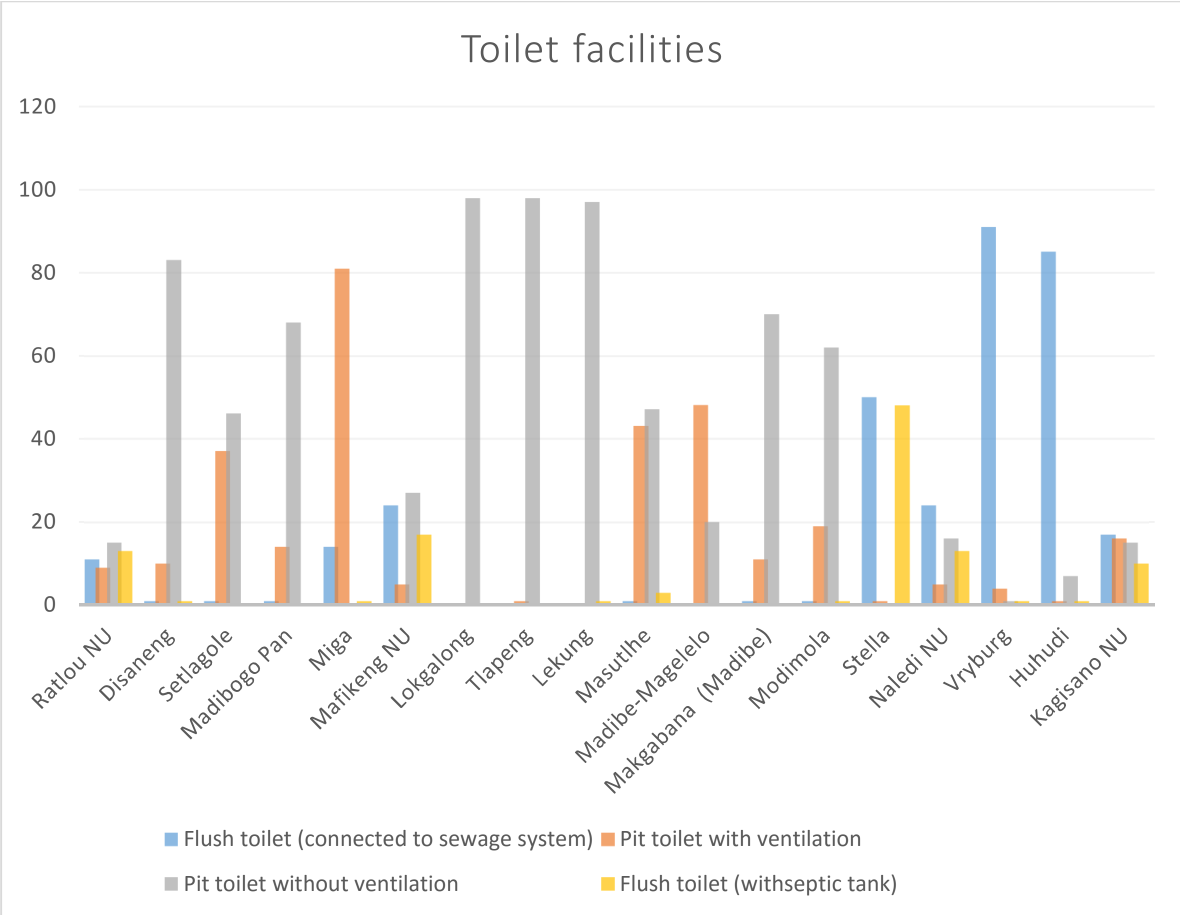


Figure 35: Access to Toilet Services in 2011

A majority of households in the affected project vicinity make use of pit toilets without ventilation, followed by flush toilets in the urban areas of the project study area, such as Vryburg and Huhudi. Pit toilets with ventilation are a common sanitation methodology with Miga having the highest percentage at 81%. Lokgalong, Tlapeng Lekung and Disaneng show the highest use of non-ventilated pit toilets.

5.2.6 Education

Education levels are assessed in order to understand the potential grade or level of employment as well as livelihood of the community. Furthermore, it indicates the functional literacy and skill level of a community. **Figure 36** provides detail on the education levels within the study area. The figures are taken from Statistics South Africa's Census 2011.

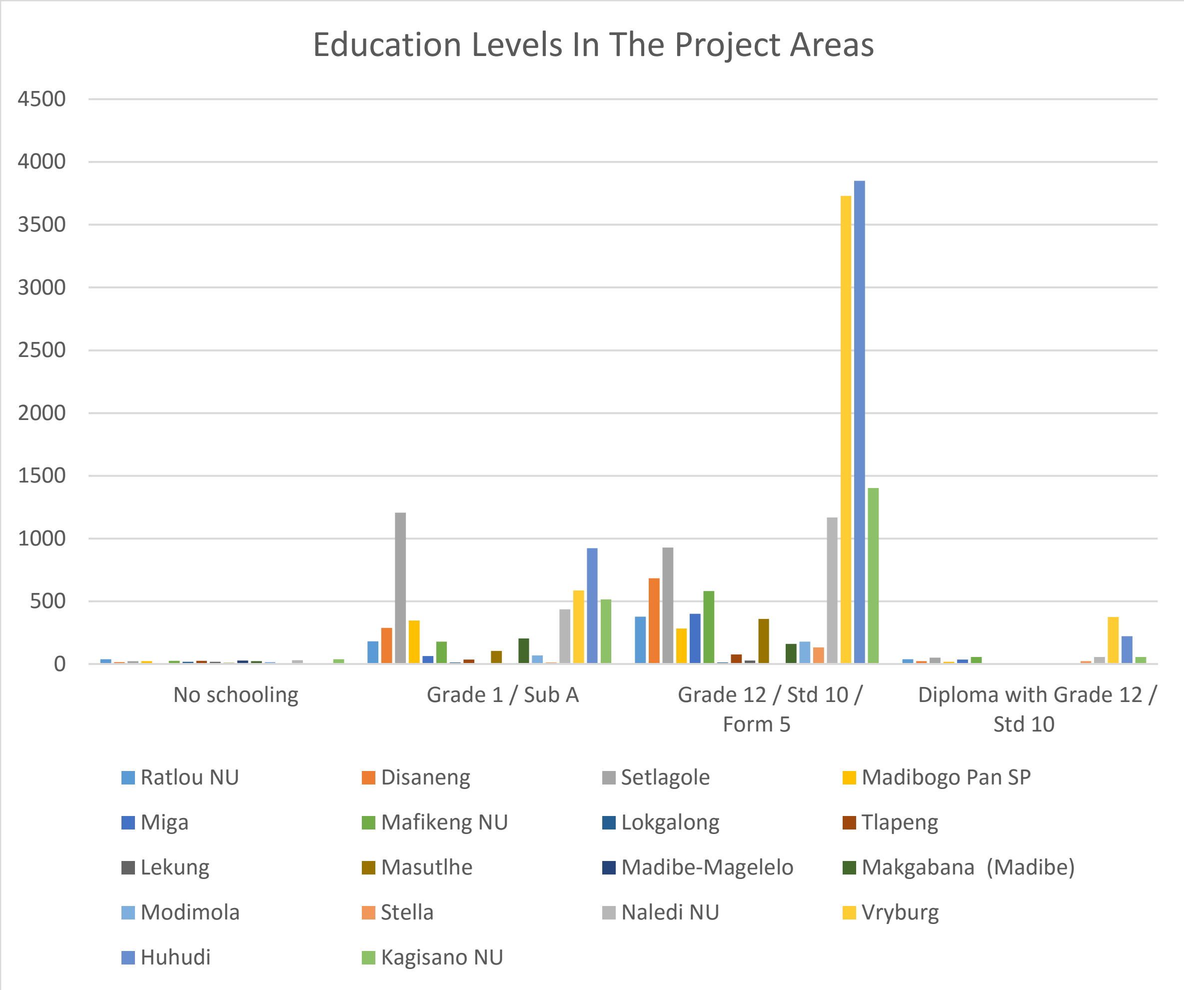


Figure 36: Education Levels in the Affected Project Areas 2011

The statistics show that an average of 30% of the inhabitants of the study areas have never been registered into school or have only attended primary school. The remaining population has achieved either primary education or matric with a very low percentage having achieved a post matric qualification.

The conclusion can be drawn from the statistics that the project study area has low levels of higher education which negatively influences income and lifestyle. Taking all of this into consideration, skills development programmes will greatly benefit the people in close vicinity to the project and assist with alleviating poverty.

Economic theory proves that education improves the level and quality of human capital, in turn increasing the productivity of individuals. Thus increasing the output generated per worker. Education facilitates long term growth and is critical to escape the poverty trap.

Economic theory is proven in practice in a study conducted by Altbeker and Storme (2013). The study shows that while the number of graduates in South Africa has more than doubled in the past fifteen years; the unemployment rate amongst graduates has declined to around five percent.

Furthermore, the study shows that the employment rate improves as the years of completed education increase (**Figure 35**) (Evelien & Altbeker, 2013). The study demonstrated that only thirty-three percent of those who had less than secondary education (eleven years or fewer) had jobs. This rose by twenty percent on completion of secondary school. With one extra year of education after secondary school, employment increased to seventy-one percent. Those with qualifications that take longer than one year after matric experience improving employments rates, until post-graduate degree holder's employment rate, which was the highest at ninety-six percent (Evelien & Altbeker, 2013).

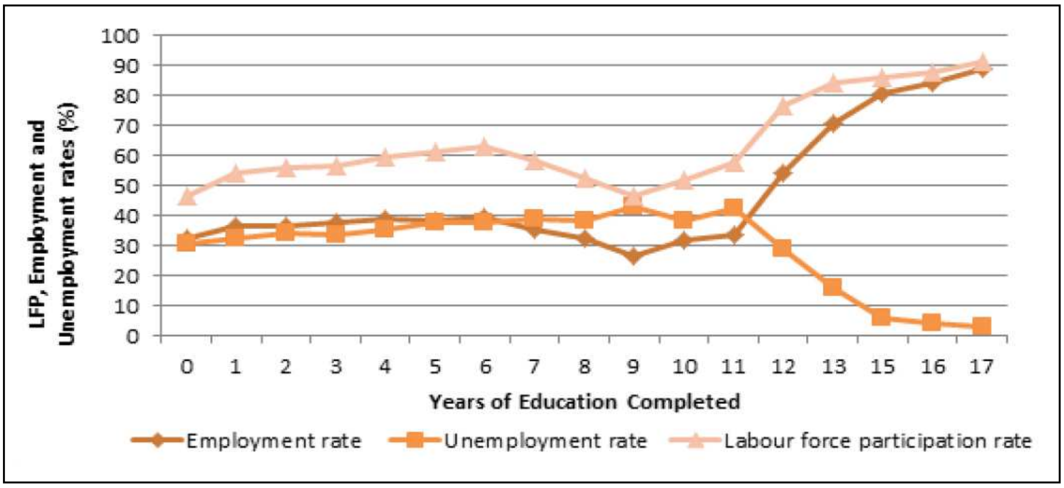


Figure 37: Labour Force Participation, Employment by Years of Education (2007)

The education levels in the study area demonstrate that most inhabitants have achieved less than eleven years of education, and the Altbeker and Storme study indicates that the study area is thus likely to be structurally geared towards high unemployment and thus higher levels of poverty.

The community are largely dependent on the population who have high school or received higher education.

The low education levels in the study areas indicate a perpetuating cycle of low income and thus perpetuating low education rates. This structural problem requires intervention of an external entity to improve current education levels. A generation of youth with some form of higher education is required to break the poverty cycle in these project areas

5.2.7 Annual Household Income

Annual household income is important to assess as it provides information on the poverty level of a community. Development of unskilled rural households is much slower than that of skilled households, this is due to the unskilled communities tending to generate low incomes per household than higher skilled communities.

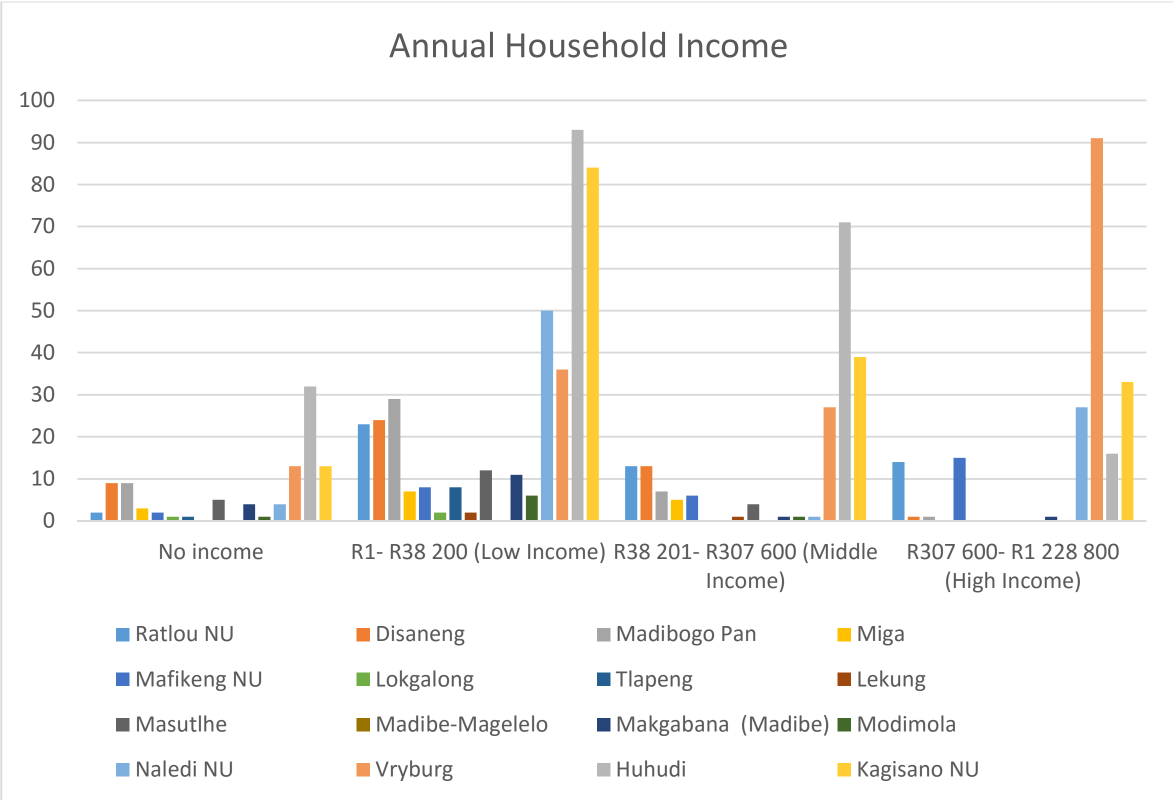


Figure 38: 2011 Annual Household Income

The data for Madibe-Magelelo and Lokgalong were unavailable. This could be due to their rural nature which could be viewed as an impact to the economic status of the area or the fact that they were not recorded. Huhudi, Vryburg and Naledi NU are the highest income areas within the project study area.

Substantial numbers of no income households are recorded for some of the affected project areas and it is evident that most communities are poor and additional employment and skills development programmes opportunities would be highly beneficial for both short and long term durations.

Overall the community of Vryburg is relatively wealthy in relation to other affected communities.

Of particular note in **Figure 38**, are the figures for households with “No Income”. Statistics SA in their publication “Income Dynamics and Poverty Status in Households in South Africa, Census 2011”, (Statistics SA: 2015) define income as being “…all money received from salary, wages or own business; plus money benefits from employer, such as contributions to medical aid and pension funds; plus all money from other sources, such as additional work activities, remittances from family members living elsewhere, state pension or grant, other pensions or grants, income from investments, etc. The census question asks for the total before tax."

According to this definition, a total of 36.9% households in Lokgalong receive no income. To justify and rationalise this level of income there are three possibilities: the households have either unreported their income; or rely on charity donations of goods; due to the study area being predominately used for agriculture, the third possibility is that the household use subsistence farming to sustain the household's food and water needs.

5.2.8 Employment

Census 2011 uses the following definitions applicable to employment that are useful for reference purposes:

- "**Employed** - Those who performed work for pay, profit or family gain for at least one hour in the seven days prior to the interview or who were absent from work during these seven days, but did have some form of paid work to return to";
- "**Economically Active Person** - A person of working age who is available for work, and is either employed, or is unemployed but has taken active steps to find work in the reference period". These are the sum of the employed and unemployed persons;
- "**Unemployed** – Those people within the economically active population who: (a) did not work during the seven days preceding the census; (b) want to work and are available to start work within two weeks of the interview; and (c) have taken active steps to look for work or start some form of self-employment in the four weeks preceding the census night."; and
- "**Other Not Economically Active** – People who are not available for work such as full-time scholars and students, full-time homemakers, those who are retired and those who are unable or unwilling to work"; and

The reported employed and unemployed person in the Main-places is reported in the graph below by using the collective Municipal statistics in which the Main places are located. These figures use the official definition for unemployment. The sum of the employed persons and the unemployed persons is the actual labour force at the time of the census.

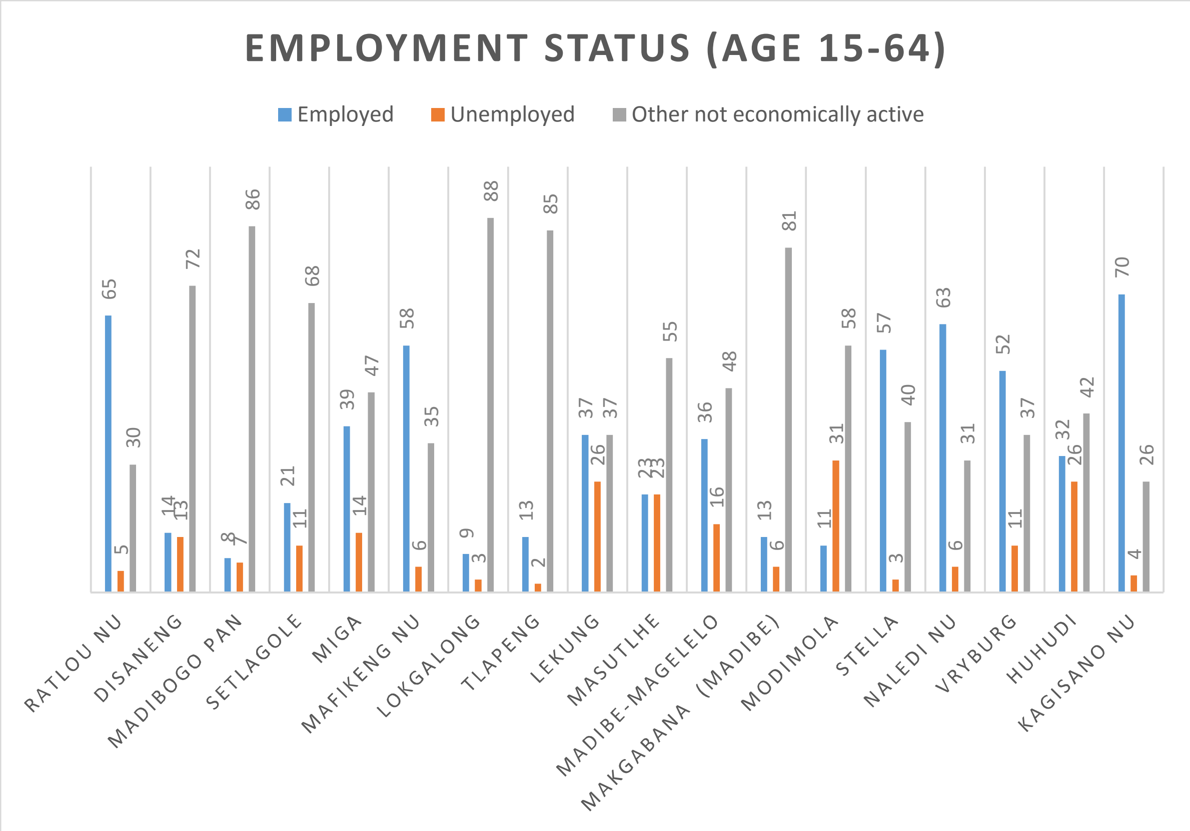


Figure 39: 2011 Employment Status

Employment in the project study areas is generally very low, with a majority of the communities either reporting very high "Other Not Economically Active" figures or high "Unemployed" figures. In a population centre such as Setlagole for example, twenty-five percent of the labour force is employed. Modimola is the best performing employment area with eighty-percent of its workforce being employed.

5.3 Stakeholder Engagement

The following stakeholder engagement was carried out as part of either the public participation process of the EIA and as part of this SIA.

5.3.1 Setlagole Commercial Hub

During a review and scoping phase of the proposed Mookodi-Mahikeng project, it was noted that the route WM13 would run in close proximity to the site reserved for the commercial hub in Setlagole. The site was presumably identified for the social and economic development of the community and has been earmarked for future development.

To have a more informed understanding of the planned development, an official of the Ratlou LM was approached with a request for additional information regarding the development and its fixed location.

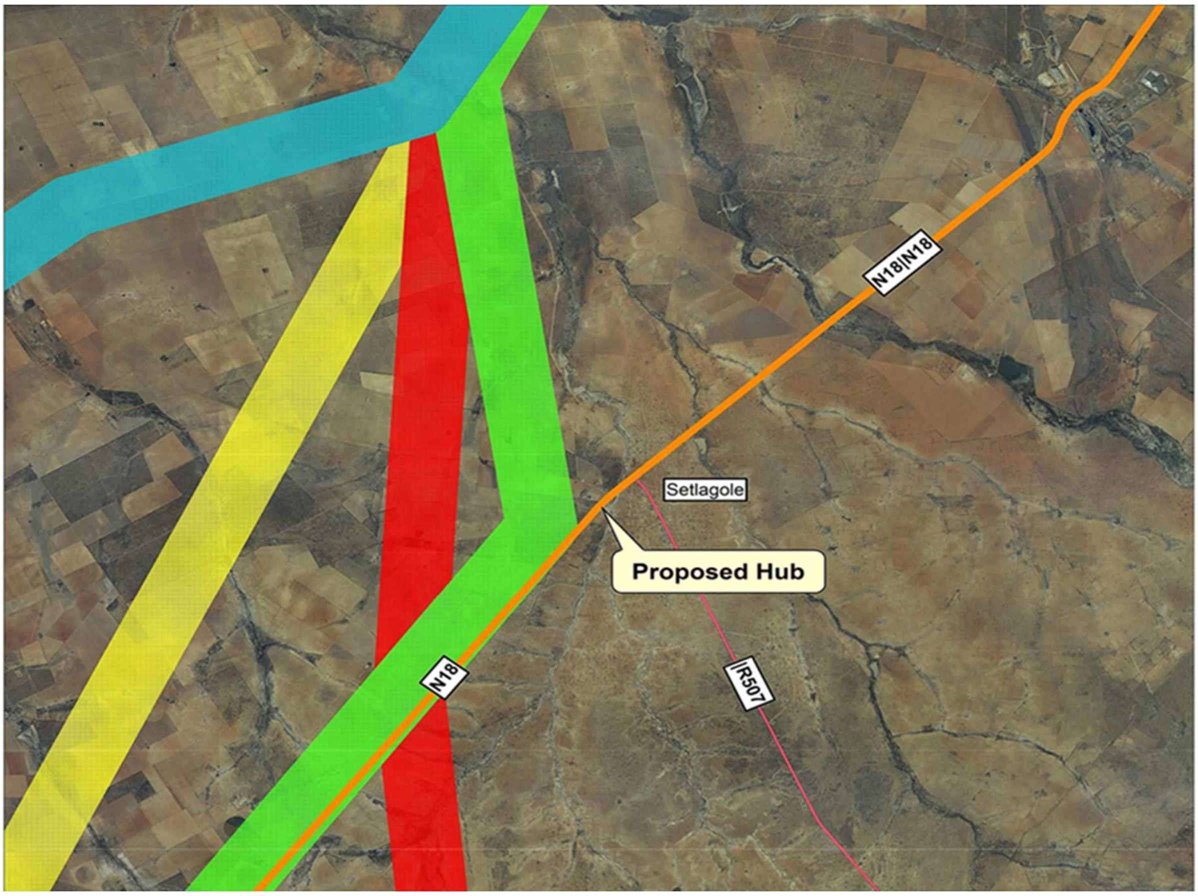


Figure 38: Proposed Setlagole Commercial Hub

From this it was determined that the development site is it falls outside the corridor of route alternative 3 and is therefore not directly affected by the powerline.

5.3.2 Contact with Directly Affected Landowners

Directly affected landowners/parties were contacted, this was carried out as part of the Public Participation process of the Environmental Impact Assessment during the Scoping phase. This process included individual meetings with the IAP's, focus group meetings, public meetings and authority meetings of the impacted areas. During the meetings, there were social issues that were raised as resulting from the proposed project. The overall responses include the following:

- Many landowners were concerned about the **Financial Compensation** for the loss of land where the towers would be located. Most of the farmers raised issues which were related to the previous experience of being promised compensation for servitudes, but that this was never forthcoming. Impacts reported included the farm footprints where there would be physical construction of towers and of reduced access to the landowner's farm;
- **Security concerns** were highlighted by participants. Concerns were mostly with regards to contractors having access to their properties throughout the duration of the project. Concerns were raised that the project would increase public movements which would increase the incidents of trespassing on private land;
- **Reduction of access to farmland**; landowners were concerned about the project reducing access to their land by the construction phase interfering with agricultural activities or permanent access roads cutting properties in half. This would have a knock-on effect on farm productivity;
- IAP's in a public meeting raised a concern about the change in **Traffic conditions**. The study area consists of both tarred toads and gravel roads with the local roads being mostly gravel. The concerns around traffic were mostly directed at the heavy trucks that may have to utilise the roads, leading to long-term damage to these roads. Public safety was also highlighted since there will be an influx of construction vehicles which would make the roads more unsafe. In addition, damage to roads during the rainy seasons was raised as concern;
- **Damage to private property** as a result of contractor action were raised as a concern, such damage would affect the operational efficiencies of farms;
- The possibility that the project would create **socio-economic** benefits was raised. This was with regards to the benefits that the project will introduce into the affected communities, these can be in form of employment of labour for the project, the development of skills for future employment and development of the communities.

A detailed analysis of the concerns and comments during the public participations is outlined below. These concerns and comments were collected as parts of the EIA scoping phase, specialist's site visits as and consultation with the Comments and Response Report (CRR):

5.3.2.1 Naledi Local Municipality Public Participation

A public participation process was carried out with the affected land owners from different parts of the project. Within the Naledi Local Municipality, the directly affected main areas include Stella, Huhudi and Vryburg. Landowners and community members' concerns were raised in the meetings and are taken into consideration through the compilation of this report.

Concerns noted during this session included:

- **Damage to private property**: concern was raised with regards damage to private property as a result of the project construction. Concern was centred on the farm operations during the construction period and the state of the properties during the decommissioning phase. To mitigate this concern it was suggested that the powerlines should run parallel to the N18. A project team member explained that was not possible owing to there being settlements, structures and unsuitable topography along most of the N 18 route
- **Soil Erosion & Soil Fertility**: concerns were raised regarding the possibility of soil erosion due to the project. Concern was also raised about the impact the project might have on soil fertility.
- **Financial Compensation**: the majority of the affected parties across the project area are concerned about compensation for servitudes used by the project. Landowners specifically noted that in the past they have not been compensated in a proper manner. It was explained at the meeting that the Expropriation Act governs compensation matters by paying out a once-off amount to the affected property owner for the loss of land.
- **Security Concerns**: the accessing of private properties by third parties and people crossing over private properties was raised as a concern. This would allow additional people onto private property. This was an especially sensitive issue amongst the majority of land owners.
- **Electromagnetic field**: general concern was raised with regards the electromagnetic field that would be introduced by the 400kV powerline. The concerns were in relation to the impacts of the EMF (electromagnetic field) on the crops, livestock and wild animals.
- **Economic implications:** some concerns were based around the economic implications of the powerlines. This was mainly raised by tourist destination owners, game/nature reserve owners. These business owners were concerned about the visual impacts of the powerline and how this would impact upon business prospects.

5.3.2.2 Ratlou Local Municipality

Within the Ratlou Local Municipality the affected main areas include Disaneng, Madibogo Pan and Setlagole. Public participation was carried out in the form of authority meetings and a public meeting in the area. The concerns which were noted from the residents are as follows:

- **Project awareness**: during the authority meeting the official in question was concerned about the landowner's knowledge of the project. Landowners have however been notified and informed of the project prior to the meeting.
- Impacts of the project on the **commercial hub of Setlagole**: Setlagole has a proposed commercial hub which is currently being planned, refer to **Figure 38** for a map of the proposed site. The proposed commercial hub is alongside the N18 and in close vicinity to route alternative 3
- **Socio-economic benefits**: community members were interested in the socio-economic benefits resulting from the proposed project. These were mainly job creation for the local community members, skills development and certification to create long terms skills within the community;
- Future **developments within the servitudes**: community members were concerned about the permanent loss of land. They enquired about the ability to erect structures underneath the powerlines and within the servitudes. It was explained that no permanent structures such as cattle kraals and centre pivots were allowed within the servitude. Normal agricultural activities such as grazing and crop planting can still commence.
- **Compensation**: loss of any individual property and structures is was a matter of great concern. Residents were concerned about being compensated for the loss of land, loss of structures and mostly for any relocation which may result from the project.
- **Duration of the project**: this was a concern to the community as they wanted to know the duration of the employment contracts which will be issued. The project is said to start construction by 2021 and to be commissioned by 2024.
- **Social benefits of the project**: concerns regarding the benefits that the project would leave behind for the community. Suggested social benefits included; health care centres, community centres, road infrastructures and improved water facilities.

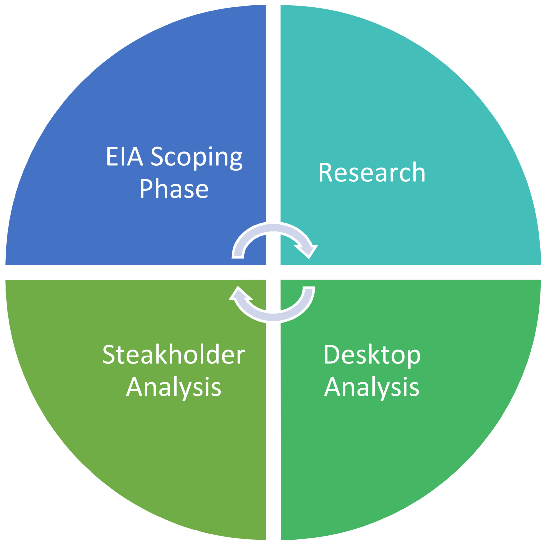
5.3.2.3 Mahikeng Local Municipality

The affected main places within this municipality are Lekung, Mahikeng NU, Lokgalong, Madibe-Magelelo, Masutlhe, Miga, Modimola and Tlapeng. The concerns noted by affected parties are as follows:

- **Compensation**: the majority of the community members were concerned about compensation as they stated that they have had previous problems with regards to the non-payment of compensation for servitudes.
- **Socio-economic benefits:** community members in Lokgalong, Mahikeng and Masulthe and were concerned about the creation of jobs by the project. It was pointed out that projects should try to employ locally based labour, rather than use labour from other areas of the country.
- **Damage to private property and infrastructure**: concerns about damage to the grave sites, farms, open grazing areas and to gravel roads were raised.
- **Traffic congestion**: traffic congestion is a concern for local residents. This concern was prompted by existing road construction on the outskirts of Mahikeng in Rooigrond, this causes traffic delays and poses a security risk for children living in the vicinity of the project.
- **Landowner Consent:** community members in Lokgalong was concerned about the project being carried out without her consent. This concern was prompted by a past where electricity poles were erected on properties without the landowner's knowledge.

6 Identification of Activities, Aspects and Impacts

The methodology for the identification of impacts was threefold. Firstly, an assessment of the scoping phase took place. This was followed a research and desktop analysis. Finally, a stakeholder and site visit was conducted.



The assessment of the scoping phase was important to understand the project background details, location and possible impacts. In this section, the Geographic Information System was used to conduct a thorough analysis of the area. Project details were understood and located.

The second aspect to the identification of impacts was a research and desktop study. Data on the community such as population statistics; health; education; and services were analysed using Census 2011 data. Consultation of relevant studies was conducted to provide an insight and supplement the already acquired knowledge where deemed necessary. A brief analysis of the economic aspect of the community was also assessed. It also allows for the identification of the challenges faced by the community. Not only does the desktop study facilitate site visits; it also directs the discussion during interviews.

Finally, stakeholder engagements were conducted in the form of interviews with directly affected landowners. The Scoping Phase Comments and Response Report also provided valuable insight on interested and affected party's views on the project. Using this methodology, aspects were identified from the activities that proposed. These aspects have triggered impacts which will be discussed in Section 7. In order to contextualise the impacts, the activity and aspects have been outlined and discussed below.

According to ISO 14001-2004 4.3.1 Environmental Aspects; the Organisation shall establish, implement and maintain a procedure(s)

- To identify the environmental aspects of its activities, products and services within the defined scope of the environmental management system that it can control and those it can influence taking into account planned new developments or new or modified activities, products and services, and
- To determine those aspects that have or can have significant impact(s) on the environment (i.e. significant environmental aspects) (International Organization for Standardization, 2011).

6.1 Identification of Activities and Aspects

An "Activity" is defined as a distinct process or risks undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation (International Organization for Standardization, 2011).

The activities identified for the project are listed below as either high risk or lower risk to the social environment.

High Risk Activities:

- Land and Servitude Rights Acquisition;
- Construction Works -
  - the Mahikeng substation;
  - the 400kV Powerline – the erection of the towers and the stringing of the conductors;
  - clearing of vegetation from the servitude;
  - creation of access roads and maintaining existing roads; and
- Rehabilitation of the construction site
- Scheme Operations
  - Operation and maintenance of the servitudes
  - Operation and maintenance of the two substations;
  - Road Maintenance;

Lower Risk Activities:

- The expansion of the Mookodi Substation

An aspect is defined as elements of an organisation's activities or products or services that can interact with the environment.

In order to capture the impacts associated with the proposed infrastructure, an activity – aspect – impact table was created refer to **Table 10**.

The table presents an overview of the impacts associated with aspects during the various stages of the project. Some impacts, including their mitigation measures, are thereafter discussed in detail while the remaining impacts not discussed in this report are addressed in a separate specialist study as part of the EIA study. If the impact is not significant then no further investigation is recommended.

Table 5: Table outlining the Activity, aspects and Impacts of the project

Activity	Aspect	Potential Impact
Land and Servitude Rights Acquisition	Land Acquisition	Partial loss of livelihood on the part of landowners
	Servitude Rights	Reduced access to productive land
	Alteration of land use	Development constraints within the sub places.
Scheme Operations	Enabling development through the network expansion of electricity.	Economic growth and induced impacts
	Supply of goods and services to the scheme	Opportunity for local business.
		Opportunity for local business.
	Administration and Technical Input	Employment of local people
		Skills development
Construction Phase	Access into properties	Security Concerns
		Damage to property or equipment
		Damage or wear to access roads
		Improvement of access in the project area
	Erection of towers and stringing of the conductors.	Proximity to construction work and associated inconvenience and dangers.
		Employment of local people
		Sourcing of equipment, machinery and services locally
	Earthworks and Roadworks	Noise
		Dust
	Concrete and Civil Works	Noise
		Influx of workers
		Employment of local people
		Sourcing of equipment, machinery and services locally
		Temporary road closures
		Increased traffic
	Transport of goods to site and employment of staff	Increased traffic
		Security
		Improved access to amenities
		Damage or wear to access roads
	Mechanical and Electrical Works	Noise
		Employment of local people
		Sourcing of equipment, machinery and services locally
	Rehabilitation	Damage or wear to access roads
		Security Concerns
		Damage to property or equipment
		Damage or wear to access roads

6.2 Impacts and Mitigation Framework

ISO 14001-2004 defines impacts as “any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspects”.

When considering an assessment of the impacts, the following definitions apply.

Nature	The project could have a positive, negative or neutral impact on the environment.
Extent	**Local** – extend to the site and its immediate surroundings. **Regional** – impact on the region but within the province. **National** – impact on an interprovincial scale. **International** – impact outside of South Africa.
Magnitude	Degree to which impact may cause irreplaceable loss of resources: **Low** – natural and social functions and processes are not affected or minimally affected. **Medium** – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way. **High** – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
Duration	**Short term** – 0-5 years. **Medium term** – 5-11 years. **Long term** – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention. **Permanent** – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability	**Almost certain** – the event is expected to occur in most circumstances. **Likely** – the event will probably occur in most circumstances. **Moderate** – the event should occur at some time. **Unlikely** – the event could occur at some time. **Rare/Remote** – the event may occur only in exceptional circumstances.
Significance	Provides an overall impression of an impact’s importance, and the degree to which it can be mitigated. The range for significance ratings is as follows- **0** – Impact will not affect the environment. No mitigation necessary. **1** – No impact after mitigation. **2** – Residual impact after mitigation. **3** – Impact cannot be mitigated.
Mitigation	Information on the impacts together with literature from social science journals, case studies and field work will be used to provide mitigation recommendations to ensure that any negative impacts are decreased and positive benefits are enhanced.

Monitoring	Monitoring usually involves developing and implementing a monitoring programme to identify deviations from the proposed action and to manage any negative impacts. The recommended mitigation measures will also include monitoring measures.

A well-designed, well implemented, well managed power line network expansion can bring significant social benefits to the communities that it serves. If configured or operated in a way that ignores significant social needs or potential impacts, a power line may have significant social costs or liabilities for the stakeholders and affected communities.

Therefore, assessing social impacts is a complex process due to the multi-dimensional nature of the human interactions. This occurs in situations where a particular impact affects a group of stakeholders differently. An inter-connection of impacts can also be encountered whereby a number of impacts are related and when assessed cumulatively their impacts may be of significance.

The impact assessment scores both before and after mitigation were arrived at by the specialist team engaging in a modified version of the Delphi technique, where the team discussed the scores, and through a process of iteration arrived at a consensus for each of the values. Where additional information was needed to make a determination, the technique would be halted, the necessary information would be uncovered and included in the report, and the technique would be recommenced.

6.3 Impact of Providing Electricity through the Network Expansion.

The network expansion proposed through the development of the proposed 400kV powerline has social implications. The social benefits of a sufficient and sustainable power supply are fundamental to the project and the community.

The United Nations Educational Scientific and Cultural Organisation highlight that socio-economic development depends upon the human's use of electricity since electricity is an essential component of modern living.

Electricity supply shortages, and the associated interruptions; have large economic and social implications. Electricity is used as an input by many businesses – manufacturing, irrigated agriculture and offices, whilst sufficient power supply ensures continuing delivery of social benefits such as health care services. Power interruptions cause negative impacts on daily social activities. These include the efficiency and flow of traffic within the cities or towns which rely on traffic lights, the running of trains, lighting in the home and public spaces and other uses in the home such as preparation of food, heating, cleaning, refrigeration and entertainment.

With a secure electricity supply, safety improves since the use of energy sources to carryout household duties such as cooking and lighting require the use of paraffin, candles and possibly small generators, all of which represent a higher safety risk that using electricity.

Agricultural production, even on a subsistence level, thrives with a secure water supply and this is often provided by electricity. Thus, increased electricity supply increases food security. These benefits are all realised through an increase and secures electricity supply.

<table>
<tr><td colspan="2">Environmental Feature</td><td colspan="5">Impacts Created by Providing a Secure, Sufficient Power Supply</td></tr>
<tr><td colspan="2">Project life-cycle</td><td colspan="5">Operational Phase</td></tr>
<tr><td colspan="2">Potential Impact</td><td colspan="5">Proposed Management Objectives / Mitigation Measures</td></tr>
<tr><td colspan="2">Economic</td><td colspan="5">• Increased business productivity;
• Economic growth;</td></tr>
<tr><td colspan="2">Social Benefits</td><td colspan="5">• Convenient and less time consuming daily tasks;
• Facilitation of education
• Facilitation of mass transport;
• Health care.</td></tr>
<tr><td></td><td>Nature</td><td>Extent</td><td>Magnitude</td><td>Duration</td><td>Probability</td><td>Significance</td></tr>
<tr><td>Before Mitigation</td><td>Positive</td><td>Regional</td><td>High</td><td>Long Term</td><td>Likely</td><td>3</td></tr>
<tr><td>After Mitigation</td><td>Positive</td><td>Regional</td><td>High</td><td>Long Term</td><td>Likely</td><td>3</td></tr>
<tr><td>Significance of Impact and Preferred Alternatives</td><td colspan="6">Mitigation is not necessary for this positive impact.

This mitigation measure does not influence the choice of alternatives considered in the study.</td></tr>
</table>

6.4 Impact Owing to Routing and Site Selection

The implementation of the proposed project will have an impact on landowners in that land would need to be acquired, and servitudes registered for the various project components.

Landowners would have a reduced land area to generate income and servitude conditions are likely to restrict the existing use of land.

In this regard, the final route and tower location will be carried out prior to construction. A final walk down survey by the specialists will be carried out and negotiations with landowners will begin after route selection has been completed.

Where impacts on agricultural productivity occur and cannot be mitigated by re-location of towers, compensation will be required for all affected landowners. Those landowners who will be directly affected through the sale of their property and loss of land through the footprints of the towers should be compensated for the land, immovable assets and loss of business. Landowners who will be impacted upon by Eskom requiring a servitude over their land should be compensated for the servitude rights.

Eskom (SOC) Ltd are responsible for land and rights acquisition. They should ensure that this process is conducted accordance with the Expropriation Act, 63 of 1975. The process should be a fair and independent land valuations should be conducted. This process should be undertaken in the project planning phase and should be concluded prior to the start of construction.

Similarly, servitudes would have to be negotiated and registered in terms of the Alienation of Land Act, 68 of 1981. There will be discussions and engagement with landowners to come to an agreement with regards to the servitude registration and servitude restrictions.

There are a number of sections along the various powerline route alternatives where impacts upon existing land-use will be higher than that along other sections. These high impact sections are captured in the figures below and in more detail elsewhere in this report.

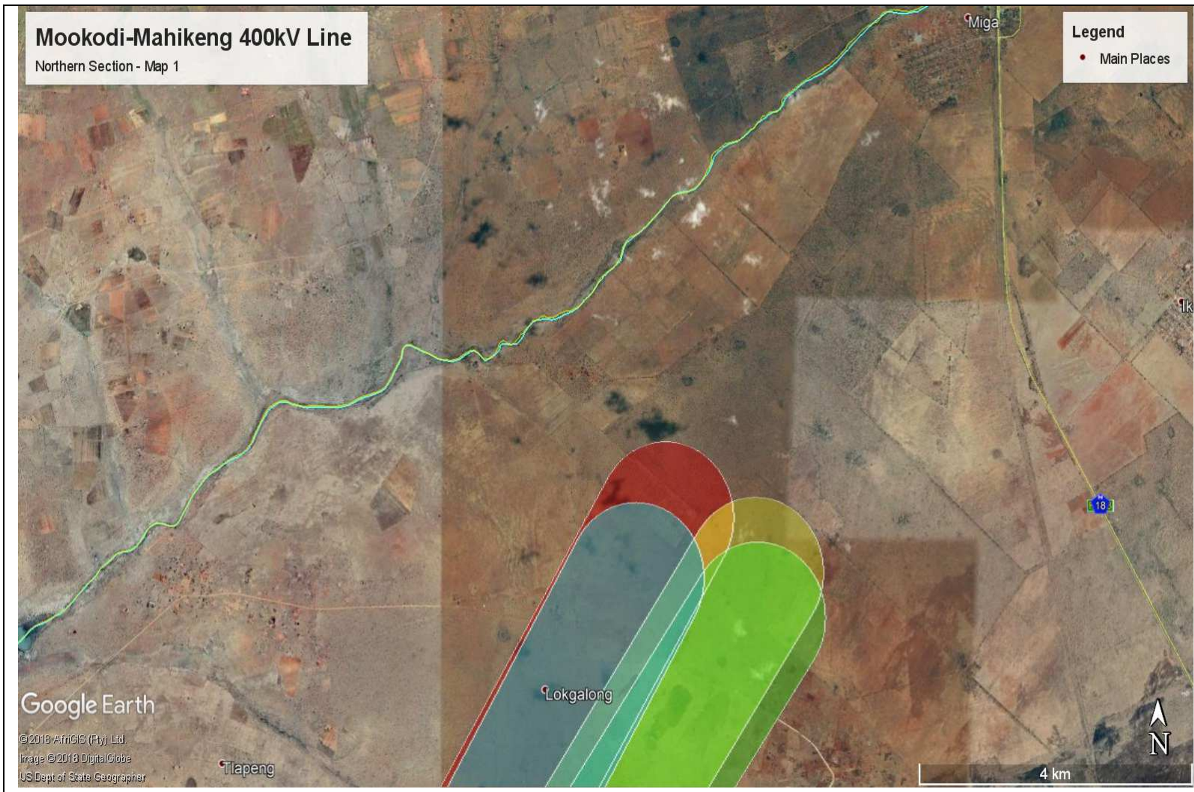


Figure 40: Lokgalong Affected Area - Northern Section

Figure 41: Lokgalong and Masutlhe - Northern Section

Figure 42: Modimola affected area - Northern Section

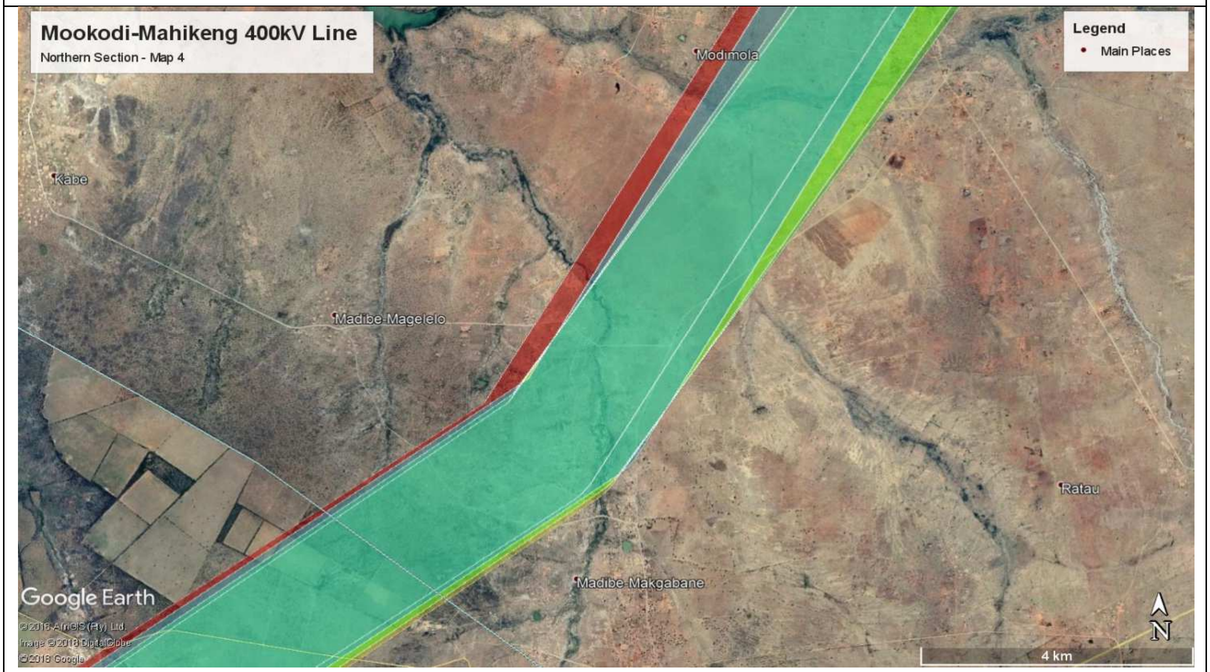


Figure 43: Madibe-Magelelo - Northern Section

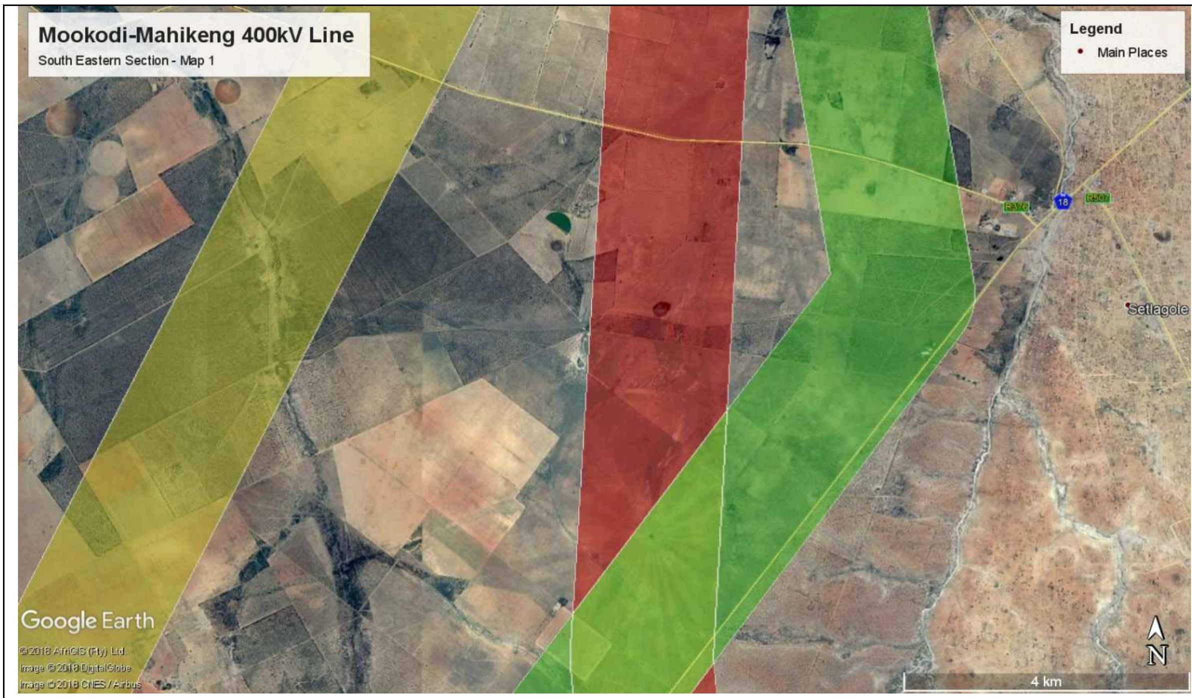


Figure 44: Setlagole - South Eastern Section

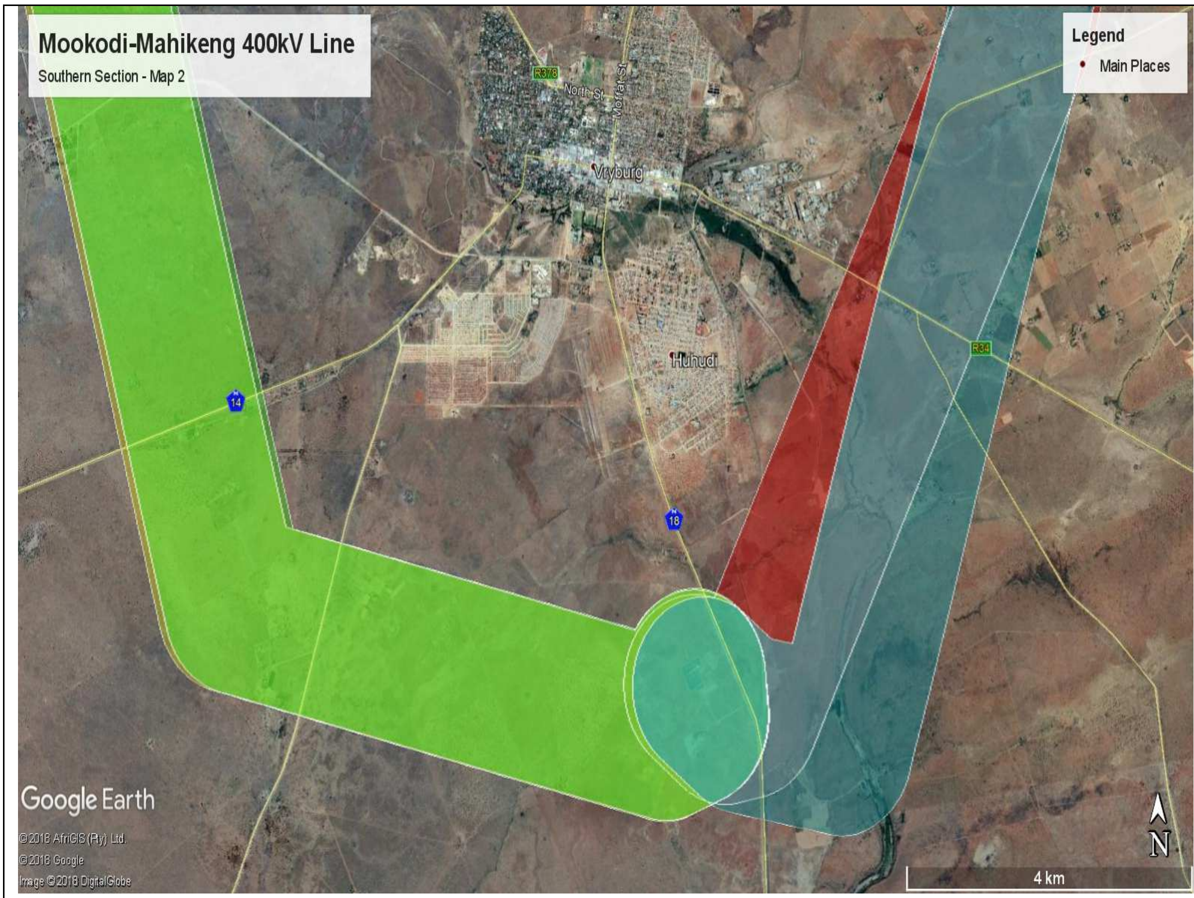


Figure 45: Vryburg Combined Affected areas - Southern Section

Figure 41 illustrates the northern section of the project which is near the proposed Mahikeng substation site. Rural settlements of Lokgalong, Tlapeng and Miga are located in this vicinity. The area consists of grazing land and substantial small scale farming. The settlements are scattered and any analysis of the corridor shows that many structures would be impacted by the new powerline. In this area, careful siting of the towers should avoid the need for relocation of inhabitants and the avoidance of infrastructure, although this outcome cannot be guaranteed.

Masutlhe is also directly affected by the project. The impact can be seen in **Figure 42** and elsewhere in this report. Again, careful siting of the towers is needed to avoid dwellings and infrastructure

Modimola, as seen in **Figure 43** is also directly affected, mainly by the north western edge of route alternative 2. Passing the powerline through this area would be less restricted were it to follow Option1, Option 3 or Option 4.

The corridors in Madibe-Magelelo region make their way through settlements as shown in **Figure 44**. In this area, the powerline can be placed so as to avoid impacting upon dwellings and infrastructure. This section of the powerline has relatively poor access roads and this would mean that new access roads may need to be developed as well as maintenance having to be carried out on existing access roads.

The impact of route alternative 3 on the town of Setlagole is seen in **Figure 45**. The green (or right-hand most route) is close to, but not impacting upon, the site proposed for the a new commercial centre. There are dwellings and infrastructure in this area, although these can be avoided through careful placement of the towers within the corridors.

Figure 46 shows the route options in the vicinity of Vryburg. Route options either run to the east of the town or to the west. Both routes will impact upon commercial and residential properties, but the highest impact is likely to be in the routes taken to the east of the town. In all cases, however, the corridor provides a great deal of flexibility with regards tower placement and direct impact can be avoided.

Environmental Feature	Impact owing to Land and Rights Acquisition
Relevant Alternatives & Activities	Acquisition of land
Project life-cycle	Pre-construction
Potential Impact	Proposed Management Objectives / Mitigation Measures
Loss of income from the acquisition of land	• Where-ever possible, the final routing of the project infrastructure should be adjusted to avoid impacts. If the powerline servitude is such that it allows powerline alignment to the extent that an impact on a dwelling can be avoided, this should be done. • Where impacts cannot be avoided, all negotiations and payments relating to compensating affected landowners should be conducted and concluded before construction begins. • Those landowners who will be required to sell their property to Eskom SOC Ltd must be compensated for any business that is operating on the premises. • All landowners whose businesses will be affected by the proposed project should be compensated to the full value of their immovable assets and any loss of income. • Negotiations should take place between the landowner and Eskom for any compensation of potential income denied as a result of the servitude agreements.
Relocation of Households	• In the event that household relocation will be necessary, the process to be followed is as follows: o A relocation action plan to be drawn up providing detail on the impacted households, the households needs and how these will be catered for during and after the relocation, provides detail on the area to which they are to be relocated and the timeframes associated with the relocation; o The relocation action plan is to be discussed with every impacted household and agreed to in writing;

	o The relocation action plan is to be discussed with every impacted landowner (if this is not the same as the impacted household) and agreed to in writing; o Relocation is to be effected in strict accordance with the relocation action plan; and o An independent audit, carried out by a suitably qualified relocation expert, is to be conducted after every relocation to: determine the relocation's effectiveness and to identify shortfalls in adhering to the relocation action plan; and o Shortfalls are to be addressed by the proponent within the duration of the construction period of the project.					
Construction Period and time frame	• Careful planning should be adopted to reduce the impact of land acquisition on the overall programme for the works					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Regional	High	Medium term	Likely	3
After Mitigation	Negative	Local	Medium	Medium term	Likely	1
Significance of Impact and Preferred Alternatives	The final routing of the powerlines within the chosen route alternative corridor and the selection of the Mahikeng substation site are the primary mitigation measures that should be adopted. The routing and site selection should be carried out so as to avoid impacting upon existing development as far as possible. The route alternative with the least impacts is route option 3, which runs for a distance of 187 kilometres. Route option 2 is the second most preferred route from an impact perspective, this route runs for 176 kilometres.					

6.5 Impacts on Siting of the Mahikeng Substation

The selection of the Mahikeng substation site will have impacts upon current inhabitants of the area surrounding the site. Lokgalong is slowly expanding in the vicinity of the proposed substation.

Site selection should be carefully considered, using a detailed and up to date survey of the structure in the vicinity, in order to site the substation with as few impact as possible.

Environmental Feature	Impact of the siting Mahikeng substation
Project life-cycle	Planning Phase

<table>
<tr><td colspan="2">Potential Impact</td><td colspan="5">Proposed Management Objectives / Mitigation Measures</td></tr>
<tr><td colspan="2">Loss of productive land due to site selection</td><td colspan="5">• Siting of the substation to avoid impacts on residents in the vicinity. This should be carried out using an up to date survey of the structures in the area and input from the Town Planning department of the Mahikeng Local Municipality;</td></tr>
<tr><td></td><td>Nature</td><td>Extent</td><td>Magnitude</td><td>Duration</td><td>Probability</td><td>Significance</td></tr>
<tr><td>Before Mitigation</td><td>Negative</td><td>Local</td><td>High</td><td>Long Term</td><td>Likely</td><td>3</td></tr>
<tr><td>After Mitigation</td><td>Negative</td><td>Local</td><td>Medium</td><td>Long Term</td><td>Likely</td><td>2</td></tr>
<tr><td>Significance of Impact and Preferred Alternatives</td><td colspan="6">The siting of the substation on in Mahikeng will impact upon the location of future residential development within Lokgalong. The site should be located so as to avoid structures erected in the vicinity and also take into account the town planning for the area.</td></tr>
</table>

6.6 Impacts during the Construction Phase

The construction activity will impact the social environment both positively and negatively. Given the nature of the project area, construction activity is likely to cause a number of social nuisances as well as possible economic implications on the communities and commercial activities.

Cumulative impacts can be both positive and negative. Cumulative impacts refer to the impacts that are incremental on the environment that results from the impacts of the proposed action when added to the existing and foreseeable future actions. These impacts can also be temporary in nature (by being restricted to the construction phase) and permanent (occurring in both the construction and operation phase).

6.6.1 Economic Opportunity

The high number of impoverished households shows that there are vulnerable communities in the study area. It is recommended that the appointed contractor use local SMME's and local labour as far as possible during the construction phase to enhance any local economic impact. In addition, this would increase the skills in the area after construction is completed.

In this way project revenue will stay in the area, raising economic activity and increasing welfare, resulting in induced economic opportunity. In South Africa, most employment is generated through small and medium business. Given the size of the proposed project, should contracts between local SMMEs be implemented, it is likely that there will be an increase in employment by SMMEs for the duration of the contracts.

In particular, the project has the potential to create a number of opportunities for existing and new local SMMEs. These opportunities range from site clearing, to fencing, parts of the construction scope and supply of materials. There are also opportunities for community members to provide labour, catering, accommodation and other services to the new workers.

Where possible, Eskom should support and encourage the development of SMMEs and local or regional suppliers in line with government policy.

Education levels provide an indication of the level of skill in the community and the degree to which skills can be skilled. Rural and less developed areas are mostly defined by poverty, while poverty is associated with poor education outcomes.

Attempts to break the poverty cycle of the project areas will require more than secondary school education. Higher education or further skills training is required. It is therefore important that the community members under-go skills development. It is also recommended that the Eskom institute a skills development program during construction.

Eskom should monitor the employment process. Employment audits should be conducted. It is important that women are also provided employment opportunities. Audits should pay attention to the employment process of women to ensure that exploitation does not take place.

6.6.2 Noise and Dust

During the construction phase communities may be exposed to increased dust, noise, visual and other nuisance disturbances.

The generation of dust stems from activities such as earthworks and as well as vehicle movement during the construction phase. This situation will be worst during the dry season and during windy seasons. Air borne particulates may pose a hazard to residents in the vicinity or downwind of the construction site that suffer from upper respiratory tract problems. Mitigation through dust suppression methods will allow for this impact to be effectively managed.

During the construction, heavy equipment may be required for the site clearance, road construction, substation and the erection of the electrical towers and powerlines. Noise generation will be unavoidable. The degree of noise, frequency of noise and individual perception are all important considerations when determining the impact on noise. Drilling; blasting and construction activities will also create noise pollution. Adequate warning of high noise events such as blasting should be communicated to the affected communities prior to carrying out the activities.

6.6.3 Worker Health and Safety

The impacts of construction can affect the health and safety of those working on the construction site; disturbance, health and income of the host communities; and disturbance to the environment and animals. These impacts can be mitigated in the Environmental Management Programme (EMPr) and through adherence to the Occupational Health and Safety Act 85 of 1993.

An influx of workers is often characterised by higher health risks, particularly if the influx is male dominated. These include a higher disease burden and rise in HIV/AIDS rates. There should also be awareness and education campaigns on health and social risks such as HIV/AIDs and crime prevention.

6.6.4 Security

There a safety concerns related to the construction activity. Landowners have expressed a number of security concerns including increased access to the farms and crime. Trespassing was cited as a concern as well of damage to property once access is granted.

Mitigation measures include Eskom, prior to construction, agreeing with farmers on appropriate access points to ensure the safety of the businesses, livestock and residents. A security policy must be drafted and strictly enforced by the contractors; this would include a requirement to obtain landowner permission prior to any property. As good practice and mitigation against security risks, Eskom should provide some level of security and emergency response services for the duration of the construction measure. All contractors and service providers should obtain permission to enter any property.

6.6.5 Damage to Property Once Access is granted

Once access to a property is granted, mitigation measures should be taken to ensure that any damage that is caused as a result of this access is made good. This includes damage to infrastructure such as fences, gates, electrical connections or roads.

Property damage includes the destruction of crops that may be required at the time of site clearance.

Where there is a risk of damage occurring, the contractor is to document to the condition prior to the start of work. If the condition has deteriorated after the completion of the work, any such damage should be made good. Landowner signed off that the damage has indeed been rectified should be obtained.

6.6.6 Local Road Condition and Traffic Impacts

Local road access will be used during the project, and as a result these roads may be subject to damage. The project is to maintain the local roads for the duration of the contract and should leave them in a state the same or better than they were prior to the start of the construction phase.

Heavy duty trucks and construction vehicles will cause damage to the current road conditions as well as contribute to congestion on the roads.

The greater the number of trucks on the road, the greater the risk of road accidents occurring. It is important that the contractors are sensitive to the road conditions and ensure that throughout the construction process that these roads are maintained and suitable for small vehicles

Environmental Feature	Economic opportunities arising from the construction phase
Project life-cycle	Construction phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
SMME Creation	• Local SMMEs should be given an opportunity to participate in the construction of the project through the supply of services, material or equipment.
Job Creation and Skills Development	• The main contractor should employ non-core labour from the Main places as far as possible during the construction phase. • The principles of Expanded Public Works Programme can be used for guiding the construction.

Environmental Feature	Economic opportunities arising from the construction phase					
Project life-cycle	Construction phase					
Potential Impact	Proposed Management Objectives / Mitigation Measures					
Indirect Employment Impacts	• Spaza/informal trader shops may open next to the site as a consequence of construction. These should be controlled by the contractor to limit their footprint and to ensure that the local Municipalities – Informal Trading By-laws are complied with.					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Medium	Short Term	Likely	1
After Mitigation	Positive	Local	Low	Short Term	Likely	3
Significance of Impact and Preferred Alternatives	Individuals who will benefit during the construction are limited to those who actively participate in the construction activity through employment, sub-contracting or other economic opportunities. Active participation should be encouraged. The benefits on such a construction will take place irrespective of which routing alternative is preferred.					

Environmental Feature	Disturbance arising from the construction phase
Project life-cycle	Construction phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Traffic	• Ensure that the necessary signage and traffic measures are implemented for safe and convenient access to the site; • Additional creation of routes and access roads must be implemented to reduce heavy traffic flow; • The EMPr must include restrictions on the Contractor and its sub-contractors related to minimising impacts on the safety of road users; Restrictions should include appropriate speed limitations, restricting travel times to daylight hours, communication measures and the establishment of haul routes.; • Measures must be put in place to prevent construction vehicles from entraining dirt onto public roads; • Traffic control personnel must be assigned where deemed necessary, this will be to control the movement of construction vehicles in relation to local vehicles to ensure maximum safety and coherence.
Local Road Condition	• A continuous condition survey of the local roads to be used during the construction phase should be made prior to construction; • Delivery routes should be defined and adhered to during the construction phase; • Maintenance of local roads should take place during the construction phase, ensuring that the local roads used by the contractor are left in the same or better condition than they were prior to the start of construction.

Environmental Feature	Disturbance arising from the construction phase
Project life-cycle	Construction phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Increase in Dust	• Dust and disturbance can be mitigated through the use of appropriate dust suppression mechanisms; • Adherence to road signage can be added as an advantage and a measure to manage the increase in dust levels; • Mitigation measures management should be adhered to according to the relevant specialist studies.
Influx of workers	• All employment of locally sourced labour should be controlled on a contractual basis. If possible, and if the relevant Ward Councillors deem it necessary, the employment process should include the affected Ward Councillors. • People in search of work may move into the area, however, the project will create a limited number of job opportunities. Locally based people should be given opportunities and preferences over others; • No staff accommodation should be allowed on site; • Influx of workers could may lead to increased diseases and HIV/AIDSs & STI as well as STD infections, therefore awareness programmes should be implemented through the local educational institutions and for the workers as well.
Worker Health and Safety	• The provisions of the OHS Act 85 of 1993 and the Construction Regulations of 2014 should be implemented on all sites; • Account should be taken of the safety impacts on the local community when carrying out the longitudinal aspects of the project, such as the pipelines; • Contractors should establish HIV/AIDs awareness programmes at their site camps.
Security	• The sites of the substations should be fenced for the duration of construction; • All contractors' staff should be easily identifiable through their respective uniforms; • A security policy should be developed which amongst others requires that permission be obtained prior to entering any property and provisions controlling trespassing by contractor staff; • Security staff should only be allowed to reside at contractor camps and no other employees; • Contractors should establish crime awareness programmes at their site camps.
Noise impacts	• Prior notice should be given to surrounding communities of drilling events; • Construction work should take place during working hours – defined as 07h00 to 17h00 on weekdays and 07h00 to 14h00 on Saturdays. Should overtime work be required, that will generate noise, consultation with the affected community or landowner should take place.
Damage to property	• If a risk existing of damage taking place on a property as a result of construction, a condition survey should be undertaken prior to construction; • The contractor is to make good and acknowledge any damage that occurs on any property as a result of construction work;

Environmental Feature	Disturbance arising from the construction phase					
Project life-cycle	Construction phase					
Potential Impact	Proposed Management Objectives / Mitigation Measures					
	• Where crops and agricultural machinery are damaged, compensation is to be paid to the farmer for the loss of these crops; • The farmer should be compensated for any loss of income experienced at the account of the contractor.					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Short Term	Likely	2
After Mitigation	Negative	Local	Low	Short Term	Moderate	1
Significance of Impact and Preferred Alternatives	Disturbances and irritation during construction is to be expected. These can then be successfully mitigated through contractor specifications that are issued at a tender stage and through the continuous monitoring of contractor proceedings and performance during construction phase. Negative impacts owing to the construction will unfortunately be experienced irrespective of the site and routing alternative that is most preferred and chosen.					

7 ANALYSIS OF ALTERNATIVES

Based on the impact assessment and the suggested mitigation measures, the following preferences with regards powerline routing alternatives can be described. These preferences are made from a social assessment perspective and do not take into account other project criteria.

Having taken into consideration the project aims of increasing and stabilising the supply of electricity in Mahikeng area, and considering the assessment above which does not indicate any fatal social flaws, the No-Go option is not supported.

The benefits from the project going ahead, from a social perspective, will be larger than the project not proceeding.

With regards to project alternatives, the table below describes the preferred alternatives and the reasons for their selection.

Table 6: Table illustrating Project Components and Alternatives

Component	Alternatives	Order of Preference (1: most preferred, 3: least preferred)	Comments
Go / No Go	To not carry out the proposed project	Not Supported	Subsequent electricity supply to the area will be less secure that if the project did not go ahead. A secure power supply is a fundamental input to the social and economic activities of the area.
400Kv Powerline	Route alternative 1 WM1	3	The social impact assessment aims to reduce the impact upon as many people as possible through the selection of a preferred alternative, it also aims to select the shortest feasible route following the principal that reducing the cost for the same outcome is a social benefit. It should be noted that there are no alternative routes available for selection as the proposed powerline travels through traditional areas. Therefore, the only selection criteria that can be applied are relevant only to the southern and central section of the powerline, sections that are dominated by commercial farming and formal enterprise.

Component	Alternatives	Order of Preference (1: most preferred, 3: least preferred)	Comments
			As a result, Option 1 is not the preferred route; it impacts upon 32 farm buildings or dwellings; 5 irrigation pivots; and 22 smallholdings. It is also 186 kilometres long, so the additional distance travelled does not have an offsetting advantage of creating a lesser social impact than the alternatives.
	Route alternative 2 WM13	1	Option 2 has the advantage of being the shortest of the four routes under consideration. It impacts upon relatively few farm buildings and the lowest number of irrigation pivots. However, it impinges upon the most smallholdings and commercial enterprises, passing as it does to the east of Vryburg. This route crosses the N18 twice as well as railway line and avoids the centre of Setlagole. Given that it is the shortest route, and does not have the shortfalls of route alternative 3, it is therefore the preferred route from a social perspective.
	Route alternative 3 WM4a	2	Route option 3 is the longest route, at 187 kilometres. It does however impact the least number of farm buildings. The corridor does travel over the most number of irrigation pivots and two hatcheries. It impacts upon the least number of smallholdings. This route also impacts upon the centre of Setlagole and might impede its natural growth. The route crosses the N18 twice and passes to the west of Vryburg, creating a ring around the town that may impact upon future development. Having regard to the above, this route is not preferred by the social impact assessment.
	Route Alternative 4 WM9a	3	Route option 4 is another long route, at 185 kilometres. This route is similar to Option 2 in the sense that it impacts the most smallholdings and commercial enterprises to the east of Vryburg. In addition, it impacts upon the most number of farm

Component	Alternatives	Order of Preference (1: most preferred, 3: least preferred)	Comments
			buildings or dwellings of all the options. Given that it has a higher impact than Option 2, being longer, this route is not preferred by the social impact assessment.

8 CONCLUSION

The study assessed the social and potential economic impacts of the proposed project. As expected of any construction project, there were several positive and negative social as well as economic impacts identified.

No social fatal flaws were identified resulting from the development of the project and the most serious long term impact would be the location of the Mahikeng substation, which may impact upon the future development of the settlements within the vicinity and Mafikeng NU collectively.

The identified negative impacts can be successfully mitigated and the positive impacts will bring economic and social benefit to the area, they therefore do not require any mitigation.

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APPENDIX 1: CENSUS OF PROPOSED POWERLINE IMPACTS

Table 1: Farm Dwellings Directly Impacted by the Project – All Routes

Name	Co-Ordinates	Route Option	Image
Farm Dwelling	S 25 54 52 E 25 23 34	All Routes	
Farm Dwelling	S 25 56 55 E 25 19 32	All Routes	
Farm Dwelling	S 26 00 17 E 25 14 55	All Routes	
Farm Dwelling	S26 00 36 E 25 14 48	All Routes	

Table 2: Farm Dwellings Directly Impacted by the Project – Route Option 1

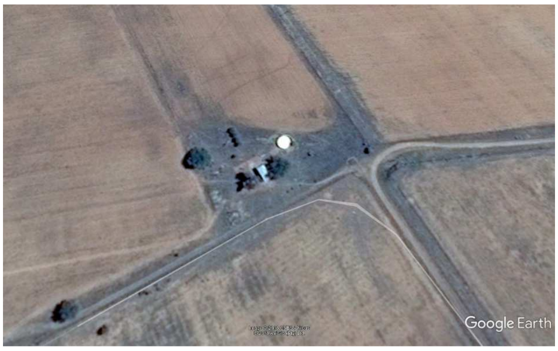
Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 13 28 E25 02 08	Route Option 1	
Farm Buildings	S 26 14 00 E 25 02 20	Route Option 1	
Farm Buildings	S 26 17 03 E 24 59 58	Route Option 1	
Farm Buildings	S 26 18 05 E 25 00 09	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Farm Buildings and Irrigation Pivot	S 26 20 19 E 24 58 31	Route Option 1	
Farm Buildings	S 26 20 32 E 24 58 01	Route Option 1	
Irrigation Pivot	S 26 21 31 E 24 57 31	Route Option 1	
Farm Buildings	S 26 23 04 E 24 56 34	Route Option 1	
Farm Buildings	S 26 23 26 E 24 56 41	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 24 15 E 24 56 24	Route Option 1	
Farm Buildings	S 26 25 25 E 24 56 12	Route Option 1	
Farm Buildings	S 26 27 04 E 24 54 15	Route Option 1	
Farm Buildings	S 26 29 11 E 24 51 39	Route Option 1	
Farm Buildings	S 26 30 13 E 24 51 24	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 30 45 E 24 50 29	Route Option 1	
Smallholding	S26 31 10 E 24 50 14	Route Option 1	
Smallholding	S 26 31 14 E 24 50 18	Route Option 1	
Smallholding	S 26 31 19 E 24 50 19	Route Option 1	
Smallholding	S 26 31 28 E 24 50 25	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 31 32 E 24 50 27	Route Option 1	
Smallholding	S 26 31 51 E 24 50 23	Route Option 1	
Smallholding and Orchard	S 26 31 41 E 24 50 08	Route Option 1	
Smallholding	S 26 31 34 E 24 50 10	Route Option 1	
Smallholding and Irrigation Pivots	S 26 31 18 E 24 49 53	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 31 26 E 24 49 36	Route Option 1	
Smallholding	S 26 31 27 E 24 49 24	Route Option 1	
Smallholding and Crops	S 26 31 28 E 24 48 59	Route Option 1	
Smallholding	S 26 31 51 E 24 50 05	Route Option 1	
Smallholding	S 26 31 46 E 24 49 51	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 31 52 E 24 49 39	Route Option 1	
Smallholding	S 26 32 11 E 24 49 41	Route Option 1	
Farm Buildings	S 26 33 10 E 24 49 19	Route Option 1	
Farm Buildings	S 26 32 46 E 24 48 44	Route Option 1	
Farm Buildings	S 26 34 09 E 24 47 44	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 36 09 E 24 46 12	Route Option 1	
Farm Buildings and Crops	S 26 37 22 E 24 45 03	Route Option 1	
Farm Buildings	S 26 37 56 E 24 44 18	Route Option 1	
Farm Buildings	S 26 42 55 E 24 40 11	Route Option 1	
Farm Buildings	S 26 43 07 E 24 39 25	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 46 04 E 24 36 59	Route Option 1	
Farm Buildings and Irrigation Pivot and Crops	S 26 49 21 E 24 36 59	Route Option 1	
Farm Buildings	S 26 51 02 E 24 37 10	Route Option 1	
Farm Buildings	S26 51 33 E 24 37 36	Route Option 1	
Farm Buildings	S 26 53 49 E 24 38 17	Route Option 1	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 54 08 E 24 38 10	Route Option 1	
14 other impacts: same as route option 3		Route Option 1	

Table 3: Farm Dwellings Directly Impacted by the Project – Route Option 2

Name	Co-Ordinates	Route Option	Image
Farm Building, also along Route Option 3	S 26 10 49 E 25 04 13	Route Option 2 Route Option 3	
Farm Dwelling	S 26 15 47 E 23 03 57	Route Option 2	
Farm Buildings	S 26 17 47 E 25 03 34	Route Option 2	
Farm Dwellings	S 26 22 35 E 25 03 27	Route Option 2	
Farm Buildings	S 26 24 43 E 25 03 37	Route Option 2	

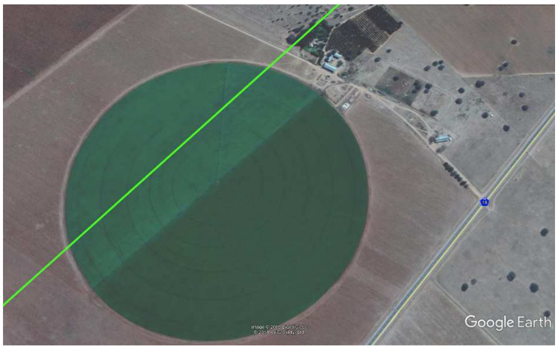
Name	Co-Ordinates	Route Option	Image
Farm Dwelling	S26 30 32 E 25 04 57	Route Option 2	
Farm Buildings	S 26 33 43 E 25 02 41	Route Option 2	
Farm Buildings	S 26 33 43 E 25 01 32	Route Option 2	
Farm Buildings	S 26 36 11 E 24 59 41	Route Option 2	
Farm Buildings	S 26 36 20 E 24 59 07	Route Option 2	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 36 47 E 24 59 43	Route Option 2	
Farm Buildings	S 26 37 01 E 24 58 29	Route Option 2	
Farm Buildings	S 26 37 55 E 24 58 41	Route Option 2	
Farm Dwelling	S 26 43 25 E 24 53 32	Route Option 2	
Farm Buildings	S 26 44 34 E 24 52 00	Route Option 2	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 46 12 E 24 50 30	Route Option 2	
Farm Buildings	S 26 48 33 E 24 49 23	Route Option 2	
Farm Dwellings	S 26 48 26 E 24 49 59	Route Option 2	
41 other impacts: same as route option 4		Route Option 2	

Table 4: Farm Dwellings Directly Impacted by the Project – Route Option 3

Name	Co-Ordinates	Route Option	Image
Building 1	S 26 10 49 E 25 04 13	Route Option 3 Route Option 2	
Irrigation Pivots 1	S 26 12 59 E 25 04 48	Route Option 3	
Commercial 1	S 26 17 54 E 25 05 42	Route Option 3	
Farm Buildings	S 26 18 02 E 25 04 45	Route Option 3	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 22 38 E 25 0 38	Route Option 3	
Farm Building	S 26 22 24 E 25 01 28	Route Option 3	
Farm Building and Pivots	S 26 23 21 E 25 00 44	Route Option 3	
Farm Buildings and Pivot	S 26 22 19 E 25 00 40	Route Option 3	
Hatchery	S 26 24 21 E 25 00 00	Route Option 3	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 24 01 E 25 00 36	Route Option 3	
Hatchery	S 26 25 43 E 24 59 19	Route Option 3	
Farm Buildings	S 26 27 17 E 24 57 35	Route Option 3	
Farm Buildings	S 26 28 23 E 24 56 59	Route Option 3	
Irrigation Pivot	S 26 28 35 E 24 56 08	Route Option 3	

Name	Co-Ordinates	Route Option	Image
Farm Buildings and Irrigation Pivots	S 26 29 56 E 24 56 31	Route Option 3	
Farm Buildings and Irrigation Pivot	S 26 36 49 E 24 54 34	Route Option 3	
Farm Buildings	S 26 39 34 E 24 50 52	Route Option 3	
Farm Buildings	S 26 41 21 E 24 49 48	Route Option 3	
Farm Buildings	S 26 42 06 E 24 49 38	Route Option 3	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 43 35 E 24 47 21	Route Option 3	
Farm Dwellings	S 24 45 30 E 24 46 38	Route Option 3 Route Option 4	
Farm Buildings	S 26 48 46 E 24 43 32	Route Option 3	
Farm Buildings	S 26 51 54 E 24 41 26	Route Option 3	
Farm Buildings	S 26 52 23 E 24 41 24	Route Option 3	

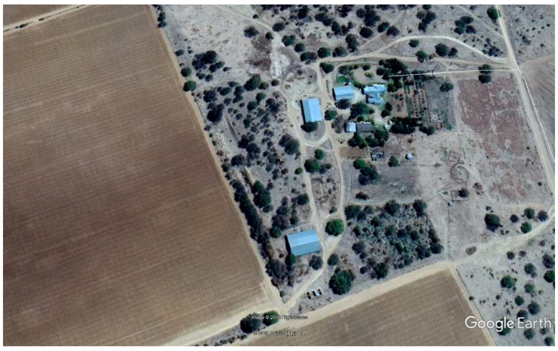
Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 54 06 E 24 38 46	Route Option 3 Route Option 1	
Two Smallholdings	S 26 54 18 E 24 39 05	Route Option 3 Route Option 1	
Smallholding	S 26 54 22 E 24 39 11	Route Option 3 Route Option 1	 Smallholding
Smallholding	S 26 54 57 E 24 39 14	Route Option 3 Route Option 1	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 54 44 E 24 39 23	Route Option 3 Route Option 1	
Smallholding	S 26 54 56 E 24 39 23	Route Option 3 Route Option 1	
Farm Building and Irrigation Pivots	S 26 55 03 E 24 38 34	Route Option 3 Route Option 1	
Institution	S 26 57 20 E 24 39 10	Route Option 3 Route Option 1	
Housing	S 26 58 59 E 24 40 53	Route Option 3 Route Option 1	

Name	Co-Ordinates	Route Option	Image
Commercial	S 26 59 08 E 24 40 24	Route Option 3 Route Option 1	
Housing	S 26 59 12 E 24 40 08	Route Option 3 Route Option 1	
Farm Buildings	S 26 59 30 E 24 40 42	Route Option 3 Route Option 1	
Farm Buildings	S 27 00 38 E 24 41 00	Route Option 3 Route Option 1	
Farm Buildings	S 27 00 09 E 24 41 59	Route Option 3 Route Option 1	

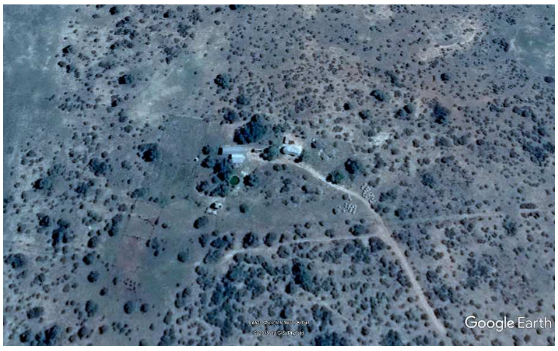
Table 5: Farm Dwellings Directly Impacted by the Project – Route Option 4

Name	Co-Ordinates	Route Option	Image
Farm Building	S 26 12 72 E 24 56 33	Route Option 4	
Farm Buildings	S 26 12 46 E 24 55 40	Route Option 4	
Farm Dwellings	S 26 13 48 E 24 54 19	Route Option 4	
Farm Dwellings	S 26 14 07 E 24 54 23	Route Option 4	

Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 14 54 E 24 53 38	Route Option 4	
Farm Buildings	S 26 18 01 E 24 52 42	Route Option 4	
Farm Buildings	S 26 22 39 E 24 49 35	Route Option 4	
Farm Buildings	S 26 25 01 E 24 47 46	Route Option 4	
Farm Building	S 26 25 54 E 24 47 14	Route Option 4	

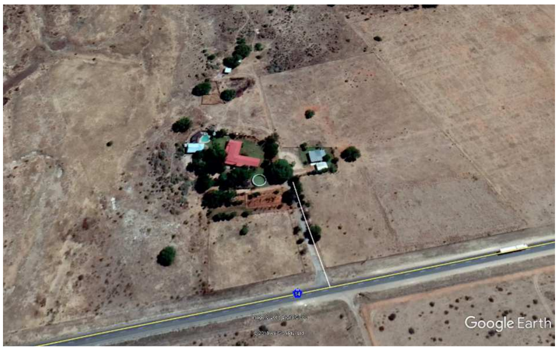
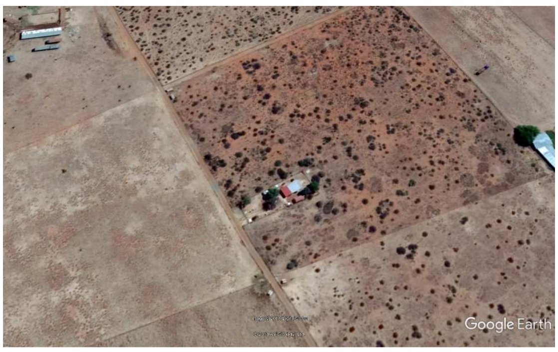
Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 28 21 E 24 46 12	Route Option 4	
Farm Buildings	S 26 29 32 E 24 45 18	Route Option 4	
Farm Buildings	S 26 30 43 E 24 44 52	Route Option 4	
Farm Buildings	S 26 31 37 E 24 44 33	Route Option 4	
Farm Buildings	S 26 32 54 E 24 43 52	Route Option 4	

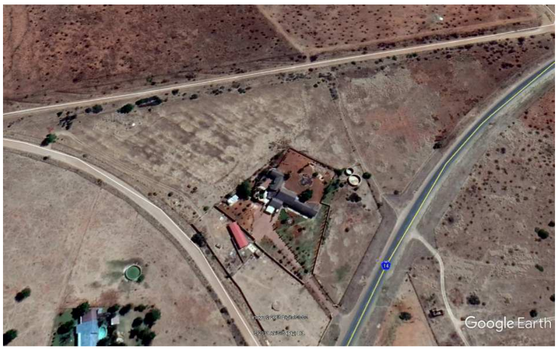
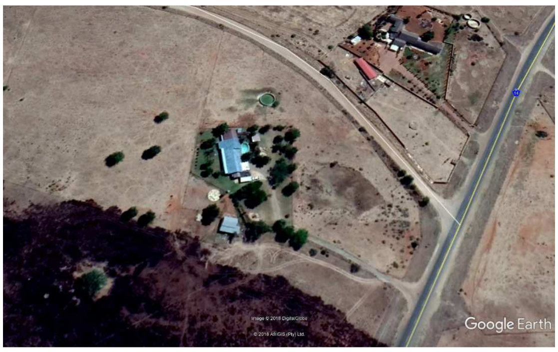
Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 34 18 E 24 42 26	Route Option 4	
Farm Buildings	S 26 35 41 E 24 42 19	Route Option 4	
Farm Buildings	S 26 36 17 E 24 42 32	Route Option 4	
Farm Dwellings	S 26 42 01 E 24 45 12	Route Option 4	
Farm Buildings	S 26 43 16 E 24 46 07	Route Option 4	

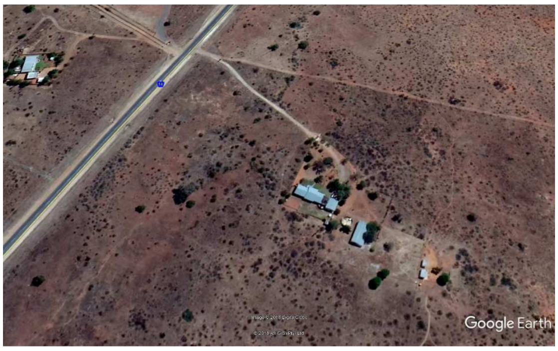
Name	Co-Ordinates	Route Option	Image
Farm Dwelling, also on Option 3		Route Option 4 Route Option 3	
Farm Buildings	S 26 45 56 E 24 47 23	Route Option 4	
Holiday Resort	S 26 47 14 E 24 47 06	Route Option 4	
Farm Buildings	S 26 49 50 E 24 48 30	Route Option 4	
Farm Dwelling	S 26 50 37 E 24 49 17	Route Option 4	

Name	Co-Ordinates	Route Option	Image
Farm Dwelling	S 26 51 02 E 24 48 47	Route Option 4	
Rail Crossing	S 26 52 31 E 24 48 17	Route Option 4 Route Option 2	Near Paradise Station
Farm Dwelling	S 26 52 35 E 24 49 04	Route Option 4 Route Option 2	
Farm Dwelling	S 26 52 51 E 24 48 13	Route Option 4 Route Option 2	
Farm Dwelling	S26 53 01 E 24 48 06	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Farm Dwellings	S 26 54 04 E 24 48 08	Route Option 4 Route Option 2	
Farm Buildings, Crops and Irrigation Pivot	S 26 55 58 E 24 47 45	Route Option 4 Route Option 2	
Commercial	S 26 56 24 E 24 47 16	Route Option 4 Route Option 2	
Farm Buildings	S 26 56 28 E 24 47 33	Route Option 4 Route Option 2	
Farm Buildings	S 26 56 30 E 24 48 05	Route Option 4 Route Option 2	

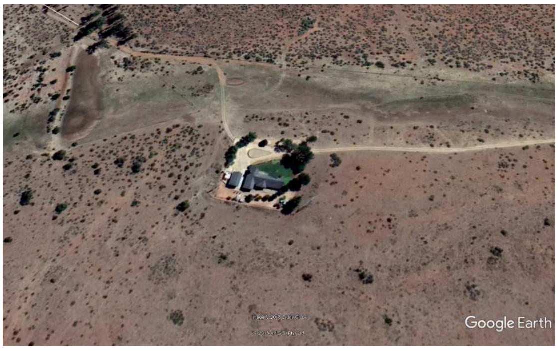
Name	Co-Ordinates	Route Option	Image
Farm Buildings	S 26 56 18 E 24 47 36	Route Option 4 Route Option 2	
Smallholding	S 26 56 48 E 24 47 53	Route Option 4 Route Option 2	
Smallholding	S 26 56 49 E 24 47 38	Route Option 4 Route Option 2	
Smallholding	S 26 56 51 E 24 47 27	Route Option 4 Route Option 2	
Smallholding	S 26 56 52 E 24 47 19	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Commercial	S 26 56 43 E 24 47 13	Route Option 4 Route Option 2	
Smallholding	S 26 56 48 E 24 46 47	Route Option 4 Route Option 2	
Commercial	S 26 57 04 E 24 47 30	Route Option 4 Route Option 2	
Smallholding	S 26 57 16 E 24 46 40	Route Option 4 Route Option 2	
Smallholding	S 26 57 20 E 24 46 35	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 57 30 E 24 46 32	Route Option 4 Route Option 2	
Smallholding	S 26 57 37 E 24 46 28	Route Option 4 Route Option 2	
Smallholding	S26 57 44 E 24 46 26	Route Option 4 Route Option 2	
Smallholding	S 26 57 41 E 24 46 39	Route Option 4 Route Option 2	
Smallholding	S 26 57 49 E 24 47 25	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 58 01 E 24 47 24	Route Option 4 Route Option 2	
Smallholding with crops	S 26 58 03 E 24 47 36	Route Option 4 Route Option 2	
Commercial, Dwelling	S 26 57 55 E 24 46 31	Route Option 4 Route Option 2	
Commercial, Dwelling	S 26 58 06 E 24 46 42	Route Option 4 Route Option 2	
Smallholding	S 26 58 11 E 24 46 56	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Smallholding	S 26 58 02 E 24 47 25	Route Option 4 Route Option 2	
Smallholding	S 26 58 15 E 24 47 18	Route Option 4 Route Option 2	
Commercial	S 26 58 31 E 24 47 12	Route Option 4 Route Option 2	
Commercial, dwelling	S 26 58 26 E 24 46 47	Route Option 4 Route Option 2	
Commercial, dwelling	S 26 58 23 E 24 46 28	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Commercial, dwelling	S 26 58 20 E 24 46 15	Route Option 4 Route Option 2	
Filling Station	S 26 58 16 E 24 46 07	Route Option 2	
Commercial	S 26 58 43 E 24 46 53	Route Option 4 Route Option 2	
Smallholding	S 26 58 59 E 24 46 49	Route Option 4 Route Option 2	
Smallholding	S 26 59 34 E 24 46 51	Route Option 4 Route Option 2	

Name	Co-Ordinates	Route Option	Image
Infrastructure, Water Treatment	S 26 59 33 E 24 45 47	Route Option 4 Route Option 2	
Farm Buildings	S 27 01 16 E 24 46 04	Route Option 4 Route Option 2	
Farm Buildings	S 27 01 08 E 24 45 25	Route Option 4 Route Option 2	

MOSAKA ECONOMIC CONSULTANTS cc
TRADING AS
CONNINGARTH ECONOMISTS
PO Box 75818 Lynnwood Ridge,0040, Pretoria, South Africa
CSIR Premises, Meiring Naudé Ave., North Gate, Bld 4e, Brummeria
Tel: +27(0)12 349 19 15
E– MAIL : congarth@global.co.za

*** Macroeconomic Analysis * Regional & Sectoral Analysis* Cost-Benefit Analysis**

CURRICULUM VITAE WILLIAM MULLINS

Date of Birth:	19 March 1945
Nationality:	South African
Current position:	Researcher: Conningarth Economists

ACADEMIC QUALIFICATIONS

1968:	University of Free State, UED.
1967:	University of Free State, BSc

William Mullins was trained as a Mathematician and Statistician, after a short spell in the industry he became a teacher for a short period. Since 1976 he farmed in Southern KwaZulu Natal and gained a lot of experience in farming and development organisations. For a period he served as chairman of the Natal Agricultural Union.

As far as development organisations are concerned, he was a member of the Regional Development Committee of Region C (RDAC) and National Regional Development Advisory Committee (NRDAC). He also served as a board member first of the KwaZulu Development Corporation and its successor the Ithala Development Corporation from 1993 to 2001. For a period he was also a member of the KwaZulu Training Trust (KTT) and a board member of the Natal Parks Board. Currently he is a researcher at Mosaka Economic Consultants (trading as Conningarth Economists).

EXPERTISE

Mr. Mullins' involvement in the projects listed below was either as team leader or as a team member.

Economic Cost Benefit Analysis and Land Trade-Off Assessment of the Bokpoort Project 150 MW Concentrated Solar Power (CSP) Tower Development. Economic Price Cost Benefit Analysis (CBA). April 2016. Client: ACWA Power.

Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear-1') and Associated Infrastructure. Economic Impact Assessment. August 2015. Client: GIBB (Pty) Ltd. on behalf of Eskom Holdings Limited.

EIA and EMP for the Proposed Eskom Conventional Nuclear Power Station and Associated Infrastructure. Economic Feasibility and Macro-economic Impact. 2013. Client: GIBB (Pty) Ltd.

The Proposed Construction of the Ariadne – Venus 400 kV Transmission Line, as well as the Extension, Upgrade and Refurbishment of the Ariadne and Venus Sub-Stations, Kwazulu-Natal. DEA Reference Number: 12/12/20/1755. Economic Impact Assessment. October 2011. Client: Eskom Holdings Limited – Transmission Division.

Proposed Invubu - Theta 400kV Transmission Power Line - DEA Reference Number: 12/12/20/1552. Macro-economic Impact Analysis. August 2011. Client: Bembani on behalf of Eskom Holdings Limited.

Guidelines/Principles for the Optimal Provision of Electricity in South Africa – an Economic Growth and Development Perspective. Demand forecast for electricity compared with the most likely outcome of electricity supply scenarios, and their funding requirements as determined by Eskom's and the economy's capability to provide these required funding resources. October 2010. Client: Development Bank of Southern Africa on behalf of Eskom Holdings Limited.

Environmental Impact Assessment for the Proposed Nuclear Power Station (Nuclear 1) and Associated Infrastructure. Economic Impact Assessment. June 2010. Client GIBB (Pty) Ltd. on behalf of Eskom Holdings Limited.

Economic Modeling for the Electricity Load Forecast and Strategic Study of the Bela-Bela Master Plan. Macro-economic Forecasting Model. March 2010. Client: Aurecon on behalf of Eskom.

The Construction of the Proposed New Vale Coal Mine and Coal-Fired Power Station - application of the Social Accounting Matrix for Mozambique. Calculation of the direct, indirect and induced impacts on the economic indicators of the construction of a new coal mine in Mozambique. Economic impact on the national, regional and local government of Mozambique. 2009. Client Standard Bank South Africa.

PEER REVIEW OF THE:

PROPOSED MOOKODI-MAHIKENG 400KV POWERLINE, NORTH WEST PROVINCE

Social Impact Assessment
May 2018
Prepared for: Eskom Holdings (SOC) Ltd

Mosaka Economic Consultants were approached by Nemai Consulting to provide a peer review of the above Social Impact Report.

1. REVIEW STRUCTURE

The following methodology was followed in doing the peer review:

- Acceptability of the Terms of Reference;
- Is the methodology clearly explained and acceptable;
- Evaluate the validity of the findings;
- Discuss the suitability of the mitigation measures and recommendations;
- Identify short comings and mitigation measures and recommendations;
- Evaluate the appropriateness of the reference literature; and
- Indicate whether a site inspection was carried out as part of the peer review.

To address the above questions the following approach was used in the review of the document:

- Introduction/Overall Review.
- Grammar, styling, spelling and graphics review.
- Technical Review.
- Summary.

2. INTRODUCTION/OVERALL REVIEW

With the initial and brief scrutiny of the document, the following was observed:

- Presentation of document is neat and well-written, but is quite a lengthy document.
- The legal provisions that guide the Environmental Impact Assessment process is a necessary part of the report and is well presented.
- With the chapter identification it provides a clear framework of the so-called research question and the objective to ultimately reflect the results and conclusion as presented in the Terms of Reference.
- The document features a number of graphics that are filtered to identify the risk areas of the operational and construction phases of the proposed development.

The “Google Earth” sourced photographs are well presented in certain sections of the report but in other sections the observation is that excessive use of photographs is made, a good thing overcooked. More detailed remarks will be offered in another section of the review.

3. GRAMMAR, STYLING, SPELLING AND GRAPHICS REVIEW

Generally, it is a well-presented document in this section, however, a number of spelling mistakes have been identified and it recommended that a spell check be run and foreign words be checked. The following two were identified:

- Page 90 – Figure 34 – Rain nWater Tank;
- Page 101 – Rooigront must be Rooigrond;

Some table numbers and title headings are missing, see the following pages for examples identified:

- Page 105;
- Page 107;

The graphics referring to the current population, education and employment levels are well presented and on a personal note I also prefer the discussion of the local situation at the specific position as where it is shown in this report. However, many consultants prefer that this section form part of the earlier section of the report that is before the discussion of the powerlines or any other construction.

As stated in the introductory part of this review, the use of the satellite images provides a good background which reflects the current situation of the land use.

The excessive use of Google images creates an information overload which distracts the reader from concentrating to the main message of the study. For example, while working through Table 8, almost 44 pages of images of the land area crossed in the different route areas. This represents 44/124 or 35% of the total document.

The suggestion from the reviewer(s) is that this must either be included in an annexure, or the document split into two – creating a Volume 1 and Volume 2 of which the Volume 1's contents has all the sections excluding the detailed images. Volume 2 can then include the detail shown in pages 40 to 84.

The reviewer(s) acknowledge the well-written section of "5.1.3 Airports and Aerodromes".

However, take cognisance of the following sentence on page 84:

1*. Mahikeng Airport – this is operated by North West Department: of Community Safety and Transport Management and is located to the west of Mahikeng*.

Mahikeng Airport has passport control facilities that suggests in must be and International Airport. The airport is managed by the Mahikeng Airport Management Company.

4. TECHNICAL REVIEW

4.1 Description of the Project Area

The section is well written and gives a good description of the rural area it passes through as well as the very dramatic difference between the commercial and rural farming areas. The recommendation that the possibility exists that a number of employment opportunities can be created is well defined.

Possible problems at the final substation outside of Mahikeng is highlighted and discussed.

4.2 Possible Negative Impacts

A number of negative impacts are discussed as identified by the technical team as well as highlighted during the public participation meetings.

4.2.1 Increased Traffic: Noise and Dust

The increased traffic, noise and dust will really only be a problem during construction and the discussion is correct.

4.2.2 Worker Health and Safety

The safety measures are mentioned and are in order.

4.2.3 Damage to Property

This issue of damage to property during the construction phase was highlighted by the commercial farmers at the public participation meetings. This is an issue which often leads to tense relationships between the land owners and the construction company. The proposed mitigation is relevant and important and repeated below:

- If a risk existing of damage taking place on a property as a result of construction, a condition survey should be undertaken prior to construction;
- The contractor is to make good and acknowledge any damage that occurs on any property as a result of construction work;
- Where crops and agricultural machinery are damaged, compensation is to be paid to the farmer for the loss of these crops;
- The farmer should be compensated for any loss of income experienced at the account of the contractor.

4.2.4 Security

Security on commercial farms is a very sensitive issue and it is necessary that it be addressed and be included as part of an agreement between the contractor and farm owner.

4.3 Analysis of Alternatives

The alternatives are well discussed, highlighting the necessity of the powerline for future economic growth therefor rejecting the no-go option.

The pros and cons of the different proposed routes is well balanced and the recommendation made that Route Alternative 2 is, from a social perspective, the preferred route is supported by the available data.

5 SUMMARY

The report is well written and the concepts well explained. The only real recommendation is that the number of google images identifying the farms transgressed by the different routes be either included as a separate Volume 2 or be included as an Annexure. The section describing the routes will be better served by a short discussion and perhaps a table indicating the different farms.

Appendix 6I: Specialist Declaration Forms

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Proposed Mookodi-Mahikeng 400kV Powerline, North West Province

Specialist:	Terrestrial Ecological Impact Assessment		
Contact person:	Avhafarei Ronald Phamphe		
Postal address:	147 Bram Fischer Drive, Ferndale, Randburg		
Postal code:	2194	Cell:	082 783 6724
Telephone:	011 781 7830	Fax:	011 781 1731
E-mail:	AvhafareiP@nemai.co.za		
Professional affiliation(s) (if any)	**Professional Natural Scientist**: South African Council for Natural Scientific Professions Ecological Science (400349/2)		

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Robertson		
Postal address:	PO Pox 1673, SUNNINGHILL		
Postal code:	2157	Cell:	0727692850
Telephone:	0117811730	Fax:	0117811731
E-mail:	kristyr@nemai.co.za		

4.2 The specialist appointed in terms of the Regulations_

I,Avhafarei Ronald Phamphe , declare that --

General declaration:

I act as the independent specialist in this application;

I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

I declare that there are no circumstances that may compromise my objectivity in performing such work;

I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

I will comply with the Act, Regulations and all other applicable legislation;

I have no, and will not engage in, conflicting interests in the undertaking of the activity;

I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

all the particulars furnished by me in this form are true and correct; and

I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Nemai Consulting (Pty) Ltd

Name of company (if applicable):

15 May 2018

Date:

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

ESKOM Mahikeng-Mookodi 400 kV powerline

Specialist:	Avifauna		
Contact person:	Dr Mathew Ross		
Postal address:	PO Box 369, Wendywood		
Postal code:	2144	Cell:	0822935752
Telephone:	0822935752	Fax:	
E-mail:	mathew@enviross.co.za		
Professional affiliation(s) (if any)	SACNASP (Ecological) Pr Sci Nat		

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Robertson		
Postal address:	PO Box 1673, SUNNINGHILL		
Postal code:	2157	Cell:	0727692850
Telephone:	0117811730	Fax:	0117811731
E-mail:	kristyr@nemai.co.za		

4.2 The specialist appointed in terms of the Regulations_

I,Dr Mathew James Ross , declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Enviross CC

Name of company (if applicable):

5June 2018

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Mookodi-Mahikeng 400kV power line project, North West Province

Specialist:	JLB Consulting		
Contact person:	Jean Beater		
Postal address:	P.O. Box 653, Umhlanga Rocks		
Postal code:	4320	Cell:	0844041118
Telephone:		Fax:	
E-mail:	Jean.beater@gmail.com		
Professional affiliation(s) (if any)	ASAPA IAIA(sa)		

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Robertson		
Postal address:	147 Bram Fischer Drive, Ferndale, Johannesburg		
Postal code:		Cell:	
Telephone:	011-781 1730	Fax:	011 – 781 1731
E-mail:	KristyR@nemail.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Jean Beater ______________________ , declare that -

- General declaration:

I act as the independent specialist in this application;

I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

I declare that there are no circumstances that may compromise my objectivity in performing such work;

I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

I will comply with the Act, Regulations and all other applicable legislation;

I have no, and will not engage in, conflicting interests in the undertaking of the activity;

I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

all the particulars furnished by me in this form are true and correct; and

I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

____

Signature of the specialist:

JLB Consulting

Name of company (if applicable):

05 June 2018

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Palaeontological Desktop Assessment of The Proposed Mookodi – Mahikeng 400kv Line, North West Province

Specialist:	Palaeontologist		
Contact person:	Elize Butler		
Postal address:	14 Eddie de Beer Street, Dan Pienaar, Bloemfontein		
Postal code:	9301	Cell:	084 4478759
Telephone:	084 4478 759	Fax:	
E-mail:	Elizebutler002@gmail.com		
Professional affiliation(s) (if any)	PSSA		

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Robertson		
Postal address:	PO Box 1673, SUNNINGHILL		
Postal code:	2157	Cell:	072 769 2850
Telephone:	0117811730	Fax:	0117811731
E-mail:	kristyr@nemai.co.za		

4.2 The specialist appointed in terms of the Regulations_

I,Elize Butler ______________________________ , declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Butler.

Signature of the specialist:

Banzai Environmental

Name of company (if applicable):

11 June 2018

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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NEAS Reference Number:	DEA/EIA
Date Received:	

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(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

10645-Mookodi-Mahikeng 400kV Powerline

Specialist:	Andries Gouws		
Contact person:			
Postal address:	P O X 26275, Monument Park		
Postal code:	0105	Cell:	082 807 6717
Telephone:		Fax:	
E-mail:	index@iafrica.com		
Professional affiliation(s) (if any)	SACNASP 400140/06 Soil Science Society of South Africa		

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Rorertson		
Postal address:	147 Bram Fischer Drive Ferndale		
Postal code:		Cell:	
Telephone:	011 781 1730	Fax:	011 781 1731
E-mail:	kristyr@nemai.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Johan Andries Gouws , declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Integrated Development Expertise (Trading as INDEX)

Name of company (if applicable):

14 May 2018

Date

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Proposed Mookodi-Mahikeng 400kV Powerline: Visual Impact Assessment

Specialist:	Mr. Vernon Siemelink		
Contact person:			
Postal address:	442 Rodericks Street, Lynnwood		
Postal code:	0081	Cell:	072 196 9928
Telephone:	012 807 0383	Fax:	
E-mail:	vernon@ecoelementum.co.za		
Professional affiliation(s) (if any)	IAIA / Decra Lead Auditor - 14001		

Project Consultant:	Eco Elementum (Pty) Ltd		
Contact person:	Vernon Siemelink		
Postal address:			
Postal code:	"	Cell:	"
Telephone:		Fax:	
E-mail:	Same as Above.		

4.2 The specialist appointed in terms of the Regulations_

I, Vernon Siemelink, declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Eco Elementum (Pty) Ltd

Name of company (if applicable):

15/05/2018

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Proposed Mookodi-Mahikeng 400kV Powerline: Economic Impact Assessment

Specialist:	Economics		
Contact person:	Dr Peter Baur		
Postal address:	12 Madden Grove, Florida Park		
Postal code:	1709	Cell:	0829255904
Telephone:	0116722734	Fax:	-
E-mail:	Peterb@uj.ac.za		
Professional affiliation(s) (if any)	Economic Society of South Africa		

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Robertson		
Postal address:	PO Box 1673, SUNNINGHILL		
Postal code:	2157	Cell:	072 769 2850
Telephone:	0117811730	Fax:	0117811731
E-mail:	kristyr@nemai.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, P~~eter Walther Baur, declare that -- General~~ declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

15/05/2018

Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Proposed Mookodi-Mahikeng 400kV Powerline, North West Province. Social Impact Assessment

Specialist:	Nemai Consulting		
Contact person:	Ciaran Chidley		
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Postal code:	2157	Cell:	082 788 1298
Telephone:	011 781 1730	Fax:	
E-mail:	ciaranc@nemai.co.za		
Professional affiliation(s) (if any)			

Project Consultant:	Nemai Consulting		
Contact person:	Kristy Robertson		
Postal address:	PO Box 1673		
Postal code:	2157	Cell:	
Telephone:	011 781 1730	Fax:	011 781 1731
E-mail:	kristyr@nemai.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Ciaran Chidley, declare that –

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

____
Signature of the specialist:

Nemai Consulting
Name of company (if applicable):

30 May 2018
Date: