

rendering this option also suitable for the project. It should be mentioned that this statement only holds true where the approved servitude follows the existing line. Should the servitude deviate from the existing line outside the deviation, the sensitivity will increase proportionally and suitability will decrease. Impacts in areas where new lines deviate from the existing corridor are regarded as a 'new' impact, in spite of the presence of an existing line in the nearby vicinity. Effects of construction and operation will therefore not be lessened or masked by the presence of existing lines in these areas.

- » No significant impacts were identified to be associated with Corridor 7.

Mitigation measures are required to be implemented in order to eliminate or reduce the significance of potential impacts on biodiversity. In this regard, mitigation measures specified in the specialist biodiversity study (refer to Appendix F) are mainly aimed at limiting the effects of construction and servitude maintenance activities.

Generic Mitigation Measures and recommendations with regard to impacts on biodiversity are included within the draft EMP (refer to Appendix O). Specific mitigation measures include:

- » Conduct a final walkthrough prior to commencement of construction activities. Responsibilities should be ensuring absence of Red Data species from construction sites, marking of protected tree species, identification of localised areas of significance, etc.
- » Identify areas of high ecological sensitivity during final walk-through and recommend localised deviations in the power line alignment.
- » Obtain permits for pruning, cutting or removal of protected trees. Protected trees should be identified and marked by the ECO/ecologist during a final walk-through prior to commencement of construction.
- » Demarcate construction areas in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit dilution or spread of peripheral impacts.
- » Limit damage/pruning/cutting of trees to a minimum in accordance to Eskom guidelines. The pruning of the woody layer is recommended instead of complete removal of all woody plants. Leaving a significant portion of the woody structure intact will prevent the establishment of an atypical habitat, limiting adverse impacts to a large extent.
- » Prohibit construction of new access roads in areas of high environmental sensitivity. Use should be made of existing roads, ensuring proper maintenance/upgrade. Alternative methods of construction/access to sensitive areas are recommended.
- » Construction of new/ temporary bridges as part of access roads across non-perennial streams and larger rivers is regarded as a prohibited activity, use should be made of existing crossings, ensuring proper maintenance/upgrade.

- » Ensure surface restoration and re-sloping after construction activities are complete in order to prevent erosion, taking cognisance of local contours and landscaping.
- » Ensure that riparian areas are spanned/ pole structures are not placed within proximity to rivers, streams. Ensure placement of footprints outside 1:100 year flood lines. Crossing of riparian systems is only permitted at existing/ approved crossing points, taking due care to prevent additional/new impacts.
- » Remove invasive and alien vegetation, particularly in vicinity of riparian zones where alien and invasive trees are known to occur. The implementation of a monitoring programme in this regard is recommended, being the responsibility of the ECO/ecologist.
- » Rehabilitation of disturbed areas subsequent to construction activities, taking cognisance of factors such as topsoil replacement, removal of introduced materials, local environmental factors.
- » Final inspection in order to ensure adherence to EMP guidelines, completion of localised/ remaining areas of impact, monitoring of rehabilitation success, etc.

## 7.2. Assessment of Potential Impacts Associated with Agricultural Potential

A summary of the various classes of agricultural potential, based on the soils and/or rock occurring in each land type, is given in Table 1 in the specialist Agricultural Potential report (Refer to Appendix H). The study refers to soil potential only, with no prevailing climatic conditions taken into account.

### 7.2.1. Comparison of Transmission Power Line Alternatives

From the desk-top analysis of agricultural potential within the proposed corridors, it was concluded that:

- » *Medupi-Mokopane Corridors:*
  - \* Corridor 1 has some high potential soils south-east of Lephalale, otherwise mostly low to medium potential soils.
  - \* Corridor 2 has mostly medium potential soils, with high potential soils west of the Lephalala River and between Steilloopbrug and Mokopane.
  - \* Corridor 8 has little high potential soils, and much rocky land.
  - \* Corridor 8 Deviation does not impact on a new land type and, as can be seen from the potential map (Appendix 2 of the specialist Agricultural Potential report (Refer to Appendix H)), the agricultural potential of the soils being traversed does not significantly vary from corridor 2 or corridor 8.

Based on the above, it would appear as if the preferred route would be the **Corridor 1** (potentially fewer high potential soils) followed by Corridor 8, and

the least favoured, Corridor 2 (where the most amount of high potential soils occur).

» *Mokopane-Witkop Corridors:*

In terms of all three Mokopane-Witkop corridors there is little variation, as the same land type, with medium potential soils, occurs throughout. Thus from Mokopane to Witkop, there is **no preference** based on soils.

### **7.2.2. Conclusions and Recommendations**

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the national Land Type Survey may also occur.

In terms of all three Mokopane-Witkop corridors there is little variation as the same land type occurs throughout with medium potential soils. However, on analysis of the soils the preferred route would be the **Corridor 1** (potentially fewer high potential soils) followed by Corridor 8, and the least favoured, Corridor 2 (where the greatest extent of high potential soils occur). It should be noted that no fatal flaws are considered to be associated with Corridors 2 and 8 since most agricultural activities can continue underneath overhead power lines. No significant impacts were identified to be associated with Corridor 7.

### **7.3. Assessment of Potential Impacts on Avifauna**

Potential impacts on avifauna associated with the establishment of the proposed transmission infrastructure include the following:

- » Electrocution of birds on overhead lines.
- » Collisions with the earth wire of power lines.
- » Habitat destruction and transformation during the construction, maintenance and eventual decommissioning of power lines.
- » Disturbance during the construction, maintenance and eventual decommissioning of power lines.

Electrocution of birds on overhead lines is an emotional issue as well as an important cause of unnatural mortality of raptors and storks. It has attracted plenty of attention in Europe, USA and South Africa. However, in the context of overhead lines above 132kV, electrocutions are not of major concern. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed

components. Due to the large size of the clearances on most overhead lines above 132kV, electrocutions are generally ruled out as even the largest birds cannot physically bridge the gap between dangerous components.

The following series of tables provides a summary of the potential impacts on avifauna associated with the construction and operation of the proposed transmission power lines.

***Impact tables summarising the significance of Transmission Line Impacts on Avifauna (with and without mitigation)***

***Nature: Impact of birds on quality of supply (Faulting) – all alternatives***

There are a number of mechanisms through which birds are able to cause electrical faults on power lines. In the case of a bird streamer induced fault, the fault is caused by the bird releasing a “streamer” of faeces which can constitute an air gap intrusion between the conductor and the earthed structure. The fault appears to flash across the air gap (i.e. between the live conductor and the tower steelwork which is earthed) and does not follow an insulator creepage path as observed on pollution faults. Bird species capable of producing large or long streamers are more likely to cause streamer faults. Bird stomach volume is important in this respect. Larger birds such as vultures and eagles are capable of holding larger quantities of food and therefore defecating larger volumes.

Bird pollution is a form of pre-deposit pollution. A flashover occurs when an insulator string gets coated with pollutant, which compromises the insulation properties of the string. When the pollutant is wetted, the coating becomes conductive, insulation breakdown occurs and a flashover results. Since this involves a build up of bird faeces or bird pollution and not a once off event such as a streamer, the size of the bird is less important, although still a factor. Obviously the more an insulator string becomes coated with faeces, the more likely that a fault will occur. Larger birds and congregations of birds are likely to result in heavy pollution of insulator strings. Bird nests may also cause faults through nest material protruding and constituting an air gap intrusion.

Relevant to this study, faulting associated with streamers and faecal pollution is possible on the self support towers of the proposed 400kV power lines, particularly those towers that are located close to water sources (rivers, dams and pans). Towers constructed within Corridor 2 will also be highly susceptible to this impact because of the proximity of the two vulture restaurants (i.e. cumulative impact). An assessment table for this impact has not been compiled as the impact is specific to self-supporting towers in areas close to water sources regardless of the Corridor chosen. The negative impact caused to the quality of the electrical supply can be mitigated through the installation of bird guards on towers identified during the site-specific EMP (walk down).

	<b>Without mitigation</b>	<b>With mitigation</b>
<b><i>Extent</i></b>	Regional (3)	Regional (3)
<b><i>Duration</i></b>	Permanent (5)	Permanent (5)
<b><i>Magnitude</i></b>	Low (4)	Low (3)
<b><i>Probability</i></b>	Highly Probable (4)	Improbable (2)
<b><i>Significance</i></b>	<b>Medium (60)</b>	<b>Low (28)</b>

<b>Status</b>	Negative impact on the power line	Negative impact on the power line
<b>Reversibility</b>	Yes	
<b>Irreplaceable loss of resources</b>	Impact on the quality of supply	Impact on the quality of supply
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
» Bird guards to be installed on towers identified during the site specific EMP. The high risk towers will be identified during the Construction EMP.		
<b>Cumulative impacts:</b>		
» Corridor 2 – High cumulative impacts due to presence of two vulture restaurants.		
<b>Residual impacts:</b>		
» High residual impacts. This impact will persist as long as the power lines are operational		

### **7.3.1. Comparison of Transmission Power Line Alternatives**

The tables overleaf provide a comparative assessment of the potential impacts on avifauna associated with each alternative corridor under consideration.

***Impact tables Comparing the significance of Impacts on Avifauna for each Transmission Line Corridor: Medupi-Mokopane Corridors***

***Nature of the Impact:*** Collisions with the 400kV power lines and turn ins (vulnerable Red Data species include Blue Crane, Secretary bird, Kori Bustard, Denham's Bustard and the various stork species)

Relevant to this study, the earth wire of the 400kV power lines will be the biggest risk from a bird collision perspective. Birds in flight tend to see the bundled conductors, and then gain height to avoid them. In the process, the much thinner earth wire is not noticed and the birds may then collide with it. The species most likely to be impacted upon include the Blue Crane, Secretarybird, Southern Bald Ibis, Denham's Bustard, Kori Bustard, White-bellied Korhaan, Greater and Lesser Flamingos, the various vulture and stork species. The dams, rivers, pans, wetlands and arable lands identified during the field investigations will undoubtedly attract most of these species and since these habitats feature along each of the proposed corridors, it is likely that significant mitigation will have to be employed regardless of the corridor chosen, however this is particularly true for Corridors 1 and 2.

	Corridor 1		Corridor 2		Corridor 8		Corridor 8 deviation	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b><i>Spatial Extent</i></b>	Regional (3)	Local (2)	Regional (3)	Local (2)	Regional (3)	Local (2)	Regional (3)	Local (2)
<b><i>Duration</i></b>	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)
<b><i>Magnitude</i></b>	Moderate (3)	Low (2)	High (4)	Moderate (3)	Moderate (3)	Low (2)	High (4)	Moderate (3)
<b><i>Reversibility</i></b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b><i>Probability</i></b>	Medium (3)	Low (2)	High (4)	Medium (3)	Medium (3)	Low (2)	High (4)	Medium (3)
<b><i>Significance</i></b>	<b>Medium (42)</b>	<b>Low (22)</b>	<b>Medium (60)</b>	<b>Medium (36)</b>	<b>Medium (42)</b>	<b>Low (22)</b>	<b>Medium (60)</b>	<b>Medium (36)</b>
<b><i>Status (positive or negative)</i></b>	Negative							
<b><i>Irreplaceable loss of resources</i></b>	Yes							
<b><i>Can impacts be mitigated?</i></b>	Yes							
<b><i>Mitigation:</i></b>								
Bird Fight Diverters to be installed on the earth wires of high risk sections of power line identified during the walk down								
<b><i>Cumulative impacts</i></b>	Cumulative impact is low, limited existing impacts		Cumulative impact is high with the presence of agricultural activities i.e. irrigated lands, subsistence and commercial farming					
<b><i>Residual impacts:</i></b>								
impact remains until power lines are decommissioned and removed								

<b>Nature of the Impact: Habitat destruction associated power line developments (vulnerable species include those Red Data species that utilise woodland and riparian habitats)</b>								
<p>During the construction phase and maintenance of power lines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimise the risk of fire under the line, since it can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat.</p> <p>Habitat destruction within sections of Corridor 2, Corridor 8 and Corridor 8 Deviation is not anticipated to be significant since much of the study area is considered to be already transformed and disturbed through the establishment of infrastructure, subsistence and commercial agricultural practices, pastoral activities and settlements. This change in land use has resulted in a relatively small extent of natural habitat left intact. However the converse is true for the vast tracts of woodland in Corridor 1.</p>								
	Corridor 1		Corridor 2		Corridor 8		Corridor 8 Deviation	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Spatial Extent</b>	Regional (3)	N/A	Regional (3)	N/A	Regional (3)	N/A	Regional (3)	N/A
<b>Duration</b>	Long Term (4)	N/A	Long Term (4)	N/A	Long Term (4)	N/A	Long Term (4)	N/A
<b>Magnitude</b>	High (4)	N/A	Moderate (3)	N/A	Moderate (3)	N/A	Moderate (3)	N/A
<b>Reversibility</b>	Irreversible (5)	N/A	Recoverable (3)	N/A	Recoverable (3)	N/A	Recoverable (3)	N/A
<b>Probability</b>	Definite (5)	N/A	High (4)	N/A	Medium (3)	N/A	Medium (3)	N/A
<b>Significance</b>	High (80)	N/A	Medium (52)	N/A	Medium (39)	N/A	Medium (39)	N/A
<b>Status (positive or negative)</b>	Negative							
<b>Irreplaceable loss of resources</b>	Yes, particularly woodland vegetation							
<b>Can impacts be mitigated?</b>	No							
<b>Mitigation:</b>	None							
<b>Cumulative impacts</b>	Cumulative impact is low, limited existing impacts		Cumulative impact is high (other impacts include an existing transmission power line, irrigated lands, road networks, housing and mining).					
<b>Residual impacts:</b>	Impact remains until power lines are decommissioned and removed							

<b>Nature of the Impact: Disturbance (vulnerable breeding Red Data species include Martial Eagle, Tawny Eagle, White-backed Vulture, Cape Griffon and the various stork species)</b>								
During the construction and maintenance of electrical infrastructure, a certain amount of disturbance results. Although existing disturbance levels are moderate to low along Corridors 8 and 8 Deviation (emanating from the existing settlements, agricultural practices and maintenance of existing power lines) it is likely that the cumulative impact of these sources of disturbance could impact negatively on the breeding activities of most bird species occurring in these corridors.								
	Corridor 1		Corridor 2		Corridor 8		Corridor 8 Deviation	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Spatial Extent</b>	Regional (3)	Local (2)	Regional (3)	Local (2)	Regional (3)	Local (2)	Regional (3)	Local (2)
<b>Duration</b>	Medium Term (3)	Short Term (2)	Medium Term (3)	Short Term (2)	Medium Term (3)	Short Term (2)	Medium Term (3)	Short Term (2)
<b>Magnitude</b>	High (4)	Moderate (3)	Moderate (3)	Low (2)	Moderate (3)	Low (2)	Moderate (3)	Low (2)
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Probability</b>	High (4)	Medium (3)	Medium (3)	Medium (3)	Medium (3)	Medium (3)	Medium (3)	Medium (3)
<b>Significance</b>	Medium (52)	Medium (30)	Medium (36)	Low (27)	Medium (36)	Low (27)	Medium (36)	Low (27)
<b>Status (positive or negative)</b>	Negative							
<b>Irreplaceable loss of resources</b>	Yes							
<b>Can impacts be mitigated?</b>	Yes							
<b>Mitigation:</b>	Identify active nests during walk down and limit construction and unnecessary driving past nests during breeding times							
<b>Cumulative impacts</b>	Low		High (existing disturbance levels emanating from the settlements and agricultural practices)		Medium (existing disturbance associated with maintenance of the existing power lines)			
<b>Residual impacts:</b>	Impact remains until power lines are decommissioned and removed							

***Impact tables Comparing the significance of Impacts on Avifauna for each Transmission Line Corridor: Mokopane-Witkop Corridors***

***Nature of the Impact: Collisions with the 400kV power lines and turn ins (vulnerable Red Data species include Blue Crane, Secretary bird, Kori Bustard, Denham's Bustard and the various stork species)***

Relevant to this study, the earth wire of the 400kV power lines will be the biggest risk from a bird collision perspective. Birds in flight tend to see the bundled conductors, and then gain height to avoid them. In the process, the much thinner earth wire is not noticed and the birds may then collide with it. The species most likely to be impacted upon include the Blue Crane, Secretarybird, Southern Bald Ibis, Denham's Bustard, Kori Bustard, White-bellied Korhaan, Greater and Lesser Flamingos, the various vulture and stork species. The dams, rivers, pans, wetlands and arable lands identified during the field investigations will undoubtedly attract most of these species and since these habitats feature along each of the proposed corridors, it is likely that significant mitigation will have to be employed regardless of the corridor chosen.

	Corridor 4		Corridor 5		Corridor 6	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b><i>Spatial Extent</i></b>	Regional (3)	Local (2)	Regional (3)	Local (2)	Regional (3)	Local (2)
<b><i>Duration</i></b>	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)
<b><i>Magnitude</i></b>	High (4)	Moderate (3)	Moderate (3)	Low (2)	Moderate (3)	Low (2)
<b><i>Reversibility</i></b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b><i>Probability</i></b>	High (4)	Medium (3)	Low (2)	Improbable (1)	Low (2)	Improbable (1)
<b><i>Significance</i></b>	<b>Medium (60)</b>	<b>Medium (36)</b>	<b>Low (28)</b>	<b>Low (11)</b>	<b>Low (28)</b>	<b>Low (11)</b>
<b><i>Status (positive or negative)</i></b>	Negative					
<b><i>Irreplaceable loss of resources</i></b>	Yes					
<b><i>Can impacts be mitigated?</i></b>	Yes					
<b><i>Mitigation:</i></b>	Bird Flight Diverters to be installed on the earth wires of high risk sections of power line identified during the walk down					
<b><i>Cumulative impacts</i></b>	Cumulative impact is low, limited existing impacts		Cumulative impact is high with the presence of agricultural activities i.e. irrigated lands, subsistence and commercial farming			
<b><i>Residual impacts:</i></b>	Impact remains until power lines are decommissioned and removed					

**Nature of the Impact: Habitat destruction associated power line developments (vulnerable species include those Red Data species that utilise woodland and riparian habitats)**

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

The vast tracts of woodland in sections of Corridor 4 would be particularly vulnerable to habitat destruction. It is likely that the majority of the raptor species recorded in the study area are resident within these woodlands. The clearing of servitudes along these corridors would pose a significant threat to these species as they require large trees in which to breed and nest successfully.

	Corridor 4		Corridor 5		Corridor 6	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Spatial Extent</b>	Regional (3)	N/A	Local (2)	N/A	Local (2)	N/A
<b>Duration</b>	Long Term (4)	N/A	Long Term (4)	N/A	Long Term (4)	N/A
<b>Magnitude</b>	High (4)	N/A	Low (2)	N/A	Low (2)	N/A
<b>Reversibility</b>	Irreversible (5)	N/A	Recoverable (3)	N/A	Recoverable (3)	N/A
<b>Probability</b>	Definite (5)	N/A	Medium (3)	N/A	Medium (3)	N/A
<b>Significance</b>	High (80)	N/A	Medium (33)	N/A	Medium (33)	N/A
<b>Status (positive or negative)</b>	Negative					
<b>Irreplaceable loss of resources</b>	Yes, particularly woodland vegetation					
<b>Can impacts be mitigated?</b>	No					
<b>Mitigation:</b>	None					
<b>Cumulative impacts</b>	Cumulative impact is low, limited existing impacts		Cumulative impact is high (other impacts include an existing transmission power line, irrigated lands, road networks, housing and mining).			
<b>Residual impacts:</b>	Impact remains until power lines are decommissioned and removed					

<b>Nature of the Impact: Disturbance (vulnerable breeding Red Data species include Martial Eagle, Tawny Eagle, White-backed Vulture, Cape Griffon and the various stork species)</b>						
During the construction and maintenance of electrical infrastructure, a certain amount of disturbance results. Although existing disturbance levels are moderate to low along Corridors 5 and 6 (emanating from the existing settlements, agricultural practices and maintenance of existing power lines) it is likely that the cumulative impact of these sources of disturbance could impact negatively on the breeding activities of most bird species occurring in these corridors.						
	Corridor 4		Corridor 5		Corridor 6	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Spatial Extent</b>	Regional (3)	Local (2)	Regional (3)	2 (Local)	Regional (3)	2 (Local)
<b>Duration</b>	Medium Term (3)	Short Term (2)	Medium Term (3)	Short Term (2)	Medium Term (3)	Short Term (2)
<b>Magnitude</b>	High (4)	Moderate (3)	Moderate (3)	Low (2)	Moderate (3)	Low (2)
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Probability</b>	High (4)	Medium (3)	Low (2)	Low (2)	Low (2)	Low (2)
<b>Significance</b>	<b>Medium (52)</b>	<b>Medium (30)</b>	<b>Low (24)</b>	<b>Low (18)</b>	<b>Low (24)</b>	<b>Low (18)</b>
<b>Status (positive or negative)</b>	Negative					
<b>Irreplaceable loss of resources</b>	Yes					
<b>Can impacts be mitigated?</b>	Yes					
<b>Mitigation:</b> Identify active nests during walk down and limit construction and unnecessary driving past nests during breeding times						
<b>Cumulative impacts</b>	Low		High (existing disturbance levels emanating from the settlements and agricultural practices)			
<b>Residual impacts:</b> Impact remains until power lines are decommissioned and removed						

» Relevant Factors in selecting a Preferred Corridor

The following factors were incorporated in the formula using field observations, the CSIR Land Cover Database and high resolution Google satellite imagery as the main source of data:

- \* *Wetlands and dams:* Wetlands and dams are of particular importance for birds in the study area, as the area is relatively arid. Currently the study area contains many large wetlands and dams which is an indicator of a higher collision risk.
- \* *Rivers:* The study area contains the Lephalale, Mokolo and Mogalakwena and their tributaries. Rivers are obviously important for birds and many waterbird species occur only along the rivers. The rivers are particularly important for stork species such as Black Stork and Yellow-billed Stork and are an indication of a higher collision risk.
- \* *Woodland:* Sections of Corridors 2, 4 and 8 lie within pristine woodland habitat. Woodland is an indication of a higher habitat destruction and disturbance risk.
- \* *Other transmission lines:* It is a proven fact that placing a new line next to an existing line reduces the risk of collisions to birds. The reasons for that are two-fold, namely it creates a more visible obstacle to birds and the resident birds, particularly breeding adults, are used to an obstacle in that geographic location and have learnt to avoid it (APLIC 1994). Other transmission lines running parallel to the proposed alignments were therefore treated as a risk reducing factor.
- \* *Roads:* These were taken as an indication of human activity and particularly vehicle and pedestrian traffic. It was assumed that the birds will avoid the immediate vicinity of roads due to the presence of traffic and pedestrians, and therefore it will reduce the risk of collision with lines running next to roads.
- \* *Settlements:* Towns are obvious centres of human activity and are generally avoided by large power line sensitive species. The presence of towns and settlements is therefore a risk reducing factor.
- \* *Irrigation:* Irrigation crops, especially lucerne, are important draw cards for species such as cranes and storks, especially in an arid landscape thereby increasing the risk of collisions.
- \* *Fallow lands:* Fallow lands create artificial open areas in woodland, which are much favoured by species such as Kori Bustards and Secretarybirds.

» Designing an index to calculate the collision risk in each corridor

The factors mentioned above were incorporated into a formula to arrive at a risk rating for each corridor (refer to Table 5 of the specialist avifauna report contained in Appendix G). The formula was designed as follows:

- \* The number of dams or wetlands within 500m of the proposed alignment was calculated.
- \* The number of rivers crossed by each alignment was counted.
- \* The distance that the proposed corridors lie directly within pristine natural woodland was measured in kilometres.
- \* The number of times a primary and/or secondary road was crossed by each of the corridors was calculated.
- \* The number of settlements located within 1km of each alignment was counted.
- \* The distance that the proposed alignments are directly parallel to other lines was measured.
- \* The length of alignment running parallel with or across irrigated crops and fallow lands was measured in kilometres.

As all these factors do not have an equal impact on the size of the risk, a weighting was assigned to each factor, based on the specialist's judgment and experience on how important the factor is within the total equation (refer to Table 6 of the specialist avifauna report contained in Appendix G). Risk reducing factors were assigned a negative weight. The final risk score for a **factor** was calculated as follows: measurements or counts multiplied by the risk weighting. The final risk rating for a **corridor** was calculated as the sum of the risk scores of the individual factors (refer to Table 7.1 below).

**Table 7.1:** Preference scores for the seven proposed corridors

Alternatives	Score
Corridor 1 (Medupi-Mokopane)	214.86
Corridor 2 (Medupi-Mokopane)	82.98
Corridor 4 (Mokopane-Witkop)	99.52
Corridor 5 (Mokopane-Witkop)	21.70
<b>Corridor 6 (Mokopane-Witkop)</b>	<b>19.92</b>
Corridor 8 (Medupi-Mokopane)	28.76
<b>Corridor 8 Deviation (Medupi-Mokopane)</b>	<b>-6.40</b>

***Medupi-Mokopane Corridors:***

From the collision risk analysis, as well as from field investigations undertaken, it is clear that **Corridor 8 Deviation** holds the least risk from a bird interaction perspective. From an avifaunal perspective, Corridor 1 is considered to be a no-go area as impacts associated with the construction within this corridor are expected to be of high significance and difficult to mitigate.

The presence of the existing Matimba-Witkop 400kV power line within this corridor played a major role in this outcome, despite the relatively extensive areas of pristine woodland, agriculture and fallow lands. The area surrounding

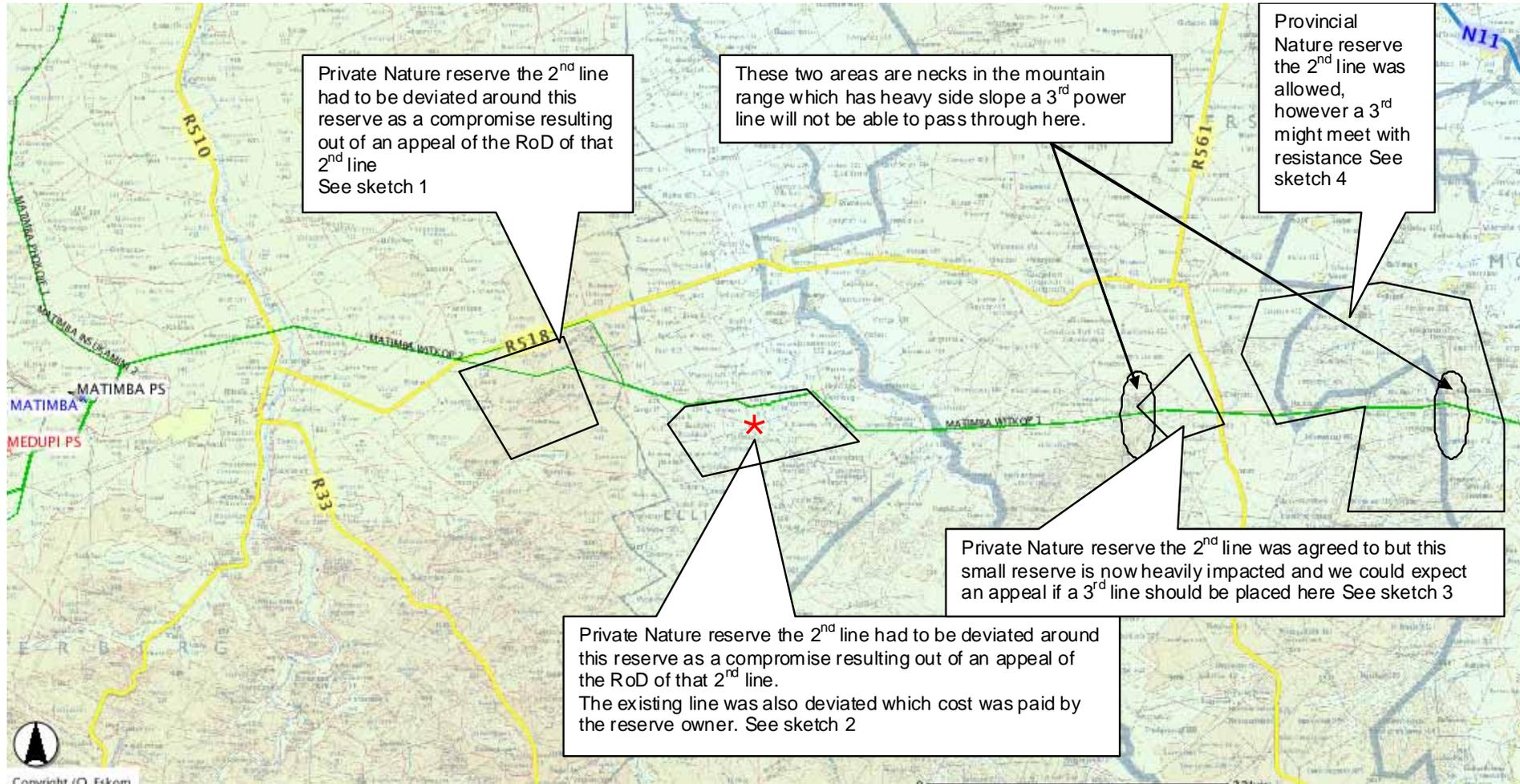
the existing servitudes is subjected to periodic disturbance as a result of annual maintenance being carried out on the Matimba-Witkop 400kV power lines and the mere presence of the existing transmission lines could potentially reduce the risk of collisions along the proposed Medupi-Mokopane and Mokopane-Witkop power lines provided that the new power lines are constructed immediately adjacent to the existing power lines, with the outer line being within 200m of the existing Matimba-Witkop 400kV power lines.

As already mentioned in Chapter 2, the conclusions of a technical investigation undertaken by Eskom indicate that it will not be technically feasible to construct the new power lines directly adjacent to the existing lines for the entire length of the corridor. This is due to two narrow gorges along the existing Matimba-Witkop alignment within Corridor 8, as well as issues raised by landowners within the EIA process for the Matimba-Witkop No 2 400kV power line which must be taken into consideration. Therefore, should Corridor 8 (or Corridor 8 Deviation) be selected as the preferred option, the new lines would have to deviate from the existing lines in a number of places. These areas are illustrated and explained in Figure 7.2.

Corridor 8 Deviation is considered to hold the least risk from a bird-interaction perspective, provided that deviations indicated in Figure 7.2 are:

- » the only areas where the proposed lines will deviate from the existing lines;
- » the deviation distances are kept short and
- » the deviations denoted in Figure 7.2 are still located within the 5 km corridor assessed within this EIA report.

It must be noted that the deviation indicated with an asterisk in Figure 7.2 will require special attention. The proposed Medupi-Mokopane power lines alongside this nature reserve cannot be placed anywhere within the 5 km corridor. It is highly recommended that the proposed line be placed to the north of the existing lines, on the outer side of reserve's northern boundary as indicated in Figure 7.3 below (yellow hatched line).



**Figure 7.2:** Map from Eskom of the existing Matimba-Witkop line indicating the two narrow gorges and sections of line where issues were raised regarding the Matimba-Witkop No 2 400kV line



**Figure 7.3:** The recommended deviation route indicated by the yellow dashed line. The 5 km corridor investigated in the EIA process is indicated by the red solid lines to the south of the proposed route deviation.

In addition to the above conditions, avifaunal sensitive areas were identified within the portion of corridor 2 which forms part of Corridor 8 Deviation (refer to Figure 7.4 and 7.5). These areas (pans, dams, irrigated lands and agricultural fields) have been classed as no go areas based on their ability to support water dependent and large terrestrial bird species, highly susceptible to collisions with the earth wires of transmission lines, therefore **construction within these areas should be avoided**. It must be noted that avoiding these areas does not preclude the marking of the proposed power lines in other areas within the preferred corridor. These areas will be required to be identified during the site specific walk down during the final EMP phase of the project.



**Figure 7.4:** No go areas identified within the portion of Corridor 2 which forms part of Corridor 8 Deviation



**Figure 7.5:** No go areas identified within the portion of Corridor 2 which forms part of Corridor 8 Deviation

### ***Mokopane-Witkop Corridors:***

As far as the Mokopane-Witkop corridors are concerned, **Corridor 6** presents itself as the preferred alternative from an avifauna perspective. This is due to the presence of an existing transmission line within the corridor. The placement of the proposed Mokopane-Witkop 400kV power lines within this corridor will partially mitigate for the anticipated impacts on avifauna, most particularly that of collision, since the more lines which are placed together, the more visible the overhead cables become, and risks are kept together rather than spread out across the landscape.

### ***Delta-Medupi Corridor:***

A single Delta-Medupi corridor was assessed using field observations and high resolution Google Earth Imagery during the EIA phase. Although the corridor does not appear to contain any rivers or drainage lines, the vegetation is largely open and as a result susceptible to collision impacts. One must however consider the existing infrastructure contained within this corridor, the proposed Delta Medupi 400kV power lines and future developments associated with the Medupi Power Station planned in this area which are likely to displace the Red Data species occurring there. Impacts are considered to be relatively low in contrast with the larger Medupi-Mokopane and Mokopane-Witkop corridors, and can be mitigated where necessary.

### ***7.3.2. Conclusions and Recommendations***

Collision of large terrestrial Red Data bird species will be a significant impact of the proposed 400kV lines. Species most likely to be affected by this impact are the more heavily-bodied species recorded in the area, i.e. Blue Crane, Secretarybird, Southern Bald Ibis, Denham's Bustard, Kori Bustard, White-bellied Korhaan, Greater and Lesser Flamingos and the various vulture and stork species. These species are priority species due to their proven vulnerability to collision with power lines, and their reported occurrence within the study area. Non-Red Data species such as water birds will also be affected. Provided that the relevant sections of the power line are comprehensively marked with a suitable anti-collision marking device, it is expected this impact can be reduced to acceptable levels. It must be noted that the negative impacts far outweigh the positive impacts associated with a development of this nature.

Following an analysis of the proposed route alignments, **Corridor 8 Deviation** (Medupi-Mokopane) and **Corridor 6** (Mokopane-Witkop) were considered to be the preferred alternatives from an avifaunal perspective. It is considered vital that the identified no-go areas within the portion of Corridor 2 which forms part of Corridor 8 Deviation be considered in the final route planning.

A single Delta-Medupi (Corridor 7) corridor was assessed and the impacts are considered to be relatively low in contrast with the larger Medupi-Mokopane and Mokopane-Witkop corridors, and can be mitigated where necessary.

The following measures are recommended in order to mitigate as far as possible for the above mentioned impacts:

» *Collision with earth wire:*

Avoid construction in the no go areas within Corridor 2 (should this corridor be selected as the preferred alternative). In addition to this, the earth wire of those sections of line that cross or are in close proximity to the dams, rivers, pans, wetlands and arable lands situated along the final power line alignment should be marked with a suitable marking device according to Eskom Transmission Guidelines (refer to the EMP contained within Appendix O for further details in this regard). The actual areas where marking will be effected can only be demarcated once a corridor has been selected and an alignment within the corridor finalised. This exercise will have to be done during the 'walk down' of the power line routes once it has been negotiated, surveyed and pegged.

» *Habitat destruction during construction activities*

All construction and maintenance activities should be carried out according to generally accepted environmental best practices. In particular, care should be taken in the vicinity of the river crossings and woodland areas. Existing roads must be used as far as possible for access during construction. The cutting down of large trees in woodland areas and deep riverine gorges should be avoided.

» *Electrocution*

Due to the large clearances on the proposed lines, electrocution through conventional means is impossible. This impact is therefore insignificant and therefore no mitigation is required.

» *Disturbance during construction activities*

It is envisaged that during the construction activities of the new power lines disturbance of nesting birds is likely to occur and could potentially have an impact on the breeding population of large raptors and other bird species occurring in the study area. The breeding season for the large raptor species is from March to November. The most critical period within this time span is from April to May when the eggs are incubated. Another sensitive period is from October to November when the young birds are almost ready to fledge. Early in the breeding season, the risk of desertion by the adults due to disturbance is larger than later in the season (when the young bird is on the

nest and being fed by the adults). At the end of the breeding season the young bird may be tempted to jump out of the nest and fly prematurely if disturbed, resulting in injury or even death. Every attempt will have to be made to restrict the disturbance of raptors and other bird species to a minimum during construction. Wherever possible, nest sites must be identified during the final EMP phase of the project and mitigated on a site-specific basis.

» *Impact on the quality of supply*

Both bird streamers and bird pollution occur as a result of birds perching on pylons or towers, often directly above live conductors. This impact is likely to occur on the self-supporting towers of the Delta-Medupi, Medupi-Mokopane and Mokopane-Witkop 400kV power lines and turns-ins associated with the Mokopane Substation, particularly those towers that are located close to water sources (rivers, dams and pans). Towers requiring mitigation in the form of bird guards to prevent the birds from perching above critical areas, will be identified during the specialist 'walk-through' survey prior to construction of the transmission lines.

#### **7.4. Assessment of Potential Visual Impacts**

The construction of transmission line infrastructure in populated areas will always be problematic from a visual impact point of view. The EIA process for the Mokopane Integration Project highlighted this through the number of complaints and concerns received from landowners and residents within the study area. The lower density residential areas (agricultural holdings), with a decidedly more rural character, will be more affected by the project infrastructure than high-density residential areas. The higher occurrence of structures and visual clutter within high-density residential areas tend to absorb the visual impact.

Potential visual impacts are expected to be associated with both the construction and operational phases of the proposed project. In the event of eventual decommissioning of the infrastructure, impacts are expected to be similar to those experienced in the construction phase of the project.

##### ***7.4.1. Potential Visual Impacts associated with the Construction Phase of the Transmission Lines***

The construction phase of the proposed 400kV power lines is expected to extend over a 24-month period. This is obviously dependent on a number of external factors that may not always be controlled by either Eskom or the preferred contractors. During this time heavy vehicles will frequent the roads to the substation site and along the transmission line corridor and may cause, at the very least, a visual nuisance to other road users and resident of the area.

Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:

- » Reduce the construction period through careful planning and productive implementation of resources.
- » Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
- » Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
- » Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

#### ***7.4.2. Potential Visual Impacts associated with the Operational Phase of the Transmission Lines***

The construction of the proposed 400 kV transmission power lines will impose a visual impact on the surrounding area. The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers or if the visual perception of the structure is favourable to all the observers, there would be no visual impact.

Visual impact is generally determined by the visual exposure of the proposed development, viewer incidence/perception, visual distance and the visual absorption capacity of the surrounding area. Potential impacts are expected where sensitive visual receptors occur or in areas where there is higher viewer incidence and/or potentially negative viewer perception of the proposed project infrastructure. Four such areas were identified for the study area:

- » The **first area** includes towns (Lephalale and Mokopane), residential areas (Onverwacht), villages and settlements (predominantly to the north and east of the study area), individual homesteads/farm residences (scattered throughout the study area) and private game reserves/farms (with tourist lodges). The last category includes the farm boundaries of consulted landowners who indicated that their farms are utilised for game viewing, hunting, photographic safaris and/or informal conservation areas. The farms are not expected to contain a high viewer density, but observers (tourists/visitors) are expected to have a potentially high negative viewer perception of the project infrastructure due to the nature-based activities within these areas. Farms in close proximity of the proposed project infrastructure within **area one** include, inter alia:

Kuipersbult 511 LQ	Spider 535 LQ
Zongezien 467 LQ	Durban 522 LR
Kalkfontein 468 LQ	Wynberg 521 LR
Vucht 436 LQ	Weltevreden 508 LR
Wellington 432 LQ	Groetfontein 494 LR
Garibaldi 480 LQ	Spektakel 526 LR
Weltevreden 482 LQ	Drakensberg 549
Grootgenoeg 426 LQ	New Belgium 608
Samaria 207 LR	Hanover 555 LR
Goa 427 LR	Rivierplaats 541
Villa Nora 428 LR	Zwellendam 548 L
Killarney 210 LR	Poeskopdrift 545
Goedgelegen 194 LR	De Koop 525 LR
Buffelsfontein 220 LR	Colesberg 556 LR
Deugdzaamheid 197 LR	Uitvlugt 567 LQ
Stinkkraal 195 LR	Duikerfontein 53
Deugdzaamheid 197 LR	Norfolk 559 LR
Turflaagte 214 LR	Rivierplaats 541
Tiel 218 LR	Eyzerbeen 553 LR
Grobbelaarshoek 462 LR	Sterkfontein 459 LR
Early Morn 215 LR	Duna 554 LR
Witpan 447 LR	Sterkwater 560 L
Pieterman 445 LR	Groot Denteren 5
Rooibokpan 216 LR	Grafton 565 LQ
Duikerrivier 568	Adelaide 557 LR
Schoonhoven 448 LR	Duikerrivier 568
Fairfield 219 LR	Sterkwater 560 L
Leerdam 443 LR	Broederschap 581
Scheveningen 444 LR	Laussonie 561 LR
Welgevonden 449 LR	Daggakraal 591 LR
Gouda 453 LR	Rhynosterfontein 538 LR
Johannisberg 509 LR	Slangfontein 655 LR
Kirstenbos 497 LR	Lola Montez 796 LR
Klip Bank 713 LR	St. Etienne 798 LR
Schrikfontein 715 LR	Wydenhoek 216 KR
Hookdoorn Draai 711 LR	Appingendam 805 LR
Windsor-Castle 493 LQ	Kranskloof 218 KR
Toulon 495 LQ	Smithsfield 536 LQ
Cradock 534 LQ	Fairfield 219 LR
Diepspruit 463 LR	Republiek 456 LR

A comprehensive indication of identified and consulted landowners can be obtained from the project database and the Landowner Map (refer to Appendix C).

The high-density residential areas are expected to have a high visual absorption capacity and will not suffer as severe a potential visual impact as the rural settlements due to the occurrence of less visual clutter. Residents along the perimeter of high-density residential areas could however still be exposed to the project infrastructure, necessitating the inclusion of these neighbourhoods into the first zone. Residents of this zone are seen as potentially sensitive visual receptors upon which the construction of the substation or transmission lines could have a negative visual impact.

Villages and rural settlements (in close proximity of the proposed project infrastructure) within **area one** include:

Neckar	Ga-Lebelo
Ga-Maeteletsa	Mosuka
Abbottspoort	Mphello
Bangalong	Uitspanning
Ga-Monyeki	Diretsaneng
Ga-Musi	Magagamatala
Ga-Nkidiktitlana	Buffelshoek
Mongatane	Ga-Tshba
Mathlati	Kgopeng
Setateng	Ga-Malope
Ga-Monare	Diphitshi
Sepobe	Lenkwane
Vianen	Matebeleng
Segole 1	Ga-Monene
Nong	Ga-Malapila
Ga-Rapadi	Ga-Mokwena
Senita	Ga-Molekwa
Ga-Mathekga	Dibeng
Mosira	Thutlane
Sandsloot	Vlakfontein B
Phofu	Ngope
Madietane	Ga-Mosoge
Nokayamatlala	Sekuruwe
Goedehoop	Ga-Malebana
Phetole	Morwasethula
Ga-Masipa	Phatsane
Pudiyakgopa	Ga-Mashashane
Ga-Mabusela	Sebora
Jupiter	Ramorulana
Diana	Ga-Mabuela
Ga-Malokwa	Ga-Tshaba
Ga-Ramu	Mapela
Manyapye	Segoahleng

Ga-Mangou	Mmahlogo
Glen Roy	Ga-Motlana
Ga-Molaka	Ga-Matlapa
Makekengf	Mmamatlakala
Sepharane	Ga-Masenya 2
Utjane	Ga-Molekana
Lyden	Ga-Masenya 1

- » The **second area** includes a 1 000 m buffer zone along the national roads (N1 and N11) and arterial/main roads (R33, R510, R518 and R101) that represents an area with a high potential of sightings of the project infrastructure (by people travelling along these roads).
- » The **third area** includes the formal/statutory conservation and protected areas within the study area. These reserves qualify as potential sensitive visual receptors due to their conservation status and nature based tourism activities. The proposed project infrastructure has the potential to conflict with the current land use within this zone and will more than likely induce a negative viewer perception.

Identified conservation or protected areas include registered private nature reserves, provincial nature reserves and the UNESCO (United Nations Educational, Scientific and Cultural Organisation) declared Waterberg Biosphere Reserve. The following conservation areas form part of the waterberg Biosphere reserve: D'Nyala, Kwalata, Lapalala, Touchstone, Moepel Farms, Wonderkop, Bellevue, Wit Vinger, Percy Fyfe and Kuschke.

- » The **fourth area** includes the mountainous terrain within the study area, delineated as all areas with slope gradients greater than 20% (1:5 slope ratio). This area was identified due to its inherent aesthetic quality or potential as a scenic tourist attraction. The rationale is that the project infrastructure might negatively influence the tourism development potential of this area.

The rest of the study area, **excluding the above-mentioned zones**, is assumed to be greatly devoid of random observers or sensitive visual receptors. This zone is characterised by relatively large and sparsely populated farms that predominantly function as cattle and game farming areas. This zone has, due to the relative absence of observers, an assumed neutral viewer perception of the proposed power line infrastructure.

It has become apparent from site inspections that the visual absorption capacity of the natural veld (thicket, bushland and woodland) is considerable in mitigating the impact of the proposed project infrastructure. This is true for large tracts of land where the natural vegetation is still intact, even where overgrazing

of grass species occur on cattle and game farms in the northern portion of the study area. The observer is effectively shielded from the structures by dense vegetation adjacent to roads and in the vicinity of residences and lodges. The opposite is also very noticeable where the natural vegetation has been cleared for agricultural fields or where the vegetation cover has been removed/severely degraded through over-utilisation (e.g. wood harvesting). The project infrastructure would be exposed within these predominantly rural settlement areas.

#### ***7.4.3. Comparison of Transmission Power Line Alternatives***

Viewshed analyses for the transmission line alternatives are shown in Figure 7.6. The visibility of the transmission towers were calculated at a maximum offset of 35 m above ground level for a radius of 5 km (i.e. the expected sphere of visual influence of the transmission line infrastructure) from the centre line.

It has become apparent from site inspections that the visual absorption capacity of the natural veld (thicket, bushland and woodland) is considerable in mitigating the impact of the proposed project infrastructure. This is true for large tracts of land where the natural vegetation is still intact, even where overgrazing of grass species occur on cattle and game farms to the north of the study area. The observer is effectively shielded from the structures by dense vegetation adjacent to roads and in the vicinity of residences and lodges. The opposite is also very noticeable where the natural vegetation has been cleared for agricultural fields or where the vegetation cover has been removed/severely degraded through over-utilisation (e.g. wood harvesting). The project infrastructure would be exposed within these predominantly rural settlement areas.

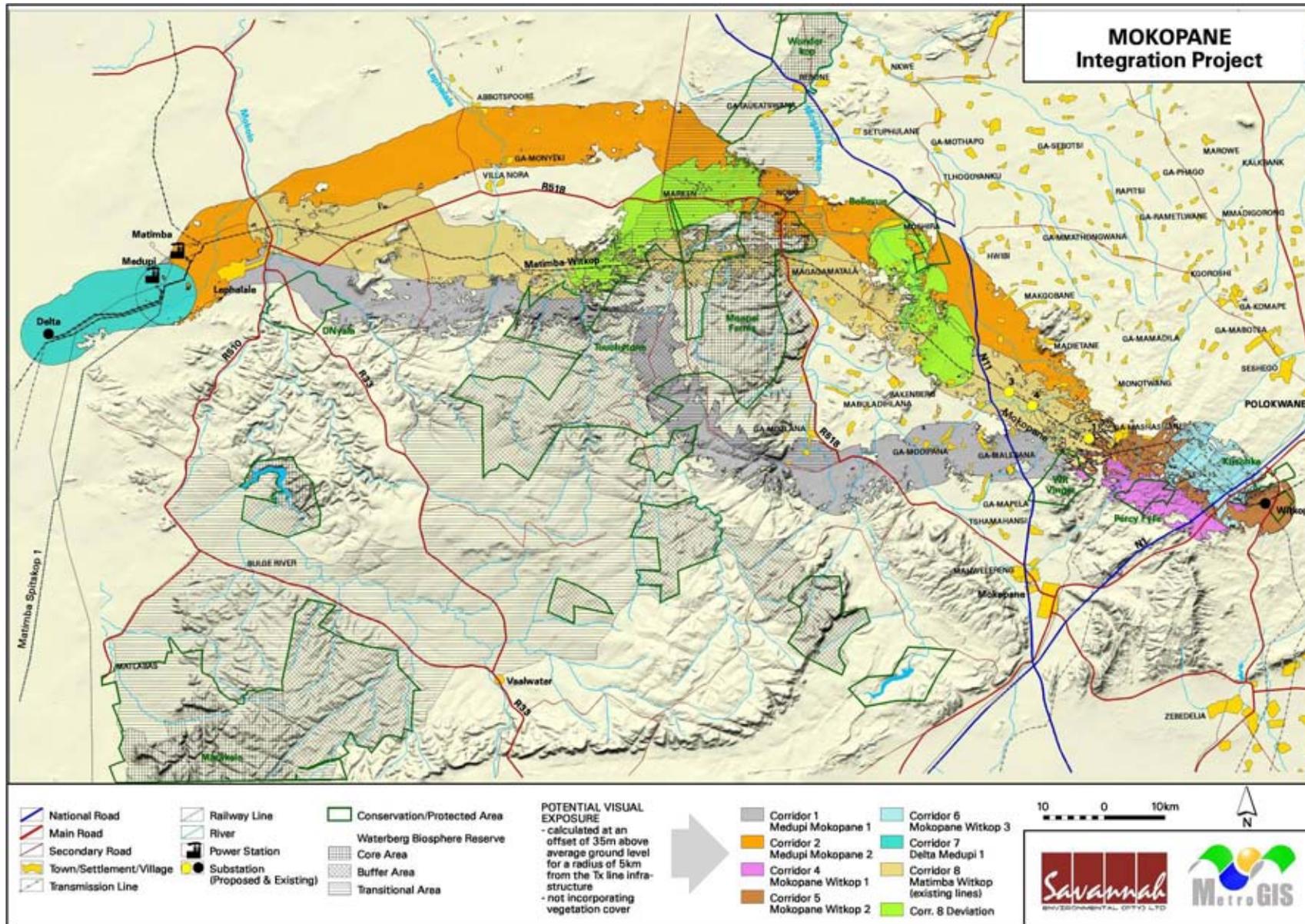
A broad visual absorption capacity map was created, identifying areas where large tracts of natural vegetation had been removed, in order to model the effects of either the absence or the presence of vegetation cover on the visual exposure of the proposed infrastructure. Areas where the natural vegetation is absent received an additional negative value on the visual impact index (i.e. increasing the potential visual impact where the structures are exposed within this zone).

From Figure 7.6 it is clear that the proposed transmission line infrastructure has the potential to be visually exposed to large areas within the 5km corridors. This is due mainly to the relatively tall (35 m) transmission line towers associated with 400kV power lines. The proposed corridors display a more even potential exposure pattern where they traverse flat terrain and more scattered patterns where they encounter varied topography. Corridor 2, which does not traverse the Waterberg Mountains and escarpment, is seen as having a larger area of potential visual exposure than Corridors 1, 8 or 8 Deviation. The latter of these

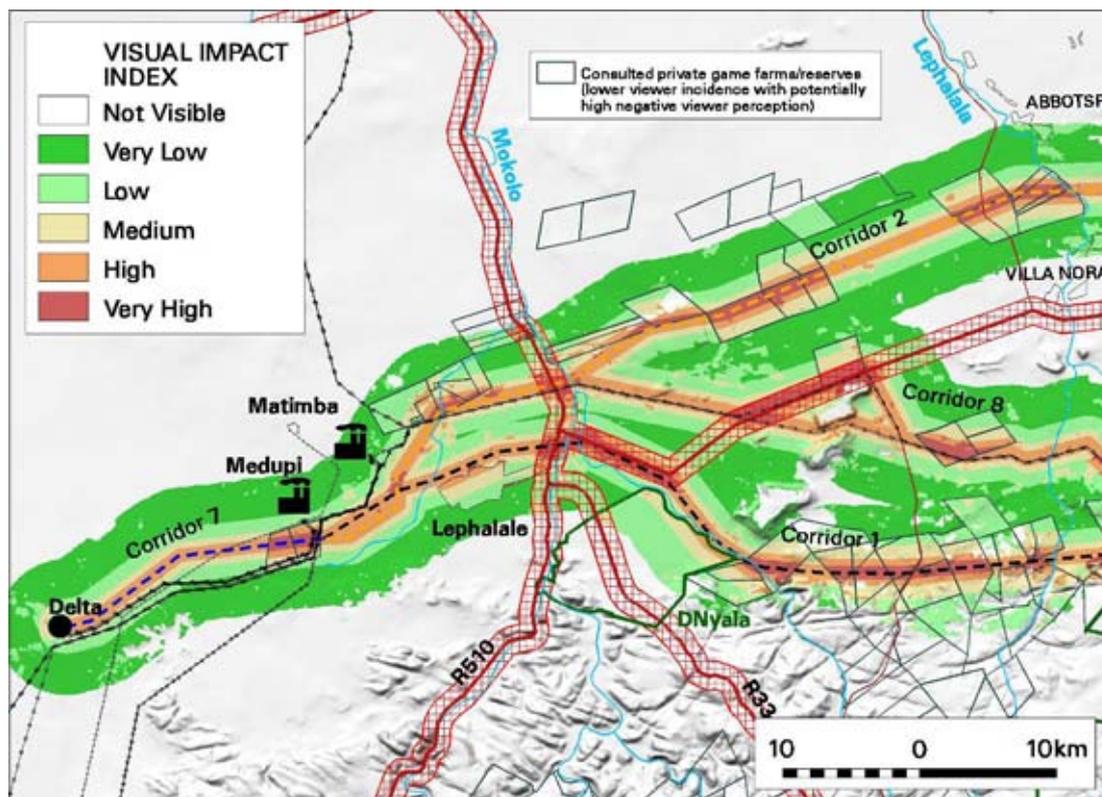
alternatives (i.e. Corridor 8 and 8 Deviation) traverse both flat terrain and the Waterberg escarpment and therefore have a combined pattern of visual exposure.

Corridors 4, 5 and 6 have very similar patterns of visual exposure due to their close proximity to each other and the relatively homogenous terrain they traverse.

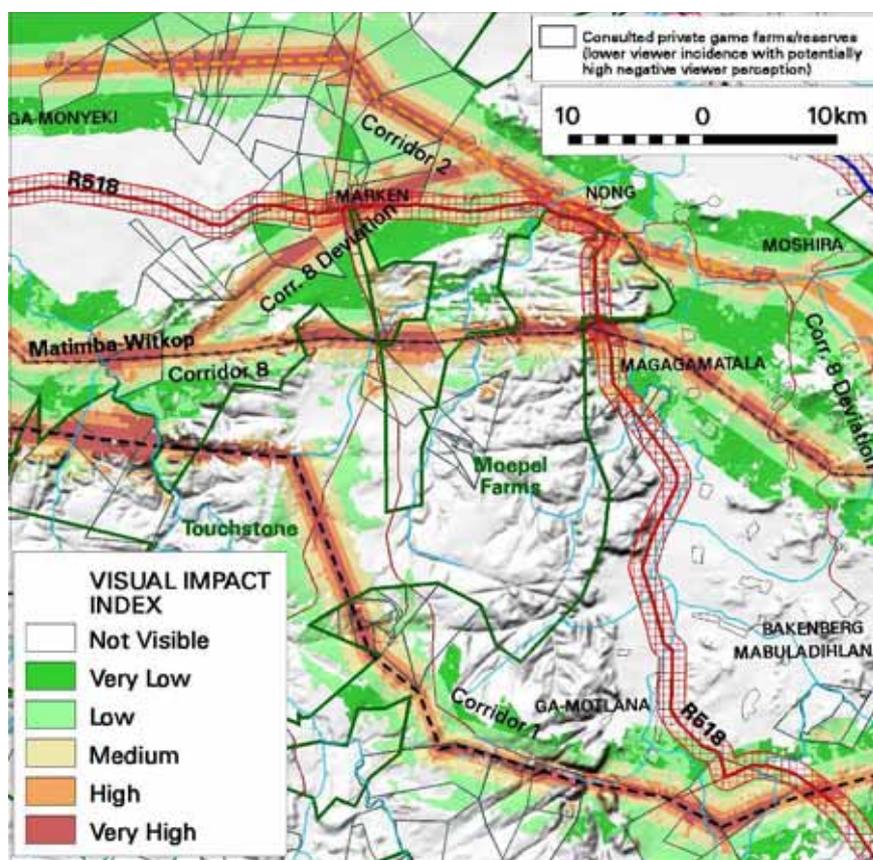
The combined results of the visual exposure, viewer incidence/perception, visual distance and the visual absorption capacity of the seven transmission corridor alternatives are displayed in Figures 7.7 – 7.9. Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category and merged in order to calculate the visual impact index. An area with short distance visual exposure to the proposed infrastructure, a high viewer incidence, a predominantly negative perception and that falls within an area of low visual absorption capacity would therefore have a higher value (greater impact) on the index. This assists in focussing the attention on the critical areas of potential impact when evaluating visual impact.



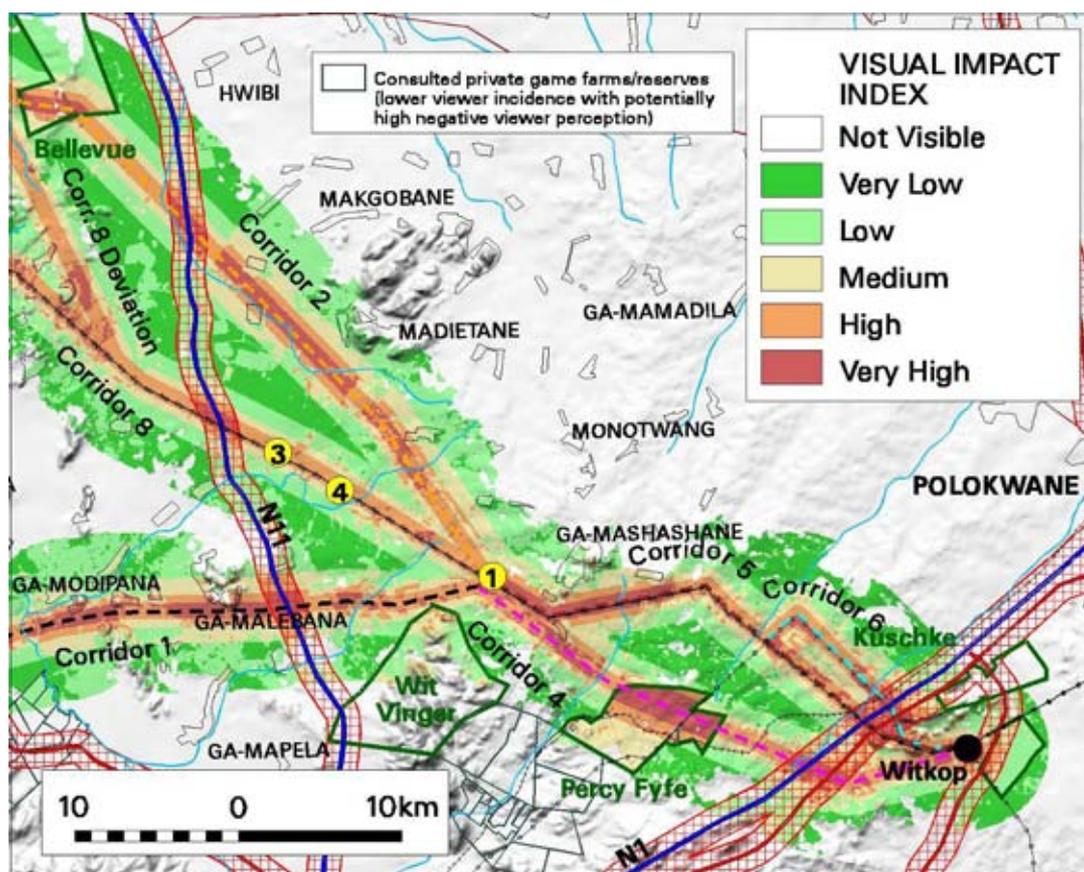
**Figure 7.6:** Potential visual exposure - transmission line corridor alternatives



**Figure 7.7:** Visual Impact Index for transmission line Corridors 1, 2, 7 and 8 (western section)



**Figure 7.8:** Visual Impact Index for transmission line Corridors 1, 2, 8 and 8 Deviation (central section)



**Figure 7.9:** Visual Impact Index for Transmission Line Corridors 1, 2, 4, 5, 6, 8 and 8 Deviation (eastern section)

» *Visual impact index – Corridor 1*

Transmission Line Corridor 1 has the potential to have a high visual impact on observers within a 500 m buffer radius along the entire length of the alignment. In many instances this zone traverses remote areas with little or no settlements or major roads (i.e. areas with few or no observers). Most sections of this zone however include isolated homesteads/residences on farms as well as lodges located on game farms and private conservation areas where high to very high visual impacts can be expected.

Farms along this corridor include, inter alia: Spektakel, Drakensberg, New Belgium, Hanover, Rivierplaats, Zwellendam, Poeskopdrift, De Koop, Colesberg, Uitvlugt, Duikerfontein, Norfolk, Rivierplaats, Eyszerbeen, Duikerrivier, Duna, terkwater, Groot Denteren, Grafton, Adelaide, Duikerrivier, Sterkwater, Broederschap, Laussonie, Daggakraal, Rhynosterfontein, Slangfontein, Lola Montez, St. Etienne, Wydenhoek, Appingendam and Kranskloof.

Specific areas of potentially very high visual impact occur where the corridor traverses north of the town of Lephalale (where it crosses over the R310) and where the line runs parallel to the R518 for almost 9 km. The transmission

lines within this corridor are expected to be visible to a great number of observers residing in this area, as well as observers travelling along these roads.

The next section of particular concern, from a visual impact point of view, occurs where the corridor enters the mountainous terrain of the northern part of the Waterberg plateau. The scenic and elevated topography of this area forms part of the buffer zone of the Waterberg Biosphere Reserve and includes a number of conservation/protected areas (including Touchstone, Lapalala, etc.). The potential visual impact for this section of the corridor is expected to be very high due to the envisaged conflicting land use priorities within these protected areas.

The proposed corridor continues across the Waterberg plateau in an easterly direction and drops down the eastern face of the escarpment. It traverses scenic topographical units and could potentially be exposed for great distances due to the elevated nature of the topography. It also passes in close proximity of the Mmamatlakala settlement and private game farms at the foot of the escarpment. This section is expected to have a very high visual impact.

The corridor next enters a more populated region as it crosses the R518, encountering the Mmahlogo, Mapela, Ga-Tshaba and Ga-Malebana settlements, before crossing the N11. This section is expected to have a high frequency of sightings from both the major roads it traverses, as well as from residents living in this area, and is expected to constitute a high to very high visual impact.

The final stretch of the transmission line Corridor 1 includes the northern section of the Witvinger Nature Reserve where it could, depending on the placement of the lines within the corridor, have a moderate to high visual impact on observers.

» *Visual impact index – Corridor 2*

Corridor 2 has the potential to have a high visual impact on observers within a 500 m buffer radius along the entire length of the alignment. This alignment, especially the northern section, is possibly the most remote of all the alternatives. It does, however, encounter a great number of individual homesteads and residences along the way. Many of these function as lodges and guest accommodation on game farms, and could potentially have a very high visual impact on residents and visitors along the corridor.

Farms along this section include, inter alia: Zongezien, Kalkfontein, Vucht, Wellington, Garibaldi, Weltevreden, Grootgenoeg, Samaria, Goa, Villa Nora, Killarney, Goedgelegen, Buffelsfontein, Deugdzaamheid, Stinkkraal,

Deugdzaamheid, Turflaagte, Tiel, Fairfield, Early Morn, Witpan, Pieterman, Rooibokpan, Schoonhoven, Fairfield, Leerdam, Scheveningen, Welgevonden and Gouda.

A number of villages along this alignment could potentially experience short distance visual impacts of the proposed transmission line infrastructure. These include: Bangalong, Ga-Musi, Mongatane, Ga-Monare, Nong, Ga-Mathekga, Ga-Lebelo (west of the N11) and Dibeng, Phofu, Jupiter and Ga-Mangou (east of the N11). Residents of these villages may experience high to very high visual impacts.

This corridor crosses or traverses adjacent to major roads within the region (i.e. the R510, R518 and N11), where very high visual impacts may occur. The corridor runs adjacent to the R518 for approximately 7 km at the northern extremity of the Waterberg escarpment, where it includes a section of the Waterberg Biosphere Reserve core area (Moepel Farms).

Corridor 2 predominantly traverses flat terrain, as it doesn't traverse the Waterberg escarpment. Smaller hills are however encountered where the alignment crosses over the southern section of the Bellevue Nature Reserve, potentially exposing the transmission lines over larger areas within the reserve. Very high visual impacts may occur due to the conflicting nature of land uses within this section.

» *Visual impact index – Corridor 8*

This transmission line alternative differs from the previously mentioned corridors in the sense that it follows the existing two Matimba-Witkop 400kV transmission lines for the entire length of its alignment. It is therefore considered as a "brown fields" linear development as opposed to Corridors 1 and 2 that traverse large tracts of natural land. This development corridor encounters a number of potential visual impacts along its length, but does possess the greatest potential to consolidate the linear infrastructure within the region due to the vertical disturbance caused by the existing lines.

The visual impact index of the Corridor 8 indicates general areas where the construction of two additional transmission lines may contribute to the potential cumulative visual impact along the alignment. These areas, along the entire length of the lines, include individual homesteads/farm houses, lodges and villages/settlements within the corridor.

Villages/settlements along this corridor include: Uitspanning, Magagamatala, Diretsaneng, Ga-Malope, Diphitshi, Ga-Malapila, Ga-Mokwena, Vlakfontein B and Goedehoop.

Farms along this corridor include, inter alia: Johannesburg, Kirstenbos, Klip Bank, Schrikfontein, Hookdoorn Draai, Windsor-Castle, Toulon, Cradock, Smithsfield, Spider, Durban, Wynberg, Weltevreden and Groetfontein

These settlements, lodges and homesteads may experience cumulative visual impacts ranging from moderate to very high.

Specific areas of potentially very high visual impact (due to increased viewer incidence) may occur where the corridor traverses adjacent to the R518 (near Lephalale) for approximately 10 km, the location where it crosses the R518 (near Marken) and the where it crosses the N11 north of Mokopane.

Another area of potentially very high visual impact may occur where the additional lines cross the Waterberg Biosphere Reserve buffer and core areas (Touchstone and Moepel Farms) as well as the section where it drops down the eastern face of the Waterberg escarpment. This entire section of the alignment traverses scenic mountainous terrain that should ideally not have accommodated transmission power line infrastructure.

It must be borne in mind that the potential visual impacts mentioned above would be additional to the existing visual impacts of the two Matimba-Witkop 400kV transmission lines.

» *Visual impact index – transmission line Corridor 8 Deviation*

The transmission line Alternative 8a corridor has the potential to have a high visual impact on observers within a 500m buffer radius along the entire length of the alignment. The western section of this deviation traverses over or near a number of private game farms where it is expected to have a very high visual impact.

Farms along this corridor include: Grobbelaarshoek 462 LR, Diepspruit 463 LR, Sterkfontein 459 LR, Republiek 456 LR and Gouda 453 LR. It further traverses near the little town/settlement of Marken and over the R518 main road, where it will be exposed to a higher number of observers, potentially resulting in a very high visual impact. Villages/settlements along this corridor include: Buffelshoek, Ga-Mokwena and Vlakfontein B.

The eastern section of the Alternative 8a deviation traverses mainly community land where it may have a high visual impact on settlements/villages within the development corridor.

» *Visual impact index – Corridor 4*

The visual impact index of transmission line corridor Alternative 4 indicates potentially high to very high visual impacts within a 500 m buffer of the

proposed lines where the lines traverse near homesteads and a settlement (Ga-Matlapa), where the corridor spans across the Percy Fyfe Nature Reserve and where the corridor crosses the N11 and R101 west of the Witkop substation.

» *Visual impact index – Corridor 5*

Corridor 5 is similar to Corridor 8 due to the fact that it follows the existing Matimba-Witkop transmission lines. The potential visual impacts associated with this alternative are therefore additional to the visual impacts associated with the existing lines.

The cumulative visual impact of the two proposed 400kV transmission lines relates to potentially high to very high visual impacts on homesteads and settlements (Segoahleng, Ga-Matlapa and Seborā) within the corridor, as well as the section where the two new lines cross the R101 and N1 roads.

» *Visual impact index – Corridor 6*

Corridor 6 deviates from Corridor 5 where it follows the two Warmbad-Witkop 275kV transmission lines. Potential cumulative visual impacts (ranging from high to very high) may occur within a 500 m buffer zone of the proposed lines, where the lines traverse adjacent to individual residences, and where the lines cross the R101 and N1 adjacent to the existing power lines.

Both Alternatives 5 and 6 would have to traverse the hills north-west of the Witkop substation, potentially aggravating the cumulative visual impact of power line structures already present on the hills.

» *Visual impact index – Corridor 7*

The 20 km long corridor between the Delta substation and the Medupi power station is relatively uninhabited, except for three or four individual homesteads and the farm Kuipersbult 511 LQ (located south of the Medupi Power Station) that may experience high to very high visual impacts of the proposed new 400kV transmission lines (depending on where they are placed within the corridor). This corridor is adjacent (north) to no less than six transmission power lines originating at the Matimba Power Station, which creates an existing visual disturbance.

***Impact tables summarising the significance of Visual Impacts (mitigation not possible) associated with the Transmission Lines – Medupi-Mokopane***

<b>Nature of Impact: Potential visual impact on users of major roads in close vicinity of transmission line Corridors 1, 2, 8 and 8 Deviation.</b>				
	<b>Corridor 1</b>	<b>Corridor 2</b>	<b>Corridor 8</b>	<b>Corridor 8 Deviation</b>
<b>Extent</b>	Local (4)	Local (4)	Local (4)	Local (4)
<b>Duration</b>	Long term (4)	Long term (4)	Long term (4)	Long term (4)
<b>Magnitude</b>	Very high (5)	Very high (5)	Very high (5)	Very high (5)
<b>Probability</b>	High probability (4)	High probability (4)	High probability (4)	High probability (4)
<b>Status</b>	Negative	Negative	Negative	Negative
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Significance</b>	<b>High (64)</b>	<b>High (64)</b>	<b>High (64)</b>	<b>High (64)</b>
<b>Irreplaceable loss of resources?</b>	No	No	No	No
<b>Can impacts be mitigated during operational phase?</b>	No	No	No	No
<b>Mitigation:</b>				
» The Alternative 8 corridor has a higher potential to consolidate the transmission line infrastructure by placing the proposed lines adjacent to existing power lines.				
<b>Cumulative impacts:</b>				
» Alternative 1 runs adjacent to main roads (R518) for longer distances (9km) exposing more power line towers to a higher frequency of road users, thereby increasing the potential visual impact.				
» The placement of too many power lines in one servitude can increase the potential cumulative visual impacts associated with Alternative 8, especially at a local scale. This alternative will run adjacent to the existing Matimba-Witkop power lines, and next to the R518, for approximately 10km.				
<b>Residual impacts:</b>				
N.A.				

<b>Nature of Impact: Potential visual impact on residents and visitors in close proximity to the Corridors 1, 2, 8 and 8 Deviation.</b>				
	<b>Corridor 1</b>	<b>Corridor 2</b>	<b>Corridor 8</b>	<b>Corridor 8 Deviation</b>
All alternatives have the potential to visually impact on residents and visitors in close proximity to the proposed infrastructure. Corridor 8 has a greater potential to consolidate the visual impact if the lines are placed adjacent to the existing power line infrastructure inside the corridor. Ironically this may also increase the potential cumulative visual impact (at a site specific or local scale) of having four power line servitudes next to each other. Ultimately this is preferable due to the comparatively "greenfields" alignments associated with Corridor 1 and 2 being considered more visually sensitive.				
<b>Extent</b>	Local (4)	Local (4)	Local (4)	Local (4)
<b>Duration</b>	Long term (4)	Long term (4)	Long term (4)	Long term (4)
<b>Magnitude</b>	Very high (5)	Very high (5)	Very high (5)	Very high (5)
<b>Probability</b>	High probability	High probability	High probability	High

	(4)	(4)	(4)	probability (4)
<b>Status</b>	Negative	Negative	Negative	Negative
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Significance</b>	<b>High (64)</b>	<b>High (64)</b>	<b>High (64)</b>	<b>High (64)</b>
<b>Irreplaceable loss of resources?</b>	No	No	No	No
<b>Can impacts be mitigated during operational phase?</b>	No	No	No	No
<b>Mitigation:</b>				
» The placement of the proposed lines within Corridor 8 (or 8 Deviation) adjacent to existing power line infrastructure.				
<b>Cumulative impacts:</b>				
» Corridor 8 and Corridor 8 Deviation will potentially increase the cumulative visual impact of viewing four transmission lines parallel to each other.				
<b>Residual impacts:</b>				
N.A.				

**Nature of Impact: Potential visual impact on scenic topographical features and statutory conservation areas of the transmission line Corridors 1, 2, 8 and 8 Deviation.**

Alternatives 1 and 8 traverse the Waterberg plateau and escarpment, and subsequently cross central sections of the Waterberg Biosphere Reserve and associated nature reserves. Alternative 2 traverses the southern section of Bellevue Nature Reserve and the northern transitional zone of the Waterberg Biosphere Reserve. This corridor intrudes marginally on the core area of the Biosphere Reserve along the northern section of the Waterberg plateau. The proposed Corridor 8 deviation skirts the north-western section of the Waterberg Biosphere Reserve's buffer area near Marken, but may, together with the joint section with Corridor 2, successfully evade both the Waterberg Biosphere Reserve and the Waterberg Mountains if placed correctly within their respective 5km development corridors.

	<b>Corridor 1</b>	<b>Corridor 2</b>	<b>Corridor 8</b>	<b>Corridor 8 Deviation</b>
<b>Extent</b>	Local (4)	Local (4)	Local (4)	Local (4)
<b>Duration</b>	Long term (4)	Long term (4)	Long term (4)	Long term (4)
<b>Magnitude</b>	Very high (5)	High (4)	Very high (5)	High (4)
<b>Probability</b>	High probability (4)	High probability (4)	High probability (4)	High probability (4)
<b>Status</b>	Negative	Negative	Negative	Negative
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Significance</b>	<b>High (64)</b>	<b>Moderate (60)</b>	<b>High (64)</b>	<b>Moderate (60)</b>
<b>Irreplaceable loss of resources?</b>	No	No	No	No
<b>Can impacts be mitigated during operational phase?</b>	No	Yes	No	Yes
<b>Mitigation:</b>				
» The deviation of Alternative 2 (within the designated corridor) to traverse north of the Waterberg Biosphere Reserve's core areas (i.e. north of the Waterberg mountain) and south of the Bellevue Nature Reserve.				
<b>Cumulative impacts:</b>				

» Alternative 8 will potentially increase the cumulative visual impact of viewing four transmission lines parallel to each other where they traverse scenic topographical features and protected areas.
<b>Residual impacts:</b> N.A.

**Total significance of visual impacts - transmission line Corridors 1, 2, 8 and 8 Deviation**

	Corridor 1	Corridor 2	Corridor 8	Corridor 8 Deviation
<i>Potential visual impact on users of major roads in close vicinity of transmission line Corridors</i>	64	64	64	64
<i>Potential visual impact on residents and visitors in close proximity to the Corridors</i>	64	64	64	64
<i>Potential visual impact on scenic topographical features and statutory conservation areas of the transmission line Corridors</i>	64	60	64	60
<b>Total significance</b>	192	188	192	188
<b>Average significance</b>	64 (High)	62.6 (High)	64 (High)	62.6 (High)

The above table indicates a marginal quantitative preference for Corridor 2 and Corridor 8 Deviation. Corridor 2 however has a low potential to consolidate the visual impact of linear infrastructure within the region. Corridor 8 (utilising the proposed deviation) has a higher potential to succeed should this principle be followed in order to prevent the spreading of power line infrastructure across the region. The true benefit of this visual impact mitigation measure will only be achieved if the additional lines are placed directly parallel to the existing lines. The mountainous terrain where this principle would not have been achieved due to topographical and technical considerations (space constraints) by the Corridor 8 can successfully be overcome by using the Corridor 8 deviation. This allows for the maximum utilisation of existing power line infrastructure without further compromising scenic topographical features or statutory protected and conservation areas.

**Alternative 8 Deviation** is therefore preferred above Corridors 1, 2 and 8 as a transmission line development corridor for the Medupi Power Station to the proposed Mokopane substation section of the Mokopane Integration Project.

***Impact tables summarising the significance of Visual Impacts (with and without mitigation) associated with the Transmission Lines – Mokopane-Witkop***

<b>Nature of Impact: Potential visual impact on users of major roads in close vicinity of Corridors 4, 5 and 6</b>			
	<b>Corridor 4</b>	<b>Corridor 5</b>	<b>Corridor 6</b>
<b>Extent</b>	Local (4)	Local (4)	Local (4)
<b>Duration</b>	Long term (4)	Long term (4)	Long term (4)
<b>Magnitude</b>	Very high (5)	High (4)	High (4)
<b>Probability</b>	High probability (4)	High probability (4)	High probability (4)
<b>Status</b>	Negative	Negative	Negative
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Significance</b>	<b>High (64)</b>	<b>Moderate (60)</b>	<b>Moderate (60)</b>
<b>Irreplaceable loss of resources?</b>	No	No	No
<b>Can impacts be mitigated during operational phase?</b>	No	No	No
<b>Mitigation:</b>			
» The Alternative 5 (and to a lesser degree Alternative 6) corridor has a higher potential to consolidate the transmission line infrastructure by placing the proposed lines adjacent to existing power lines.			
<b>Cumulative impacts:</b>			
» The placement of too many power lines in one servitude can increase the potential cumulative visual impacts associated with Alternative 5 and 6, especially at a local scale. It is, however, still preferable to Alternative 4 which will spread the visual impact of lines crossing these roads across a longer distance.			
<b>Residual impacts:</b>			
N.A.			

<b>Nature of Impact: Potential visual impact on residents in close proximity to the transmission line Corridors 4, 5 and 6</b>			
All three alternatives have the potential to visually impact on residents in close proximity to the proposed infrastructure. Corridors 5 and 6 have greater potential to consolidate the visual impact if the lines are placed adjacent to the existing power line infrastructure inside the corridor. Ironically this may also increase the potential cumulative visual impact (at a site specific or local scale) of having four power line servitudes next to each other. However, consolidation of the impacts is still preferable due to the comparatively "greenfields" alignment of Corridor 4 being considered more visually sensitive.			
	<b>Corridor 4</b>	<b>Corridor 5</b>	<b>Corridor 6</b>
<b>Extent</b>	Local (4)	Local (4)	Local (4)

<b>Duration</b>	Long term (4)	Long term (4)	Long term (4)
<b>Magnitude</b>	Very high (5)	Very high (5)	Very high (5)
<b>Probability</b>	High probability (4)	High probability (4)	High probability (4)
<b>Status</b>	Negative	Negative	Negative
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Significance</b>	<b>High (64)</b>	<b>High (64)</b>	<b>High (64)</b>
<b>Irreplaceable loss of resources?</b>	No	No	No
<b>Can impacts be mitigated during operational phase?</b>	No	No	No
<b>Mitigation:</b>			
» The placement of Alternatives 5 and 6 adjacent to existing power line infrastructure.			
<b>Cumulative impacts:</b>			
» Alternatives 5 and 6 will potentially increase the cumulative visual impact of viewing three or four transmission lines parallel to each other.			
<b>Residual impacts:</b>			
N.A.			

<b>Nature of Impact: Potential visual impact on conservation areas of the Corridors 4, 5 and 6</b>			
	<b>Corridor 4</b>	<b>Corridor 5</b>	<b>Corridor 6</b>
<b>Extent</b>	Local (4)	Local (4)	Local (4)
<b>Duration</b>	Long term (4)	Long term (4)	Long term (4)
<b>Magnitude</b>	Very high (5)	Low (2)	Low (2)
<b>Probability</b>	High probability (4)	Improbable (1)	Improbable (1)
<b>Status</b>	Negative	Negative	Negative
<b>Reversibility</b>	Recoverable (3)	Recoverable (3)	Recoverable (3)
<b>Significance</b>	<b>High (64)</b>	<b>Low (13)</b>	<b>Low (13)</b>
<b>Irreplaceable loss of resources?</b>	No	No	No
<b>Can impacts be mitigated during operational phase?</b>	No	No	No
<b>Mitigation:</b>			
N.A.			
<b>Cumulative impacts:</b>			
N.A.			

**Residual impacts:**

N.A.

Total significance of visual impacts - transmission line Alternatives 4, 5 and 6

	Corridor 4	Corridor 5	Corridor 6
<b>Table 6 significance</b>	64	60	60
<b>Table 7 significance</b>	64	64	64
<b>Table 8 significance</b>	64	13	13
<b>Total significance</b>	192	137	137
<b>Average significance</b>	64 (High)	45.6 (Moderate)	45.6 (Moderate)

Corridor 4, a "greenfields" alignment that traverses the Percy Fyfe Nature Reserve, fared considerably worse (64) than Corridors 5 and 6 (45.6). Both Corridors 5 and 6 will follow existing power line infrastructure, but Alternative 6 will increase the length of the alignment by 2 km thereby increasing the distance over which visual impacts will manifest. **Corridor 5** is therefore nominated as the preferred alternative from a visual impact perspective.

***Impact tables summarising the significance of Visual Impacts (with and without mitigation) associated with the Transmission Lines – Delta-Medupi***

**Nature of Impact: Overall potential visual impact of Corridor 7.**

This corridor is expected to have a relatively localised, yet potentially significant, visual impact on a few individual homesteads and the farm Kuipersbult 511 LQ (located south of the Medupi Power Station).

	Corridor 7
<b>Extent</b>	Local (4)
<b>Duration</b>	Long term (4)
<b>Magnitude</b>	High (4)
<b>Probability</b>	High probability (4)
<b>Status</b>	Negative
<b>Reversibility</b>	Recoverable (3)
<b>Significance</b>	<b>High (60)</b>
<b>Irreplaceable loss of resources?</b>	No
<b>Can impacts be mitigated during operational phase?</b>	No
<b>Mitigation:</b>	
» The placement of Alternative 7 transmission lines in close proximity of existing power line infrastructure.	

**Cumulative impacts:**

- » This area contains a significant number of power lines (approximately 8 existing lines) and will come under increasing visual strain with the addition of two new power lines. The cumulative visual impact threshold appears to have been exceeded already, negating the addition of two 400kV power lines (in very close proximity of the existing lines) to some degree.

**Residual impacts:**

N.A.

#### **7.4.4. Conclusions and Recommendations**

The construction of power line infrastructure in natural areas with potential conflicting land uses will always be problematic from a visual impact perspective. The study area for the Mokopane Integration Project not only covers large tracts of land that are still in a natural state, but also includes the scenic Waterberg Mountains and escarpment. Ideally the transmission line infrastructure should not traverse mountainous terrain due to the high scenic topographical value and pristine vegetation cover. From a visual impact perspective, **Corridor 8 Deviation** (Medupi-Mokopane) and **Corridor 5** (Mokopane-Witkop) are nominated as the preferred alternatives for the proposed 400kV transmission power lines. No significant impacts were identified to be associated with Corridor 7.

These corridors manage to avoid (or can avoid with minor deviations) the Waterberg plateau and escarpment as well as the formal protected areas (i.e. the Waterberg Biosphere Reserve and Bellevue Nature Reserve) along their respective alignments. The use of Corridor 8 Deviation does however create a new section of transmission line corridor (i.e. the section where the corridor deviates from Corridor 8 and the section of Corridor 2 forming part of this corridor) that may contribute to the visual fragmentation of the region at a larger scale, or encounter additional individual visual impacts at a local scale

The primary visual impact, namely the appearance and dimensions of the substation and transmission power line infrastructure is very difficult to mitigate. The broad functional design of the structures and the dimensions of the substation are unlikely to be changed in order to reduce visual impacts.

The transmission line towers should, in spatially constrained sections of the development corridors (i.e. in built-up areas), consist of monopole structures that are less bulky (albeit slightly taller) and less visually intrusive than conventional power line towers. Where space and technical considerations permit, the utilisation of cross rope suspension tower structures is recommended in preference to the more obtrusive conventional self-supporting strain towers.



**Figure 7.10:** Examples of monopole distribution power line towers. Similar structures have been used for 400kV towers where space is limited

### 7.5. Potential Impacts on Heritage Sites

The Phase I Heritage study for the options for the proposed Mokopane Integration Project identified a number of heritage resources. Undiscovered heritage resources may raise this number, although it is generally accepted that this number will decrease after a detailed walk-through study of the final surveyed alignments have been done, and the power lines have been realigned in order to avoid some of these heritage resources whilst others may continue to exist (unaffected) in the power line servitudes. The exact number of heritage resources that may be affected by the proposed power lines and the significance of each of these heritage resources therefore are not yet known.

The following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) were recorded in or near the study area:

- » Scatters of stone tools occur along the Vaalsloot, Klein Sandsloot and Mohlosane Rivers in the Langa Ndebele sphere of influence. Sites are more common along the central parts of both Corridor 1 and Corridor 8 in the mountainous Waterberg areas and include open sites as well as sites located in rock shelters.
- » Rock painting sites occur in the northern mountainous part of the project area, particularly along the central stretches of Corridor 1 and Corridor 8. A cluster with five rock art sites occurs near the start of both these corridors in the west. Here, the mountains of Ga Mabula and Tafelkoppe also hold high rock art sites of high heritage significance (not documented as yet).
- » Early Iron Age Eiland sites have been recorded near the central stretch of Corridor 8 and possibly also occur in or near the central stretch of Corridor 1. These sites are inconspicuous as they mostly cover small surface areas and

are not associated with any stone walls. Their most characteristic feature, if visible on the surface of the land, is the presence of decorated potsherds.

- » Late Iron Age (LIA) Moloko sites, some with stone walls and characterised by Moloko styled pottery as well as with Nguni types of pots, occur in and near the central stretches of both Corridor 1 and Corridor 8. These sites are also common in the Masebe Nature Reserve (e.g. Magagamatala) and in the Villa Nora area (e.g. Bobididi) between Corridors 1 and 8. These sites are also common in the Lange Ndebele sphere of influence in the south-east. The eastern stretch of Corridor 1 runs across this area. LIA Moloko stone walled sites in a poort in Thaba Tšweu fall inside Corridor 6 and are associated with the Langa Ndebele.
- » Historical remains, mostly consisting of homesteads, occur along the eastern stretch of Corridor 1 along the Fonthane mountains in the Langa Ndebele sphere of influence. Widely dispersed colonial farm residences (historical houses) occur in low numbers along the western and central stretches of Corridors 1, 2 and 8.
- » Graveyards occur along all stretches of all the power line corridors. Some of these graveyards are associated with villages which are scattered across the project area whilst others are associated with historical remains from the Langa Ndebele sphere of influence. Inconspicuous graves occur along the eastern stretch of Corridor 1. Graveyards in association with colonial farmsteads are generally low in numbers. Those that are associated with villages are higher in numbers considering the population numbers in these areas.
- » A commemorative beacon has been erected in the Kloof Pass.
- » Other heritage phenomena such as an open-air church occur near the village of Ga-Mathekgwa.
  
- » *Stone Age sites*  
Stone Age sites generally do not cover large surface areas and can be expected to occur nearly anywhere. Stone tools were recorded along the proposed alignment for Corridor 1. Stone Age sites may be impacted when towers are constructed on top of concentrations of stone tools. Stone tools are not destroyed by this action but are usually scattered from a disturbed archaeological context which already has been disrupted as a result of natural environmental occurrences in the past. However, the impact that may be caused by the project will be due to human intervention and will not be caused by natural environmental processes.
  
- » *Stone walled settlements*  
Stone walled settlements are found in areas where low mountains and hills occur as stone were used as the prime source of building material. The biggest concentration of stone walled sites occurs in Thaba Tšweu (Witkop Mountains), to the west of these mountains and in the former sphere of

interest of the Langa Ndebele. The surface of land that is covered by single or clusters of stone walled sites vary considerably. These types of sites are generally absent from the study area.

The stone walled sites in the Witkop Mountains in particular may be impacted by the proposed project if the towers for the power lines are erected within the perimeters of these sites or when the power lines cut across these sites which, together, constitute a small cultural landscape.

» *Historical structures*

The relatively low number of widely distributed colonial homesteads in the area need not be affected by the proposed transmission lines, also when considering that most of these houses are single structures which do not constitute cultural landscapes. Newly planned power lines are also usually designed in such a way as to avoid existing infrastructure. However, when power lines are grouped together, broad power line corridors may require that historical buildings have to be demolished to make way for power lines.

The stone walled homesteads in the Langa Ndebele sphere of influence have little significance. However some of these structures hold the graves of the occupants of these dwellings. Consequently, some of these remains may be considered to be of high significance and may be affected if towers are erected on top of these remains.

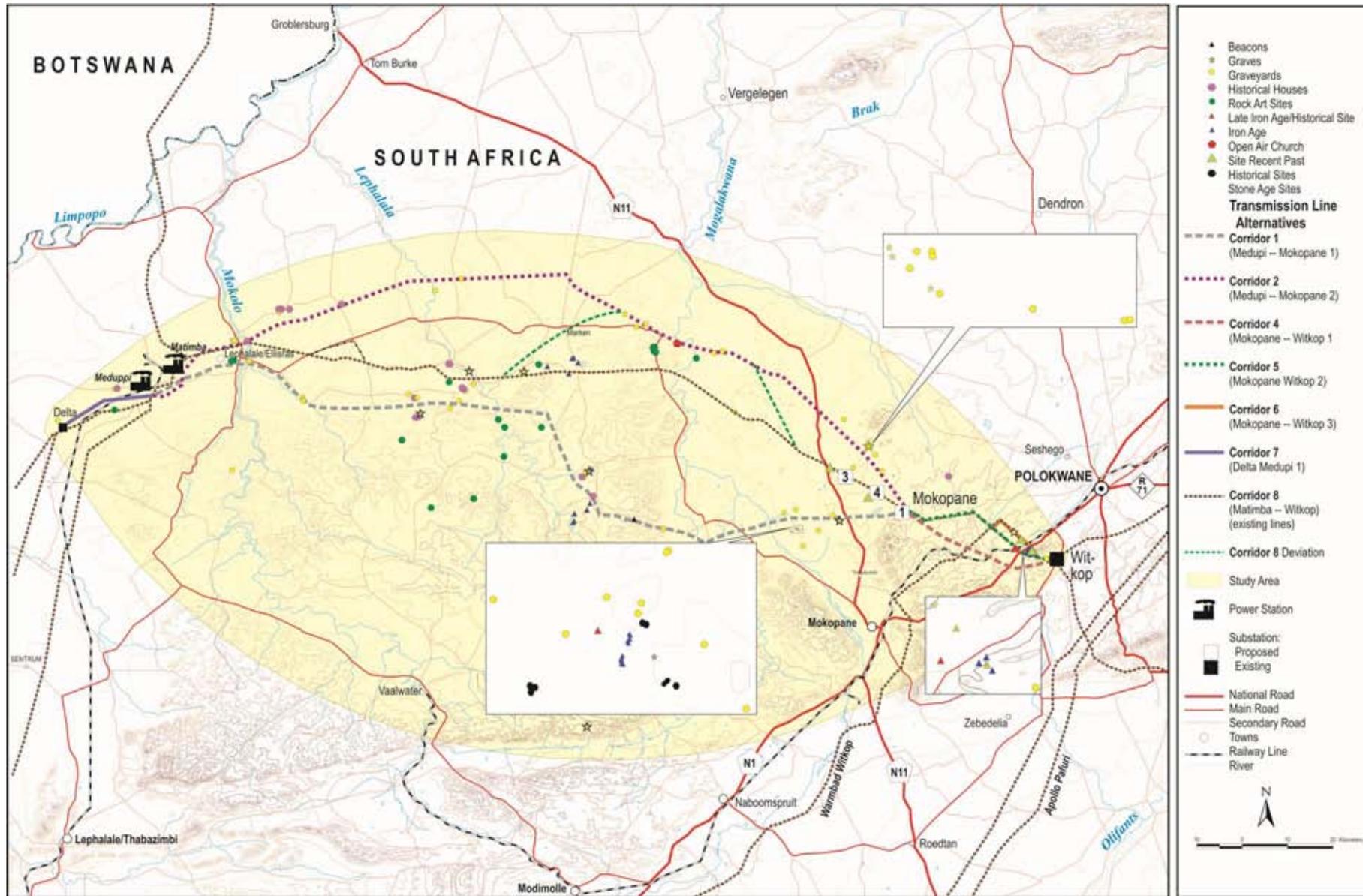
» *Memorabilia*

It is highly unlikely that the commemorative beacon in the Kloof Pass will be affected by the proposed lines as Corridor 1 is unlikely to be constructed along this kloof due to technical reasons and aesthetics.

» *Graveyards*

Any of the recorded graveyards or graves or those detected during the walk-through study of the final surveyed power line alignments may be impacted if towers are erected on top of these structures.

The locations of sites recorded within the study area are reflected in Figure 7.11.



**Figure 7.11:** Heritage resources recorded in the study area

Power lines are generally more sensitive and conservation friendly towards heritage resources than other kinds of development projects. The impact of power lines on heritage resources therefore, in many instances, can be categorised as being of medium or low significance. Two main types of impacts can be distinguished with regard to heritage resources and power lines, namely:

- » Physical impacts which occur when towers are constructed on top of heritage resources which occur on the surface of the earth.
- » Visual impacts occur when power line infrastructure affects the aesthetics and visual appearance, sense of place, context, or other aspects relating to heritage resources in a negative way.

The number of heritage resources that may be affected by the proposed project can be decreased if the power lines are realigned slightly after the walk-through study has been completed during the final EMP stage.

***Impact tables summarising the significance of Transmission Line impacts on Heritage Sites (with and without mitigation)***

<b>Nature: Alter, damage or destroy Stone Age sites in/near the power line corridors as a result of pre-construction, construction, or operational activities.</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Very high (5)	Minor (1)
<b>Probability</b>	Probable (3)	Improbable (1)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low 7)</b>
<b>Status</b>	Negative	Negative
<b>Irreplaceable loss of resources</b>	Yes	Yes
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
<ul style="list-style-type: none"> <li>» Corridor 8 and Corridor 8 Deviation: Constructed to the north of Tafelkoppe and Ga Mabula (along the R518); Follow dirt road to the north of Kleindenteren 485 and Kirstenbosch 497 (avoiding the kloof and reserve); Constructed further to the north or south on Klipbank 713 (avoid the second kloof); Follow existing corridor to avoid crossing the Masebe Nature Reserve.</li> <li>» No specific mitigation measures for other corridors.</li> </ul>		
<b>Cumulative impacts:</b>		
None.		
<b>Residual impacts:</b>		
None.		

<b>Nature: Alter, damage, destroy Iron Age sites in/near the power line corridors as a result of pre-construction, construction, or operational activities.</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Very high (5)	Moderate (3)
<b>Probability</b>	Probable (3)	Improbable (1)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (9)</b>
<b>Status</b>	Negative	Negative
<b>Irreplaceable loss of resources</b>	Yes	Yes
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
<ul style="list-style-type: none"> <li>» Corridor 8 and Corridor 8 Deviation: Constructed to the north of Tafelkoppe and Ga Mabula (along the R518); Follow dirt road to the north of Kleindenteren 485 and Kirstenbosch 497 (avoiding the kloof and reserve); Constructed further to the north or south on Klipbank 713 (avoid the second kloof); Follow existing corridor to avoid crossing the Masebe Nature Reserve.</li> <li>» No specific mitigation measures for other corridors.</li> </ul>		
<b>Cumulative impacts:</b>		
None.		
<b>Residual impacts:</b>		
None.		

<b>Nature: Alter, damage, destroy Historical Houses in/near the power line corridors as a result of pre-construction, construction, or operational activities.</b>		
	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Very high (5)	Moderate (3)
<b>Probability</b>	Probable (3)	Improbable (1)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (9)</b>
<b>Status</b>	Negative	Negative
<b>Irreplaceable loss of resources</b>	Yes	Yes
<b>Can impacts be mitigated</b>	Yes	
<b>Mitigation:</b>		
<ul style="list-style-type: none"> <li>» Corridor 8 and Corridor 8 Deviation: Constructed to the north of Tafelkoppe and Ga Mabula (along the R518); Follow dirt road to the north of Kleindenteren 485 and Kirstenbosch 497 (avoiding the kloof and reserve); Constructed further to the north or south on Klipbank 713 (avoid the second kloof); Follow existing corridor to avoid crossing the Masebe Nature Reserve.</li> <li>» No specific mitigation measures for other corridors.</li> </ul>		
<b>Cumulative impacts:</b>		
None.		

**Residual impacts:**

None.

**Nature: Alter, damage, destroy battlefields or memorabilia in/near the power line corridors as a result of pre-construction, construction, or operational activities**

	Without mitigation	With mitigation
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Very high (5)	Moderate (3)
<b>Probability</b>	Probable (3)	Improbable (1)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (9)</b>
<b>Status</b>	Negative	Negative
<b>Irreplaceable loss of resources</b>	Yes	Yes
<b>Can impacts be mitigated</b>	Yes	

**Mitigation:**

- » Corridor 8 and Corridor 8 Deviation: Constructed to the north of Tafelkoppe and Ga Mabula (along the R518); Follow dirt road to the north of Kleindenteren 485 and Kirstenbosch 497 (avoiding the kloof and reserve); Constructed further to the north or south on Klipbank 713 (avoid the second kloof); Follow existing corridor to avoid crossing the Masebe Nature Reserve.
- » No specific mitigation measures for other corridors.

**Cumulative impacts:**

None.

**Residual impacts:**

None.

**Nature: Alter, damage, destroy graves and graveyards in/near the power line corridors**

	Without mitigation	With mitigation
<b>Extent</b>	Local (1)	Local (1)
<b>Duration</b>	Permanent (5)	Permanent (5)
<b>Magnitude</b>	Very high (5)	Moderate (3)
<b>Probability</b>	Probable (3)	Improbable (1)
<b>Significance</b>	<b>Medium (33)</b>	<b>Low (9)</b>
<b>Status</b>	Negative	Negative
<b>Irreplaceable loss of resources</b>	Yes	Yes
<b>Can impacts be mitigated</b>	Yes	

**Mitigation:**

- » Undertake heritage walk-through survey during the power line route planning and design phase.
- » Avoid graveyards in final alignment of power line.

<b>Cumulative impacts:</b> None.
<b>Residual impacts:</b> None.

### 7.5.1. Comparison of Transmission Power Line Alternatives

#### Medupi-Mokopane

The table below provides a comparison of the alternatives investigated through this study. The corridor alternatives are ranked, with 12 being the least preferred and 3 being the most preferred corridor.

<b>Ranking</b>	<b>Options</b>	<b>Heritage character</b>	<b>Conditions</b>
1	Corridor 01	Will affect the highest number of heritage resources; highest number of types and ranges of heritage resources and heritage resources with possible high significance	Mitigation is possible but may be extensive
2	Corridor 08	Will affect the second lowest number of heritage resources; second lowest number of types and ranges of heritage resources and no outstanding significant heritage resources	Mitigation is possible Construct to the north of Tafelkoppe and Ga Mabula (along the R518). Follow the dirt road north of Kleindenteren 485 and Kirstenbosch 497. Avoid sanstone valleys and Masebe Nature Reserve
3	Corridor 02	Will affect the lowest number of heritage resources; lowest number of types and ranges of heritage resources and no outstanding significant heritage resources	Mitigation is possible and will be limited
3	Corridor 08 Deviation	Will affect the lowest number of heritage resources; lowest number of types and ranges of heritage resources and no outstanding significant heritage resources	Mitigation is possible and will be limited Construct to the north of Tafelkoppe and Ga Mabula (along the R518). Follow the dirt road north of Kleindenteren 485 and Kirstenbosch 497. Avoid sandstone valleys and Masebe Nature Reserve

From the findings of the Phase 1 Heritage Impact Assessment, it was concluded that construction of the proposed power lines within Corridor 2 or Corridor 8 Deviation will affect the lowest number of heritage resources, the least types and ranges of heritage resources, as well as no outstanding significant heritage resources. Corridor 08 Deviation will be required to be constructed to the north of Tafelkoppe and Ga Mabula (along the R518) in order to avoid impacting on significant heritage resources in these areas.

Therefore, **Corridor 2 or Corridor 8 Deviation** are nominated as the preferred alternatives from a heritage perspective.

Corridor 8 is considered acceptable corridor provided the following deviations can be implemented in order to consider current technical constraints and landowner issues:

- » The power lines must be constructed to the north of Tafelkoppe and Ga Mabula (along the R518); follow the dirt road to the north of Kleindenteren 485 and Kirstenbosch 497, avoiding the kloof and reserve; constructed slightly further to the north or south on Klipbank in order to avoid the second kloof and follow its existing corridor in order to avoid crossing the Masbe Nature Reserve.

Corridor 1 is the least preferred from a heritage perspective as construction of the proposed power lines within this corridor will affect the highest number of heritage resources, the greatest variety of heritage resources and heritage resources with possible high significance.

### ***Mokopane-Witkop***

The table below provides a comparison of the alternatives investigated through this study. The corridor alternatives are ranked, with 12 being the least preferred and 3 being the most preferred corridor.

<b><u>Ranking</u></b>	<b><u>Options</u></b>	<b><u>Heritage character</u></b>	<b><u>Conditions</u></b>
1	Corridor 06	Cluster of stone walled sites in poort Possible graves in a sisal bush.	Mitigation
3	Corridors 04, 05	Stone walled site	Mitigation
3	Corridor 07	Historical houses and Graveyards	Mitigation

From the findings of the Phase 1 Heritage Impact Assessment, it was concluded that construction of the proposed power lines within Corridor 6 will have the highest impact on heritage resources as it contains the following:

- » A cluster of stone walled sites which are already impacted by Eskom's existing 132kV power lines as they run through a poort in Thaba Tsweu in which the power lines are located.
- » This corridor is also associated with a possible graves located in a sisal bush.

Therefore, this corridor is identified as the least preferred corridor from a heritage perspective.

No specific preference, from a heritage point of view, can be made between **Corridor 4 and Corridor 5**. Therefore, the construction of the proposed power lines within either of these corridors would be considered acceptable.

### ***Delta-Medupi***

Corridor 7 has no alternatives. However it appears as if this corridor holds no outstanding significant heritage resources other than one or more historical houses and a few graveyards. These heritage resources can either be avoided, or can be incorporated in the power line servitudes.

### ***7.5.2. Conclusions and Recommendations***

From a heritage perspective, **Corridor 2 or Corridor 8 Deviation** (Medupi-Mokopane) and **Corridors 4 or 5** (Mokopane-Witkop) are nominated as the preferred alternatives for the proposed 400kV transmission power lines. No significant impacts were identified to be associated with Corridor 7.

An important aspect relating to the mitigation (conservation) of heritage resources in power line corridors is the undertaking of walk-through studies which are done before transmission lines are constructed and have the following benefits, namely:

- » Transmission line towers can be relocated in order to avoid (conserve) heritage sites.
- » Heritage resources can be conserved unaffected (in situ) underneath power lines and can subsequently be managed as long as power lines are operational.

**Stone Age sites** can in some instances be avoided by means of placing towers on opposite ends (outer perimeters) of these sites. Stone Age sites therefore can be kept underneath (in situ) any number of power lines. It is also possible that affected stone tools can be collected from the surface before the power lines are constructed. These stone tools can be donated to museums (preferably closest to the project area) or to an accredited institution such as a national museum or a

university. Here, it can be safe-kept and be used in displays or in educational programmes.

**Stone walled sites** can in some instances be avoided by means of placing towers on opposite ends (outer perimeters) of single or small clusters of stone walled sites. Incorporation of a small cluster of stone walled sites underneath any number of power lines may impact on these sites if they constitute cultural landscapes. However, the impact will be visual and not necessarily physical. No fixed prescriptions exist for 'safe distances' that has to be maintained between power lines and stone walled sites. If stone walls have to be destroyed to make way for towers, these stone walled sites must be subjected to Phase II investigations. These investigations require that stone walled sites be documented by means of mapping the sites and possibly by means of small test excavations of the sites.

**Historical houses** (sometimes with associated infrastructure) which may constitute cultural landscapes can in some instances be avoided by means of routing power lines around these structures. Historical infrastructure, however, cannot be preserved underneath power lines. Power lines that avoid historical structures may still impact visually on these remains. No fixed prescriptions exist that outline 'safe distances' between power lines and historical structures. Historical structures may not be affected (demolished, renovated, altered) by the proposed project prior to their investigation by a historical architect in good standing with SAHRA.

In terms of **memorabilia**, the commemorative beacon in the Kloof Pass must preferably be avoided by the proposed project. If the monument, which can also be conserved beneath the power line, has to be moved it must be shifted to a location where it is accessible to the public, tourists and other interested individuals or groups as it holds educational and other values.

**Graves and graveyards** in the project area can be mitigated by following one of the following strategies, namely:

- » Graveyards and graves can be conserved in situ beneath power lines. Towers should be erected on opposite ends of graves or graveyards. Consequently, power lines can be strung across and above graves and graveyards. Conserving graves and graveyards in power line servitudes creates the risk that they may be damaged, accidentally, and that Eskom may be held responsible for such damages. Controlled access must exist for any relatives or friends who wish to visit graves or graveyards in power line servitudes.
- » Graves can also be exhumed and relocated. The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. This task is undertaken by

forensic archaeologists or by reputed undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains have to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police.

The protection and conservation of heritage resources in power lines servitudes is advanced by means of walk-through studies which are conducted before the final alignments for power lines are fixed and before the construction of power lines commences. During the walk-through study, the real (factual) impact on recorded heritage resources as well as on earlier undetected heritage resources may be determined. By rerouting the power lines or changing the placement of towers, possible impacts on heritage sites can either be minimised or can be avoided.

#### **7.6. Potential Impacts on the Social Environment**

Impacts on the social environment as a result of the proposed transmission lines are expected to occur during both the construction and operation phases (as well as during the eventual decommissioning of the infrastructure).

The Social Impact Assessment considers the following:

- » Demographic processes (the number and composition of people – e.g. number of tourists);
- » Economic processes (the way in which people make a living and the economic activities in society – e.g. income from tourists);
- » Geographical processes (land use patterns – e.g. how land is developed for tourists);
- » Empowerment, institutional and legal processes (the ability of people to be involved and influence decision making processes; and the role, efficiency and operation of governments and other organisations); and
- » Socio-cultural processes (the way in which humans behave, interact and relate to each other and their environment and the belief and value systems which guide these interactions – e.g. the way in which the landscape contribute to tourist expectations and experiences).

Considering all of these processes, potential social health impacts will also be assessed.

A distinction was made between change processes and impacts. A change process is defined as change that takes place within the receiving environment as a result of an intervention. A potential social impact follows as a result of the change process occurring. However, a change process can only result in an impact once it is experienced as such by an individual/household/community/organisation on a physical and/or cognitive level.

The change processes and impacts on the social environment that were assessed included:

- » *Geographical Processes - involuntary resettlement:* Description and Assessment of the Psycho-social Impacts as a result of involuntary resettlement.
- » *Geographical Processes- agricultural activities:* Description and Assessment of mental/psycho-social and physical health impacts as a result of land use changes during construction and operation.
- » *Demographic processes- influx of workers:* Description and Assessment of physical health impacts as a result of influx of workers during construction and operation.
- » *Demographic processes- influx of job seekers:* Assessment of physical health impacts as a result of influx of job seekers during construction and operation.
- » *Socio-cultural processes- influx of workers:* Description and Assessment of impact on social cohesion as a result of influx of workers during construction and operation.
- » *Socio-cultural processes- nuisance impacts:* Description and Assessment of nuisance impacts during construction and operation.
- » *Socio-cultural processes- Impact on sense of place:* Description and Assessment of impact on sense of place during construction and operation.
- » *Bio-physical processes- impact on health:* Description and Assessment on health impacts as a result of bio-physical changes during construction and operation.
- » *Economic Processes- Impact on hunting and tourism industry:* Description and Assessment of the impact on hunting and tourism industry output as a result of project activities.
- » *Economic processes- impact on hunting and tourism industry employment:* Description and Assessment of impact on hunting and tourism industry employment.
- » *Economic Injections:* Description of economic injections and Assessment of project related economic output.
- » *Employment as a result of project activities:* Description and Assessment of employment impact.
- » *Impact on property values:* Description and Assessment of potential impacts on property values.

**Impact Tables summarising the significance of Social Impacts associated with the Transmission Lines.**

In order to assess the corridor alternatives in respect of their anticipated social impacts, a distinction was made between the following impacts:

- » **Category 1:** Impacts that are not expected to differ between the proposed Corridor alternatives, e.g. the number of construction workers that will be needed for the proposed project remains the same, irrespective of the chosen alternative;
- » **Category 2:** Impacts that are expected to differ between the proposed alternative Corridors, e.g. the number of households to be resettled increases if the development traversed densely populated areas as opposed to skirting populated areas.

<b>Nature: Psycho-social impact as a result involuntary resettlement</b>		
Involuntary resettlement has to take place where dwellings fall in the servitude to mitigate the potential impact of Electro and Magnetic Fields (EMFs) on people. The effect of EMFs as such is not assessed here, because the servitude width is regarded as sufficient mitigation measure to mitigate the potential physical health impacts of EMFs.		
Resettlement is not voluntary. Unmitigated involuntary resettlement could lead to landlessness, joblessness, marginalisation, food insecurity, rejection by host communities. The process could be positive if compensation is considered adequate and the negotiation process is executed in a professional manner.		
This is considered to be a <b>Category 2 Impact</b> .		
	<b>Before Mitigation</b>	<b>After Mitigation</b>
<b>Extent (Scale)</b>	Site only (1)	Site only (1)
<b>Duration</b>	Very short-Permanent (1-5)	Very short-Permanent (1-5)
<b>Magnitude</b>	Low-Moderate (2-3)	Low-Moderate (2-3)
<b>Reversibility</b>	Irreversible (5)	Irreversible (5)
<b>Probability Corridor 1</b>	High (4)	Medium (3)
<b>Probability Corridors 2, 7, 8, 4-6</b>	Medium (3)	Low (2)
<b>Significance Corridor 1</b>	Medium (36-56)	Low-Medium (27-42)
<b>Significance Corridors 7, 2, 8, 4-6</b>	<b>Low-Medium (27-42)</b>	<b>Low (18-28)</b>
<b>Status</b>	Negative, could be positive for some (better circumstances for the poor)	Negative, could be positive for some (better circumstances for the poor)
<b>Mitigation</b>		
» Areas where religious activities take place should be identified during the negotiation		

process and mitigation measures should be implemented to ensure that these activities can carry on.

- » Avoid the involuntary resettlement of people as far as possible.
- » If resettlement is unavoidable, residents should be sufficiently compensated for loss of livelihood and assisted with the relocation process.
- » Those with lack of negotiation skills and lack of knowledge about the negotiation process should be educated and assisted.
- » Impacted people should be informed about the timeframes for the project – not knowing when involuntary resettlement will take place will add to the stress.
- » Poverty and equity: A form of compensation should also be granted to individuals who are residing in informal settlements within the servitude and assistance with relocation should be given. This issue should be approached with caution as this might set a precedent for future projects (people might deliberately move onto a servitude for the purpose of receiving compensation).
- » Compensation should not focus on monetary compensation only. Where necessary, impacted people should be assisted to move, and should receive counselling. Monetary compensation should preferably not be given to the poor because of lack of experience to work with larger amounts of money. Compensation should rather be in the form of material goods and assistance, or financial guidance should be given.
- » A common standard of compensation should be applied to all properties.
- » Landowners should be made aware that a pre- and post evaluation of their land value is possible.
- » Labour tenants who do not move with their employers to their new destination (e.g. where farms are bought out) should be assisted to find alternative long-term jobs.
- » The World Bank guidelines for involuntary resettlement should be followed.
- » Clear roles and responsibilities of Eskom and the impacted people should be formalised and adhered to.
- » Local customs should be acknowledged. E.g. the necessary ceremonies should be performed during the relocation and reburial of graves and Eskom should compensate affected families. However, this is unlikely to happen as Eskom would reroute the line and/or move towers to avoid this
- » Photos of the servitude should be taken prior to the negotiation process to monitor opportunistic settlement in the servitude for the purpose of being compensated.

To minimise the likelihood of development into the servitude during operation, the following mitigation measures are suggested:

- » Educate surrounding communities about the dangers of living in the servitude.
- » Community awareness on the safety mechanisms of a transmission power line and potential dangers.
- » The awareness campaign should also focus on standard operating procedures when there is a breakdown in the line, e.g. people should steer clear of the area, who to contact, etc.
- » Such an awareness campaign should be based on and addressed Frequently Asked Questions (FAQs) regarding a transmission power line.
- » A form of signage on the towers should also indicate that it is dangerous.
- » In some way a barrier (psychological and/or physical) should indicate that no structures should be built in the servitude.

» Eskom together with municipalities and Tribal Authorities should make decisions about whose responsibility it is to move people illegally settling in the servitude.

**Cumulative Impacts**

None.

**Residual impacts**

N/A.

**Nature: Mental and physical health impacts as a result of the impact of construction activities on farming**

Cultivated land and natural vegetation cover a large part of the study area. Game farms and nature reserves occur in the study area. In proximity to villages, subsistence crop farming and livestock farming occur. Commercialised agriculture largely occurs in the northern part of the study area. Irrigated areas can be found along all the alternatives. Potential impacts during construction include:

- » Impacts on cultivation activities because of the access roads needed and occupation of additional land for construction activities.
- » During stringing of the lines it will not be possible to carry on with irrigation.
- » Damage to roads which could impact on safety of people and animals.

This is considered to be a **Category 2 Impact**.

	<b>Before Mitigation</b>	<b>After Mitigation</b>
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>		
<b>Crop farming activities</b>	Low (2)	Minor (1)
<b>Cattle farming activities</b>	Moderate (3)	Low (2)
<b>Game farming activities</b>	High (4)	Moderate (3)
<b>Reversibility (all)</b>	Reversible (3)	Reversible (3)
<b>Probability Crop Farming</b>		
<b>Corridors 2, 8, 4, 5, 6, 7</b>	High (4)	Medium (3)
<b>Corridor 1</b>	Medium (3)	Low (2)
<b>Probability Cattle Farming</b>		
<b>Corridor 1, 8, 4, 5, 6</b>	Medium (3)	Low (2)
<b>Corridor 2, 7</b>	High (4)	Medium (3)
<b>Probability Game Farming</b>		
<b>Corridors 1, 2, 8, 4, 5, 6, 7</b>	High (4)	Medium (3)
<b>Significance</b>		

<b>Crop Farming</b> 2, 8, 4, 5, 6, 7	Low (28)	Low (18)
<b>Crop Farming</b> 1	Low (21)	Low (12)
<b>Cattle Farming</b> 1, 8, 4, 5, 6	Low (24)	Low (14)
<b>Cattle Farming</b> 2, 7	Medium (32)	Low (21)
<b>Game Farming</b> 1, 2, 8, 4, 5, 6, 7	Medium (36)	Low (24)
<b>Status</b>	Negative	Negative
<p><b>Mitigation</b></p> <ul style="list-style-type: none"> <li>» To mitigate the potential impacts of transmission power lines on the health and safety of people executing game capturing and crop spraying activities by aircraft, the transmission power lines should avoid areas where these activities take place, e.g. put them along roads. If this is not possible, they should be located along the borders of farms, and lines should be marked.</li> <li>» Where possible, towers should be located on the border of grazing areas and crop fields.</li> <li>» Towers should be placed in such a way as to avoid impacting on the operation of centre pivots, as far as possible.</li> <li>» Where possible, towers should be located on the border of the game farms and away from capturing nets to lessen the potential impacts.</li> <li>» If necessary, mitigation measures should be implemented to avoid any negative impact on animals (e.g. fencing off the construction area).</li> <li>» Eskom or its appointed contractor(s) should assist with the temporary relocation of livestock.</li> <li>» It is suggested that construction not take place during animal breeding months or during the main hunting seasons (winter months).</li> <li>» Construction activities should be communicated and finalised with the affected property owners, and adhered to. Should this not be possible, the landowner should be informed and consulted about alternative arrangements.</li> <li>» A grievances procedure should be implemented.</li> <li>» Two locks on either side of one chain gate could be used to ensure that the landowner always has access to the same lock even though Eskom/construction team might change the other lock.</li> <li>» The negotiation process should consider the mitigation of all relevant health and safety impacts on people and animals.</li> <li>» A common, standard to compensation should be applied to all properties.</li> <li>» Landowners should be aware that they can refuse to sign the release form after construction until they are satisfied with the level of rehabilitation.</li> <li>» Discussions on conditions set for construction or maintenance between landowners and Eskom should involve the relevant parties from Eskom Transmission and the Regions when the need arises as <i>“we know what happens on site and what could be implemented.”</i></li> <li>» Consultation between Eskom Lands &amp; Rights and the Regions is important when conditions are set that impact on maintenance of the line.</li> <li>» The process should be conducted with the necessary respect, and the negotiator</li> </ul>		

should be transparent about the process and expectations (do not engage in “empty promises”).

- » Negotiators should record everything that is discussed with landowners.
- » Infrastructure damage and damage to irrigation pumps should be repaired to their original or a better state.
- » The claim process for damage done by contractors should be simple.
- » Landowners can request trees not to be cut. If this does not jeopardise safety or the operation of the line, this can be adhered to and stringing can be done by hand.
- » Speed limits should be adhered to and construction vehicles marked.
- » Any contact with wild animals should be avoided as far as possible.

***Cumulative Impacts***

The impact might be less where existing lines occur as landowners have already adapted their activities to accommodate these existing lines.

***Residual impacts***

***N/A.***

***Nature: Mental and physical health impacts as a result of the impact of operation and maintenance activities on farming***

Cultivated land and natural vegetation cover a large part of the study area. Game farms and nature reserves occur in the study area. In proximity to villages, subsistence crop farming and livestock farming occur. Commercialised agriculture largely occurs in the northern part of the study area. Irrigated areas can be found along all the alternatives.

» Cultivated land

It is possible to cultivate land around power line towers, but it does complicate the process and some land for cultivation is lost. This is because the use of farming implements and equipment around/underneath power lines and anchor lines prove problematic.

It is possible to irrigate under a 400kV Transmission power line, because of its height from the ground. Although it is possible for 400kV Transmission power lines to cross centre pivots, it is not possible to have a tower in an area irrigated by centre pivots. The presence of the towers will make it impossible to carry on with the activity, unless the towers can be placed in such a way that they do not impact directly on the irrigation system. In cases where it is not possible to avoid these systems, the centre pivots will have to be moved elsewhere, including the complex irrigation system that goes with it. The impact will not only be economic, but will also cause psycho-social impacts such as frustration.

» Grazing land

Towers and lines on grazing land pose fewer problems, as livestock move around towers and less land is lost. There have been reports of animals getting entangled in towers, but these occurrences seem to be minimal.

» Game farms/Nature reserves

Game capturing becomes problematic and dangerous, if not impossible, when game

has to be captured in the vicinity of a power line using a helicopter/small aircraft. The helicopters fly low, and could collide with the line when herding game if these lines are not clearly marked. Should pilots fly higher to avoid the line, they may not be able to effectively herd the game. As a result of ineffective herding, game could collide with fences, and be injured. Game farmers with power lines on their land reported that game moved into the servitudes during game capturing to protect themselves. This makes game capturing by aeroplane/helicopter more challenging.

Other than game capturing, game farm owners will experience similar impacts to cattle farmers during construction and operation. The difference is that the game is not domesticated and the potential impacts on animals are therefore not as easy to mitigate, prolonging the potential impact on their owners. During operation, maintenance by helicopter/small aircraft will be necessary, potentially impacting on game. Some landowners with power lines on their land have claimed that power line maintenance workers have stolen game in the past.

The presence of visitors and hunters during construction and maintenance might add to the stress of landowners, as they are responsible for the safety of these visitors.

» Landing strips

The CAA (Civil Aviation Association) recommends that there are no obstacles greater than 150 feet above the average runway elevation and within 2 000 m of the runway mid-point. The impact of having to move the landing strip will not only be an economic one, but will also cause frustration. The location of landing strips are planned carefully to accommodate activities on the rest of the land and finding alternative suitable land may not be simple.

» Mining

Planning a route for new power lines within areas of likely coal extraction needs to take the potential economic and safety impacts as a result of these land uses into account. For deep underground mining, potential impacts on health and safety is expected to be minimal. Underground mining of platinum should have relatively little impact on power lines.

The avoidance of game farms should be given preference to the avoidance of cattle farms and cultivated land. However, there is hardly a difference between the three alternative corridors in terms of approximate number of game farm portions irrespective of the size of these portions as seen in the table below.

This is considered to be a **Category 2 Impact**.

	Before Mitigation	After Mitigation
<b>Extent (Scale)</b>	Local (1)	Local (1)
<b>Duration</b>	Very short-Long(1-4)	Very short-Long(1-4)
<b>Magnitude</b>		
<b>Crop farming activities</b>	Minor (1)	Minor (1)
<b>Cattle farming activities</b>	Low (2)	Minor (1)

<b>Game farming activities</b>	Moderate (3)	Low (2)
<b>Reversibility (All)</b>	Reversible (3)	Reversible (3)
<b>Probability Crop Farming</b>		
<b>Corridors 2, 8 4, 5, 6, 7</b>	Medium (3)	Low (2)
<b>Corridor 1</b>	Low (2)	Improbable (1)
<b>Probability Cattle Farming</b>		
<b>Corridor 1, 8, 4, 5, 6</b>	Low (2)	Improbable (1)
<b>Corridor 2, 7</b>	Medium (3)	Low (2)
<b>Probability Game Farming</b>		
<b>Corridors 1, 2, 8, 4, 5, 6, 7</b>	Medium (3)	Low (2)
<b>Significance</b>		
<b>Crop Farming 2, 8 4, 5, 6</b>	<b>Low (18-27)</b>	<b>Low (12-18)</b>
<b>Crop Farming 1</b>	<b>Low (12-18)</b>	<b>Low (6-8)</b>
<b>Cattle Farming 1, 8, 4, 5, 6</b>	<b>Low (14-20)</b>	<b>Low (6-9)</b>
<b>Cattle Farming 2</b>	<b>Low (24-30)</b>	<b>Low (12-18)</b>
<b>Game Farming 1, 2, 8, 4, 5, 6</b>	<b>Low (24-33)</b>	<b>Low (14-20)</b>
<b>Status</b>	Negative	Negative
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» To mitigate the potential impacts of lines in close proximity of landing strips and helicopter pads, landing strips should be avoided to ensure that activities can proceed without risk and lines should be marked.</li> <li>» Maintenance activities must be carefully planned and executed to ensure the least distress to game, and to co-ordinate hunting activities.</li> <li>» A grievances procedure should be implemented.</li> <li>» Two locks on either side of one chain gate could be used to ensure that the landowner always have access to the same lock even though Eskom/construction team might change the other lock.</li> <li>» The maintenance activities, timeframes and maintenance programme should be clearly stipulated during the negotiation process.</li> <li>» Maintenance workers should not get onto the premises without the permission of the landowner – also for their own safety.</li> <li>» Landowners should be allowed to carry out servitude maintenance.</li> <li>» Speed limits should be adhered to and maintenance vehicles marked.</li> <li>» Any contact with wild animals should be avoided as far as possible.</li> </ul>		
<b>Cumulative Impacts</b>		
The impact might be less where existing lines occur as landowners have already adapted their activities to accommodate these existing lines.		

**Residual impacts**

N/A.

**Nature : Physical health impacts as a result of the presence of construction workers**

Previous studies have indicated that an influx of construction workers (temporary migration) into an area contributed to HIV/Aids, more so in areas where the affected communities were vulnerable. Research also seemed to indicate that construction workers are at risk of contracting HIV from members of local communities, as opposed to be solely responsible for transmitting the infection.

Due to their unique situation, construction workers engage in behaviour such as risky sexual behaviour and destructive behaviour (e.g. alcohol abuse, damaging the environment), which could be explained by their migratory status. When they are separated from their homes, they are also distanced from traditional norms, prevailing cultural traditions and support systems that normally regulate behaviour within a stable community. In addition, it might also be that construction workers who are faced with dangerous working conditions and the risk of physical injury might be more preoccupied by immediate (direct) risks and therefore tend to disregard salient (more indirect) risks, such as HIV infection. Added to this the local population might be uneducated about the risk and transmission of HIV and would therefore more easily engage in risky behaviour as a result of ignorance.

The people who are most likely to be impacted are poor and vulnerable and lack knowledge, money and the means required to maintain a healthy lifestyle in the face of HIV/Aids/STDs.

This is considered to be a **Category 1 Impact**.

	Before Mitigation	After Mitigation
<b>Extent (Scale)</b>	Site-International (1-5)	Site-International (1-5)
<b>Duration</b>	Short-Permanent (1-5)	Short-Permanent (1-5)
<b>Magnitude</b>	Moderate-Very high (3-5)	Moderate-Very high (3-5)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	Medium (3)
<b>Significance</b>	<b>Medium-High (32-72)</b>	<b>Low-Medium (24-54)</b>
<b>Status</b>	Negative	

**Mitigation**

- » Aim for 30% local employment (PHS MQR 2007).
- » An aggressive STD and HIV/AIDS awareness campaign should be launched, which is not only directed at construction workers but also at the community as a whole. Include training with women and focus on family planning and gender relations.
- » Access at the construction site should be controlled to prevent sex workers from either visiting and/or loitering at the construction village.
- » Construction workers should be clearly identifiable. Overalls should have the logo of the construction company on it and/or construction workers should wear identification

<p>cards.</p> <ul style="list-style-type: none"> <li>» Local women should be empowered. This could be achieved by employing them to work on the project, which in turn would decrease their (financial) vulnerability.</li> <li>» Regular leave should be given to workers and workers' families should be given opportunity to visit.</li> <li>» A clinic should be on site/close to the village and anti retro virals available.</li> <li>» Improve conditions at the construction village by providing entertainment.</li> <li>» Mobilise local municipalities/authorities to do a skills audit and communicate skills levels and experience required to be employed by the project.</li> <li>» Housing construction workers in communities could have more positive economic impacts (e.g. rental of room), but the potential health impacts as a result of more regular and consistent interaction with local inhabitants could be more significant. It therefore seems better to house construction workers in a village or separate housing area.</li> </ul>
<p><b>Cumulative Impacts</b></p> <p>As a result of other projects and proposed projects in the study area it is likely that more workers from outside the study area will arrive and contribute to the impact.</p>
<p><b>Residual impacts</b></p> <p>N/A.</p>

<b>Nature: Physical health impacts as a result of the presence of maintenance workers - Category 1 Impact</b>		
	<b>Before Mitigation</b>	<b>After Mitigation</b>
<b>Extent (Scale)</b>	Site-International (1-5)	Site-International (1-5)
<b>Duration</b>	Short-Permanent (1-5)	Short-Permanent (1-5)
<b>Magnitude</b>	Moderate-Very high (3-5)	Moderate-Very high (3-5)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Low (2)
<b>Significance</b>	<b>Medium (24-54)</b>	<b>Low-Medium (16-36)</b>
<b>Status</b>	Negative	
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» Aim for 30% local employment (PHS MQR 2007).</li> <li>» Maintenance workers should be clearly identifiable. Overalls should have the logo of the construction company on it and/or construction workers should wear identification cards.</li> </ul>		
<b>Cumulative Impacts</b>		
None.		
<b>Residual impacts</b>		
N/A.		

<b>Nature: Physical health impacts as a result of the influx of job seekers</b>		
The influx of job seekers into the environment will lead to pressure on local services and will not necessarily lead to a boost in the local economy, since these job seekers are unemployed. The influx of job seekers might further lead to conflict with local residents in respect of competition over limited job opportunities. The presence of job seekers might contribute to the spread of HIV/Aids.		
This is considered to be a <b>Category 1 Impact</b>		
	<b>Before Mitigation</b>	<b>After Mitigation</b>
<b>Extent (Scale)</b>	Site-International (1-5)	Site-International (1-5)
<b>Duration</b>	Short-Permanent (1-5)	Medium-Permanent (3-5)
<b>Magnitude</b>	Moderate-Very high (3-5)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Medium (3)
<b>Significance</b>	<b>Medium (24-54)</b>	<b>Low-Medium (27-46)</b>
<b>Status</b>	Negative	
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» If the construction camp is located within an established community, employment procedures are discussed with the local leaders and followed to ensure that the community reaps the benefits from employment opportunities.</li> <li>» An Influx Management Plan should be developed and executed.</li> <li>» Have a recruitment desk away from the construction camp and construction areas.</li> <li>» Do not informally employ job seekers on site and at the construction village.</li> <li>» Mobilise local municipalities/authorities to do a skills audit and communicate skills levels and experience required to be employed by the project.</li> <li>» Aim for 30% local employment (PHS MQR 2007).</li> </ul>		
<b>Cumulative Impacts</b>		
<ul style="list-style-type: none"> <li>» As a result of other projects and proposed projects in the study area it is likely that more workers from outside the study area will arrive and contribute to the impact.</li> </ul>		
<b>Residual impacts</b>		
N/A.		

<b>Nature: Psychosocial impact on community level and on individuals as a result of different culture of construction workers, and the presence construction workers (construction) and maintenance workers (operation)</b>
Alcohol abuse among construction workers might be a problem during construction, especially after workers had have received payment. The issues relate to alcohol's effect on behaviour – sometimes causing irresponsible behaviour that could escalate to violence or conflict between individuals or groups.
Villages in the area lack the capacity to accommodate additional people. Although the presence of construction workers and job seekers could lead to positive impacts such as a temporary boost in the local economy, a village/town that is unable to meet its own needs might be unable to sustain additional demands on the local services, which might lead to negative impacts such as conflict if services were depleted.

The presence of construction workers who enter and move about on private property due to the construction of the transmission power line and substation could lead to conflict because of a perceived lack of control. Landowners felt that their privacy was invaded with the construction and maintenance of the Matimba-Witkop No. 2 transmission power line.

The presence of these “strangers” on their property also sparked some safety and security concerns amongst landowners. This was said within the context of increased violent crimes conducted against farmers in South Africa. Construction workers could be blamed for crime and violence in the area. It is anticipated that the presence of construction workers and Eskom representatives could lead to conflict between Eskom/construction team and impacted people, and amongst impacted people, which could result in mental and physical health impacts, and may result in community cohesion breakdown.

<b>CONSTRUCTION</b>		
<i>Category 2 Impact</i>	<b>Before mitigation</b>	<b>After mitigation</b>
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>	Moderate (3)	Moderate (3)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	Medium (3)
<b>Significance</b>	<b>Medium (32)</b>	<b>Low (24)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION AND MAINTENANCE</b>		
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>	Moderate (3)	Low (3)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Low (2)
<b>Significance</b>	<b>Low (24)</b>	<b>Low (14)</b>
<b>Status</b>	Negative	Negative
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» To ensure support of the project and reduce the risk of social mobilisation, Eskom should at all times be seen to care about the local community. The community members need to feel that they receive some tangible benefits from the project, e.g. direct and indirect employment. The undertakings in the EMP should also be implemented effectively and with due diligence.</li> <li>» Construction workers are to be introduced to the local leaders and landowners.</li> <li>» Local leaders should be made aware that only limited job opportunities will be created.</li> <li>» The local leaders should also be informed about the nature of a linear project, and that labourers will probably move along the route as construction progresses.</li> <li>» Educate women regarding gender issues and negotiating safe sexual behaviour.</li> <li>» No firearms should be allowed on the construction site.</li> <li>» Security guards should be appointed.</li> <li>» Construction and maintenance workers should be clearly identifiable by wearing overalls and/or identification cards.</li> <li>» Consult with local landowners prior to maintenance work taking place on the transmission power line, to inform them of when the maintenance team will be on site, for how long, and approximately how many persons the team will consist of.</li> </ul>		

**Cumulative Impacts**

- » Other Eskom projects in the study area. The simultaneous influx of appointed construction workers together with the influx of job seekers would further increase the demand on services to the detriment of the receiving environment.

**Residual impacts**

N/A.

**Nature: Change in sense of place as a result of nuisance impacts**

Nuisance impacts will mainly occur during construction. During operation nuisance impacts will occur during maintenance activities. It is not likely that noise as a result of the project will contribute considerably to noise levels in already noisy areas such as busy roads, mines, and towns.

Noise originates from chainsaws, drill machines and bull dozers on site. Helicopters along the line during maintenance could also impact on landowners. The number of trucks on the site could increase to around 20 for one line. In addition, two bull dozers, two excavators, two big cranes and two drill rigs could be expected on site. In addition to the heavy vehicles, workers move around in light trucks (bakkies). It is estimated that a maximum of around 25 bakkies will be on site during the busiest periods of construction. Stringing activities require the most vehicles.

However, noise levels are expected to be low and only people living in close proximity to a construction site will be exposed to noise generated by the construction activities taking place.

Speeding of construction vehicles and dust could be an issue to landowners and affected communities surrounding the construction site.

The construction camp could be noisy, and may contribute to nuisance impacts should it be away from villages – villages in general are noisy.

This is considered to be a **Category 1 Impact**.

<b>CONSTRUCTION</b>		
	<b>Before mitigation</b>	<b>After mitigation</b>
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Medium (3)
<b>Significance</b>	<b>Low (21)</b>	<b>Low (21)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION AND MAINTENANCE</b>		
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Low (2)	Low (2)

<b>Significance</b>	<b>Low (14)</b>	<b>Low (14)</b>
<b>Status</b>	Negative	Negative
<b>Mitigation</b>		
<i>Construction Mitigation</i>		
<ul style="list-style-type: none"> <li>» Affected parties should be informed about the construction schedule.</li> <li>» Adjacent property owners should also be consulted regarding construction activities.</li> <li>» Construction activities should not take place between 18:00 and 06:00.</li> <li>» Construction should not be done on Sundays or public holidays and contractors should get permission from landowners to carry on with construction activities on these days.</li> <li>» The hunting season (winter) should be taken into account.</li> <li>» Ensure that the owners/residents are informed about imminent noise before it starts.</li> <li>» The negotiation process should include agreements on construction activities.</li> </ul>		
<i>Dust</i>		
<ul style="list-style-type: none"> <li>» Keep to speed limits.</li> <li>» Water roads.</li> </ul>		
<i>Corona</i>		
<ul style="list-style-type: none"> <li>» Avoid dwellings / lodges.</li> </ul>		
<i>Operation Mitigation</i>		
<ul style="list-style-type: none"> <li>» Affected parties should be informed about the maintenance schedule.</li> <li>» Maintenance should not be done on Sundays or public holidays. It is important to have some mechanism in place that Eskom can undertake maintenance at these times if necessary.</li> <li>» The hunting season (April to August) should be taken into account, and game farms where hunting takes place be avoided.</li> </ul>		
<b>Cumulative Impacts</b>		
Could be cumulative impacts due to construction activities from other projects in the area.		
<b>Residual impacts</b>		
N/A.		

**Nature: Change in sense of place as a result of the presence of the line**

A sense of connectedness a person/community feels towards a place or places cannot be measured in monetary terms. It is because of a sense of place and belonging that some people loath to be moved from their dwelling place, despite the fact that they will be compensated for the inconvenience and impact on their lives. Dissatisfaction with their surroundings (sense of place) could lead to a reduction in visitor numbers which could have an economic and mental health impact on owners and workers. Landowners might want to sell their land and/or might have to adapt activities to accommodate the lines.

Sense of place is directly linked to the natural environment and apart from the visual impact, the impact on nature will also impact on sense of place. In addition, the servitude fragments the landscape, which impacts on sense of place.

A survey completed by MasterQ Research concluded the following about the potential impact of lines on tourists' experience of the areas east and south of Lephalale:

- » There might be a decrease in international and local visitors with very specific expectations, should Transmission power lines cross game farms. It seemed as if the

hunting experience included a natural setting and an appreciation for a pristine natural environment for most hunters. Although research amongst visitors should be conducted to confirm this hypothesis, it is expected that some international tourists come to a game farm in Africa to experience the wilderness. A visible Transmission power line would detract from the experience, and other farms without lines might be preferred.

- » Not all potential tourists would be lost. Game farms with power lines crossing their property are still in business. In fact, some of these owners reported a 100% occupation in the hunting season. Visitors included international hunters. However, results of depth interviews with game farmers indicated the presence of a power line detracted from the sense of place of a game farm, which had financial implications. Game farmers said that they lost some of their income potential due to the visual impact of the power line on their property, and that it was not easy to mitigate the presence of the line. Game farmers interviewed indicated that it was difficult to quantify the loss in income as a result of the line going through their property. However, they had comments from tourists regarding the negative visual impact of the line.
- » The decision whether to hunt on a farm with a power line depends on the hunters' expectations. Hunters might want a wilderness experience, but also a good trophy and value for money. A game farm with a power line might be given preference should it better fulfil the expectations of the visitor. This does not mean that the strategic placement of the power lines is not important. The bigger the farm, the easier it would be to manage the farm and hunting safari around the transmission power line. It will also be more difficult to strategically place lines in flat areas.
- » The international definition of eco-tourism is not only experiencing nature, it includes diverse community activities and cultures of a country's inhabitants as well as its sensitive natural resources. The key here is that local communities are included in the activities of the reserve/park, and many jobs are afforded – for example Pilanesberg National Park. Most of the game farms are therefore not eco-tourism destinations in the strict sense of the word, as exposure to diverse community activities and cultures are not offered. The main focus is hunting.
- » The placement of the line will be crucial to reduce potential socio-economic and socio-cultural impacts. The final recommendations in the Social Impact Assessment will have to be informed by the Visual Impact Assessment.
- » Should hunters not book as a result of the line, the money already spent on marketing might prove to have been a waste of money. The game farm owner might have to change his target market once a power line is on his farm. This might involve a new marketing strategy. It will take years to build up a strong customer base in a new segment of the hunter population.
- » Not only game farms with power lines might experience the possible loss of visitors, but also the neighbouring game farms. Game farmers might have to divert game routes and roads on their farms to steer hunters clear of the lines. This will have an economic impact.
- » It might be difficult to find a similar property elsewhere in South Africa. Purchasing at replacement value should be considered, and depreciation of the property as a result of the power line(s). Eskom does a before and after valuation exercise.
- » Loss of jobs as a result of the presence of the lines should be considered in the final assessment.

» Ideally, a study in tourism areas needs to be done to determine the loss of livelihood as a result of a line. Such a study should involve a baseline measurement of the situation prior to the construction of the power line, followed by an assessment post the construction of the power line. The assessment should be done over a period of years, and changes in other variables such as marketing etc. should be considered in the assessment. Ideally, a control group should also be part of the study to assess whether measured changes could be as a result of what was happening in the area, e.g. a decrease in tourism figures was happening in the whole area, and not only on those properties with a power line. The control group should consist of farms with and without a transmission power line.

The acceptance of power lines in nature/game areas are strengthened by the fact that people still visit the Ben Alberts Nature Reserve and the Waterberg Biosphere, for example, despite the presence of power lines.

It is important to note that higher and lower sensitivity will apply to different farms depending on the size of the land, the topography, the flora and the number of existing lines on the land, the landowners' history with the land, use of the land, and attachment to the land, and the significance of impacts after mitigation will therefore be very farm specific.

This is considered to be a **Category 1 Impact**.

<b>CONSTRUCTION</b>		
	<b>Before mitigation</b>	<b>After mitigation</b>
<b>Impact</b>		
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short term(1)	Very short term(1)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	High (4)
<b>Significance</b>	<b>Low (28)</b>	<b>Low (28)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION CORRIDOR 1</b>		
<b>Category 2 Impact</b>	Change in sense of place as a result of the presence of the line.	
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	High (4)	Moderate (3)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	High (4)
<b>Significance</b>	<b>Medium (48)</b>	<b>Medium (44)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION CORRIDOR 2</b>		
<b>Category 2 Impact</b>	Change in sense of place as a result of the presence of the line.	
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	Moderate (3)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)

<b>Probability</b>	High (4)	High (4)
<b>Significance</b>	<b>Medium (44)</b>	<b>Medium (40)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION CORRIDOR 8</b>		
<b>Category 2 Impact</b>	Change in sense of place as a result of the presence of the line.	
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	High (4)
<b>Significance</b>	<b>Medium (40)</b>	<b>Medium (40)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION CORRIDOR 4</b>		
<b>Category 2 Impact</b>	Change in sense of place as a result of the presence of the line.	
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	High (4)	Moderate (3)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Medium (3)
<b>Significance</b>	<b>Medium (36)</b>	<b>Medium (33)</b>
<b>Status</b>	Negative	Negative
<b>OPERATION CORRIDOR 5, 6, 7</b>		
<b>Category 2 Impact</b>	Change in sense of place as a result of the presence of the line.	
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Magnitude</b>	Moderate (3)	Moderate (3)
<b>Probability</b>	Medium (3)	Medium (3)
<b>Significance</b>	<b>Medium (33)</b>	<b>Medium (33)</b>
<b>Status</b>	Negative	Negative
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» Mitigation measures detailed in the Visual Impact Assessment and Ecological Assessment must be implemented.</li> <li>» Eskom considers buying the farm should power lines take up more than 50% of the land. This guideline should be revised, as farmers might lose their livelihood where Eskom lines take up less than 50% of their land. The impact on livelihoods should be monitored and evaluated before and after the construction of the line.</li> <li>» As far as possible, construction activities should be limited to the summer months to ensure that hunting activities are not adversely affected.</li> <li>» As far as possible, maintenance activities should be limited to the summer months to ensure that hunting activities are not adversely affected.</li> <li>» As far as possible, the Transmission power line should follow existing infrastructure, such as roads and existing transmission power lines as this type of environment is already regarded as "stained."</li> <li>» A pre- and post valuation should be conducted for properties during the negotiation process.</li> </ul>		

- » Farm workers should be compensated for loss of livelihood should they lose their jobs.
- » It is difficult to follow borders of farms, because the Corridors mostly cross them and do not follow them. This might mean that some farms might have to be bought out. The mitigation measure to ensure that these landowners are the same or better of than before should include:
  - \* Consideration of cost of and availability of similar farms;
  - \* Ensuring that those who lose jobs as a result, find other jobs;
- » Not only land value, but expenses incurred to market and run the game farm should be considered.

**Cumulative Impacts**

The existing lines in the area have already scarred the landscape and the cumulative impact of more lines along existing lines might not be as negative compared to putting lines through areas with no power lines. For tourists the impact on sense of place might be more pronounced where lines are constructed along existing lines.

**Residual impacts**

N/A.

**Nature: Impact on health as a result of pollution of the natural environment by construction/maintenance workers and construction/maintenance activities.**

The construction workers could be housed in a construction village or the surrounding communities. Their presence will impact on the environment, which in turn will impact on the surrounding communities. Littering, water pollution, air and dust pollution could be experienced during the construction phase of the project. Ground water and surface water could be polluted, for example, as a result of inadequate sanitation for construction workers. Construction workers' excretion could be infected with worms, and as a consequence spread infection amongst livestock. Overall, it is not expected that the status quo will change significantly because of the project in areas where there is a lack of services (impacts already occur) and areas where there are services (it will be easier to provide services to workers).

The construction vehicles will contribute to air and dust pollution, but it is not likely to change the status quo significantly.

This is considered to be a **Category 1 Impact**.

	Before mitigation	After mitigation
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short-Medium (1-3)	Very short-Medium (1-3)
<b>Magnitude</b>	Low (3)	Minor (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Medium (3)
<b>Significance</b>	<b>Low-Medium (24-30)</b>	<b>Low (21-27)</b>
<b>Status</b>	Negative	Negative

**Mitigation**

- » Construction workers are required to be treated for worms.
- » Adequate water facilities should be provided.
- » Sufficient portable chemical toilets must be provided on site and at the construction

village.		
<ul style="list-style-type: none"> <li>» Refuse on site should be discarded in sealed bins and/or in covered skips. Refuse should be removed from the site on regular intervals (at least once a week) and disposed of at an approved waste disposal site.</li> <li>» Littering</li> <li>» Bins should be provided on site and at the camp.</li> <li>» Some form of punishment should be implemented for littering.</li> <li>» Construction workers should adhere to a contract with the contractor. These rules of conduct should be stipulated in construction management plans and contracts with workers. These should include the use of sanitation, water and waste as well as informal trading, running of shebeens, and interfering in community affairs.</li> <li>» The construction management plan should indicate how its water sanitation and waste facilities are in line with legislation.</li> <li>» Emergency health facilities should be available at the camp.</li> </ul>		
<b>OPERATION AND MAINTENANCE</b>		
<b>Extent (Scale)</b>	Site (1)	Site (1)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>	Minor (2)	Minor (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Low (2)	Low (2)
<b>Significance</b>	<b>Low (14)</b>	<b>Low (14)</b>
<b>Status</b>	Negative	Negative
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» Maintenance workers are required to be treated for worms.</li> <li>» Sufficient portable chemical toilets during servitude maintenance.</li> </ul>		
<b>Cumulative Impacts</b>		
The situation will be exacerbated in areas where influx of job seekers occur and as a result of the activities of teams on other power line projects which take place simultaneously in the same area.		
<b>Residual impacts</b>		
N/A.		

**Nature: Reduction in industry output and earnings due to the construction of the power transmission line during construction and operation**

A study conducted by MasterQ Research (2007) amongst 50 landowners who registered as Interested and Affected parties for the Medupi-Dinaledi, Medupi-Marang, and Mmamabula-Delta Projects as per December 2006 revealed the following:

- » The average tariff for catered accommodation was R916.88 per person per night and for self-catering accommodation R281.30 per person per night.
- » Landowners were investing money to develop their farms. The capital investment in the past three years (prior to 2007) was estimated at R184.58 million with an average of R5.13 million per landowner and a standard deviation of R32.83 million.
- » To hunt an impala cost between R600 and R3 000 with an average of R1 088.89 and a standard deviation of R760.00.
- » There were more game farms and international visitors in the 1000ha+ category and

higher occupation rates occurred in the 1000ha- category. The occupation in the 1000ha+ category was on the increase. The bigger farms generated higher incomes.

- » It seemed cost intensive to run these establishments, as 0.3 jobs per hectare were created, or three jobs per visitor.
- » The average years that an establishment was in operation was estimated at 11 years, with a standard deviation of 8.6 years. These results indicate that the number of game farms in the LP have increased since 1997.
- » Interviews conducted in the Marken area for this study indicated a similar importance of the area in terms of game farming/hunting and eco-tourism, four respondents in the area indicated that they derive 100% of their income from tourist and hunting activities and employ between three and 32 individuals per farm in doing so. The interviews also indicated a high percentage of outsider owned farms with two respondents estimating that the level of outsider ownership exceeding 40% in that area.

Research conducted previously by MasterQ Research (2007 and 2009) specifically around the impacts of power transmission lines indicates that property that derives its primary value from having a pristine or natural character may suffer some reduction in value when developments of an industrial nature (specifically transmission power lines) occur. This would most often mean that a transmission power line is constructed on or near a property, within relatively close visual range. However, this is dependent on a multitude of factors such as typography and size of the property, and does not include all types of agricultural properties. If the assumption is made that the majority of properties along all routes are in fact prized for their pristine character it is likely that placing the Transmission power lines along existing lines would have the least impact across all routes.

This is considered to be a **Category 1 Impact**.

	Before Mitigation	After Mitigation
<b>Extent</b>	Local (2)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	Minor (1)	Minor (1)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	High (4)
<b>Significance</b>	<b>Medium (44)</b>	<b>Medium (36)</b>
<b>Status</b>	Negative	Negative

**Mitigation**

- » Determine route with minimum visual impact.
- » Avoid passing close to residences and lodges, especially if the lines would be visible at the main frontage.
- » Maintenance of the servitude should be done regularly and efficiently.
- » Construction should occur outside the winter months (main hunting season).
- » Implement Visual and Ecological Impact Assessment mitigation measures diligently.
- » Corridor 8: existing lines should be followed as diversion from the existing lines will affect the magnitude and significance of the impact.

<p><b>Cumulative Impacts</b></p> <p>The impact might be less where existing lines occur as landowners have already adapted their activities to accommodate the existing lines.</p>
<p><b>Residual impacts</b></p> <p>N/A.</p>

<p><b>Nature: Reduction in industry employment during construction and operation phases</b></p>		
<p><b>Category 1 Impact.</b></p>		
	<b>Before Mitigation</b>	<b>After Mitigation</b>
<b>Impact</b>		
<b>Extent</b>	Local (2)	Local (2)
<b>Duration</b>	Medium (3)	Medium (3)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Magnitude</b>	Low (2)	Low (2)
<b>Probability</b>	Low (2)	Improbable (1)
<b>Significance</b>	<b>Low (20)</b>	<b>Low (10)</b>
<b>Status</b>	Negative	Negative
<p><b>Mitigation</b></p> <ul style="list-style-type: none"> <li>» The local people have the skills to do unskilled/semiskilled work during construction, decommissioning and maintenance. Local people should be given equal opportunity to apply for jobs, where possible. Local steering committees/the municipality and Traditional Authorities could be used to identify local people for employment. A local person could be identified in the local community – this could happen through the Department of Labour – and this person could assist in the establishment of a steering committee. The contractors could then communicate their labour needs to the steering committee that would compile a list of people that are available for employment. Alternatively, the Unions or the Local Economic Development Forum could be asked for assistance.</li> <li>» Equal opportunities for employment should be created to ensure that the local female population also have access to these opportunities. Females should be encouraged to apply for positions.</li> <li>» Individuals with the potential to develop their skills should be afforded training opportunities. Eskom should be involved in this process.</li> <li>» Mechanisms should be developed to provide alternative solutions for creating job security upon completion of the project. This could include formal and/or informal training on how to look for alternative employment, information on career progression, etc. to ensure that people are equipped to seek other jobs with the skills that they have gained.</li> <li>» Develop a procurement policy that is easy to understand and ensure that local subcontractors also comply with the procurement policy and any other applicable policies.</li> <li>» Ensure that local subcontractors receive the necessary support in terms of resources.</li> <li>» Agree on specific performance criteria prior to appointment.</li> <li>» Identify the segment that might benefit from informal indirect opportunities, and</li> </ul>		

<p>assist them with skills development and subsidise initiatives that are sustainable.</p> <ul style="list-style-type: none"> <li>» Encourage maintenance workers to make use of local services if and where such services exist.</li> <li>» Employment opportunities should first be offered to the local community if the skills are available within the community.</li> </ul> <p>A significant visual impact could lead to a reduction in tourism numbers and impact on jobs. Therefore</p> <ul style="list-style-type: none"> <li>» Determine route with minimum visual impact.</li> <li>» Avoid passing close to residences and lodges, especially if the lines would be visible at the main frontage.</li> </ul>
<p><b>Cumulative Impacts</b></p> <p>The impact might be less where existing lines occur as landowners have already adapted their activities to accommodate the existing lines.</p>
<p><b>Residual impacts</b></p> <p>N/A.</p>

<p><b>Nature: Increase in employment opportunities due to the construction of the power transmission line.</b></p> <p>Construction detail sheets regarding the construction of power transmission line indicate that is a moderate creator of employment, with approximately 30 to 80 unskilled workers and 5 to 10 semiskilled workers that can be sourced other than skilled teams utilised by the contractor. The moving nature of transmission power line construction means that this employment will probably be temporary in nature for any person residing in a specific area. During operation employment creation will be minimal and maintenance will utilise existing manpower.</p> <p>Economic benefits to a worker will benefit dependents and might have a mental and physical health impact on the worker and dependents.</p> <p>This is considered to be a <b>Category 1 Impact</b>.</p>		
	<b>Before Enhancement</b>	<b>After Enhancement</b>
<b>Extent</b>	Local (2)	Local (2)
<b>Duration</b>	Very short (1)	Very short (1)
<b>Magnitude</b>	Minor (1)	Low (2)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	High (4)	Definite (5)
<b>Significance</b>	<b>Low (36)</b>	<b>Medium (50)</b>
<b>Status</b>	Positive	Positive
<p><b>Enhancement</b></p> <ul style="list-style-type: none"> <li>» Require contractors to employ contractor staff and temporary labourers are sourced from areas that the power transmission line crosses or from the region whenever possible.</li> </ul>		

**Nature: Reduction in property values due to the construction and operation of the power transmission line: Corridors 1, 2, 4 (Construction and Operation)**

Research conducted previously by MasterQ Research specifically around the impacts of power transmission lines indicates that property that derives its primary value from having a pristine or natural character may suffer some reduction in value when developments of an industrial nature (specifically transmission power lines) occur. This would most often mean that a transmission power line is constructed on or near a property. However, this is dependent on a multitude of factors such as typography and size of the property, and does not include all agricultural properties. If the assumption is made that the majority of properties along all routes are in fact prized for their pristine character it is likely that placing the power transmission lines along existing lines would have the least impact on property values across all routes. However, the property value loss along Corridor 8 may be exacerbated due to the presence of additional lines.

This is considered to be a **Category 2 Impact**.

	Before Mitigation	After Mitigation
<b>Extent</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	Low (2)	Minor (1)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Definite (5)	High (4)
<b>Significance</b>	<b>Medium (50)</b>	<b>Medium (36)</b>
<b>Status</b>	Negative	Negative
<b>Mitigation</b>		
<ul style="list-style-type: none"> <li>» Determine route with minimum visual impact.</li> <li>» Avoid passing close to residences and lodges, especially if the lines would be visible at the main frontage if Corridors 1 and 2 are chosen.</li> </ul>		
<b>Cumulative Impacts</b>		
The impact might be exacerbated where more than two lines are in one Corridor.		
<b>Residual impacts</b>		
N/A.		

**Nature: Reduction in property values due to the construction and operation of the power transmission line: Corridor 8, 5, 6, 7 (Construction and Operation)**

**Category 2 Impact**

	Before Mitigation	After Mitigation
<b>Extent</b>	Site (1)	Site (1)
<b>Duration</b>	Long (4)	Long (4)
<b>Magnitude</b>	Minor (1)	Minor (1)
<b>Reversibility</b>	Reversible (3)	Reversible (3)
<b>Probability</b>	Medium (3)	Medium (3)
<b>Significance</b>	<b>Low (27)</b>	<b>Low (27)</b>
<b>Status</b>	Negative	Negative

<b>Mitigation</b> » Should Corridor 8 be selected the proposed transmission power lines must follow existing lines.
<b>Cumulative Impacts</b> None.
<b>Residual impacts</b> N/A.

### **7.6.1. Comparison of Transmission Power Line Alternatives**

From the Social Impact Assessment undertaken, the following conclusions have been made:

- » To avoid potential negative impacts on health and safety and of displacement of people, the preferred Corridors are **Corridors 2 and 8**:
  - \* Corridor 1 will potentially impact the highest number of households (relocation), followed by Corridors 8 and then 2.
  - \* Corridor 8 already has access roads to existing lines and is therefore preferred – involuntary resettlement as a result of access roads can be avoided.
  - \* In terms of the current and future development of Lephalale, the town will develop between Lephalale and Onverwacht. A nodal linkage between Maropong and Onverwacht is planned. A Transmission line going between Maropong and Onverwacht should therefore follow existing lines and stay on Eskom land where possible.
  - \* The P138-1 road to the south of these towns is planned. Corridor 1 should preferably follow the planned 138-1 road. However, this will mean the involuntary resettlement of a number of people – the exact number cannot be determined at this stage.
- » The avoidance of game farms should be given preference to the avoidance of cattle farms and cultivated land. However, there is hardly a difference between the alternative corridors in terms of approximate number of game farm portions irrespective of the size of these portions.
- » In terms of impacts on sense of place the preferred corridors are **Corridor 8** followed by 2 (Medupi-Mokopane) and **Corridor 5 or 6** (Mokopane-Witkop).
- » The impact of involuntary resettlement could be high and should be avoided. Should Corridor 1 be selected the likelihood of the servitude following the proposed road south of Lephalale (P138-1) is high. This will result in the involuntary settlement of people. On the other hand, this option will be in line with the Spatial Development Framework of the municipality and therefore not completely undesirable. Corridor 8 could also lead to involuntary resettlement. It is likely that one household will have to be resettled and maybe more, should it be necessary to deviate from the existing lines as a result of technical challenges. It seems possible to avoid involuntary

resettlement of households in Corridor 2, and **Corridor 8** is therefore preferred in this regard.

- » When considering the potential for development into the corridors, it seems a possibility that development will take place into the servitude for all corridors. Although the preference is that settlements are avoided to mitigate the potential health impacts as a result, all the corridors cross settlements. **Corridor 1** crosses the lowest number of settlements and is therefore the preferred option in this regard. Corridor 2 shows rapid developments between villages closer to Lephahale, but it is more likely that these developments would occur along the main roads. The settlements in Corridor 2 should already be sensitive to the fact that development should not occur towards the servitude. Nevertheless, power lines close to settlements remain a health and safety concern and villages in this corridor also show a tendency to develop towards each other.
- » The other Category 2 impacts that could occur during both construction and operation are the potential psychosocial and physical health impacts as a result of changes that occur in land use activities to accommodate the construction and maintenance activities of the 2x400kV transmission power lines. However, the significance of these impacts is low and very similar for different land uses after mitigation - during construction and operation.

The selection of a preferred corridor should therefore not be based on the differences in the occurrence in crop and cattle farming activities between corridors because it is possible to manage these potential impacts and reduce the significance to a very low level. The corridor selection should also not be made on the basis of the game farming activities between corridors because the occurrence of game farms between the corridors are very similar for Corridors 1, 2 and 8. Should land use be regarded as the primary selection criteria, a detailed study should be done regarding the hectares of different land uses within the different corridors.

Rather, following involuntary resettlement and health and safety of people, the impact on sense of place should be regarded as a primary corridor selection criterion, which is closely linked to economic impacts. However, it should be kept in mind that it is difficult to determine the economic impacts of a power line on tourism activities because the indication is that people still visit nature reserves and game farms despite the presence of power lines. It is therefore more than the visual impact of the power line that could detract people from visiting a place or the mere lack of a power line that detract people from a place.

The impact on sense of place can be reversed after decommissioning, providing that rehabilitation is done to a satisfactory level (as opposed to involuntary resettlement, which is irreversible). The impact on sense of place should be considered in the context of the study area as a whole, as the impact on sense of

place per farm portion will depend on a number of variables, such as the visual impact, the biodiversity impact, the placement of the line in relation to dwellings and lodges, the activities on the land, the attachment of the landowner to the land, etc.

In light of the guiding principles of the Waterberg Biosphere, the compatibility of the transmission power lines with development plans and existing activities in the area, cultural landscape and settlements along corridors, **Corridor 8** followed by Corridor 2 is nominated as the preferred alternative between the Medupi Power Station and Mokopane Substation. Corridor 8 should follow the existing line without deviation, except for the alternative around Tafelkop and the deviation where it joins Corridor 2 for some distance (i.e. **Corridor 8 Deviation**).

For the Mokopane-Witkop section of the power line **Corridor 5** is preferred, followed by Corridor 6.

Corridor 7, from Delta substation, should follow the existing lines in the corridor to consolidate the impact on sense of place.

#### **7.6.2. Conclusions and Recommendations**

Involuntary resettlement is irreversible and the involuntary resettlement of people should be avoided and kept to a minimum as far as possible. Corridor selection is therefore mainly based on avoiding involuntary resettlement. Only if avoidance of involuntary resettlement would lead to unsustainable practices in the area, should the involuntary resettlement of large numbers of people be deemed acceptable. The effective and participatory execution of the negotiation and compensation process is crucial to ensure that the impact is kept to a minimum.

A decommissioning and closure plan should be in place to ensure that social impacts are reversed. The impact on sense of place during operation could impact the sustainability of game farms. Knock-on effects of unsustainable farms would be loss of jobs, impacts on neighbouring farms and loss of livelihood. The impact on sense of place should be kept to a minimum and the mitigation measures for the reduction of the visual and ecological impacts should be implemented, monitored and evaluated. The proper maintenance of the servitude is one of these.

Across all impact categories it seems that **Corridor 8** followed by **Corridor 2** (Medupi-Mokopane) and **Corridor 5 and 6** (Mokopane-Witkop) are the most preferable for the minimisation of negative impacts. Corridor 8 should follow the existing line without deviation, except for the alternative around Tafelkop and the deviation where it joins Corridor 2 for some distance (i.e. **Corridor 8 Deviation**).

It is highly recommended that Eskom investigates the general use of wide service corridors between all major power generation areas that can accommodate further development in the future in order to avoid the “spider web” effect often associated with short term focused planning of economic development. This study therefore places a strong emphasis on long-range economic planning.

Corridor 7, from Masa (Delta) substation, should follow the existing lines in the corridor to consolidate the impact on sense of place.

Finally, to ensure that social impacts are mitigated during construction and operation it is recommended that the following be implemented and monitored by a Social Engagement Officer:

- » A Social Management Plan during construction and operation;
- » A social Impact Assessment during construction and operation;
- » A Local Labour and Workforce Plan;
- » An Influx Management Plan;
- » A Decommissioning Plan;
- » A Grievances Mechanism for the construction and operational phases;
- » A Stakeholder Engagement and Education plan for construction and operation.

## 7.7. Potential Impacts on Economics

For purposes of identifying the possible economic impacts of the power lines, the different corridors have been grouped in four options as explained below:

- » **Option 1:** Corridor 7 ► Corridor 1 ► Corridor 4, 5 and 6;
- » **Option 2:** Corridor 7 ► Corridor 2 ► Corridor 4, 5 and 6;
- » **Option 3:** Corridor 7 ► Corridor 8 ► Corridor 4, 5 and 6.
- » **Option 4:** Corridor 7 ► Corridor 8 ► Corridor 8 Deviation ► Corridor 2 ► Corridor 8 Deviation ► Corridor 8 ► Corridor 4,5 and 6

### 7.7.1. Macro Economic Impact Analysis Results

#### » Current Macro Economic Results

The current macro-economic parameters for the four routes are presented in Table 7.1.

**Table 7.1:** Current macro-economic parameters for the four Identified route options (2009 prices)

	<b>Option 1 (Corridors 7, 1, 4, 5 and 6)</b>	<b>Option 2 (Corridors 7, 2, 4, 5 and 6)</b>	<b>Option 3 (Corridor 7, 8, 4, 5 and 6)</b>	<b>Option 4 (Corridors 7, 8, 8dev, 2, 8dev, 8, 4, 5 and 6)</b>
Gross Domestic Product (R.mil.)				
Direct	R67.13	R62.54	R46.45	R50.15
Indirect/Induced	R40.47	R38.82	R28.09	R30.39
Total	R107.60	R101.36	R74.54	R80.54
Employment (Numbers)				
Direct	1 235	1 183	849	920
Indirect/Induced	644	618	447	484
Total	1 879	1 801	1 296	1 403
Capital Formation (R.mil.)	R160.95	R152.99	R112.74	R121.56
Household Income (R.mil.)				
Low Income	R8.48	R8.26	R5.83	R6.33
Medium/High	R46.39	R44.64	R32.10	R34.77
Total	R54.87	R52.89	R37.93	R41.11

The above table indicates that in all four route options the economic activities are relatively extensive. In terms of employment creation in the area, the direct number varies between 1 235 for Route Option 1 and 849 for Route Option 3. A number of the indirect and induced parameters are also in the Lephalale area. Overall Route Option 1 is at present the route with the most economic activities with Route Option 3 the lowest.

» *Impacted Macro Economic Results*

Table 7.2 presents the potential negative impact of the construction of the power lines as a percentage per route after the Delphi technique was applied to each of the routes and was used in the monetary calculation (refer to specialist economic report contained within Appendix L for further details). In the interpretation of the following table it must be kept in mind that it is an average percentage shown, in the calculations different impacts are used for the individual sections.

**Table 7.2:** Average negative percentage applied to the respective corridor options

<b>Corridor Option</b>	<b>Option 1 (Corridors 7, 1 plus 4, 5 and 6)</b>	<b>Option 2 (Corridors 7, 2 plus 4, 5 and 6)</b>	<b>Option 3 (Corridors 7, 8 plus 4, 5 and 6)</b>	<b>Option 4 (Corridors 7, 8, 8dev, 2, 8dev, 8 plus 4, 5 and 6)</b>
Negative Impact	-52.9%	-51.9%	-38.0%	-34.4%

Table 7.3 presents the potential negative impacts due to the construction and operation of the power lines after the negative percentages were applied to the respective bench marks.

**Table 7.3:** The estimated negative annual macro economic impacts of the impact of the construction and operation of the power lines (2009 prices)

	<b>Option 1 (Corridors 7, 1 plus 4, 5 and 6)</b>	<b>Option 2 (Corridors 7, 2 plus 4, 5 and 6)</b>	<b>Option 3 (Corridors 7, 8 plus 4, 5 and 6)</b>	<b>Option 4 (Corridors 7, 8, 8dev, 2, 8dev, 8 plus 4, 5 and 6)</b>
Gross Domestic Product (R.mil.)				
Direct	-R29.53	-R28.26	-R6.21	-R14.32
Indirect/Induced	-R19.60	-R18.75	-R4.12	-R9.51
Total	-R49.13	-R47.01	-R10.33	-R23.83
Employment (Numbers)				
Direct	-613	-587	-129	-298
Indirect/Induced	-312	-298	-66	-151
Total	-925	-885	-194	-449
Capital Formation (R.mil.)	-R73.10	-R69.96	-R15.37	-R35.46
Household Income (R.mil.)				
Low Income	-R4.46	-R4.27	-R0.94	-R2.16
Medium/High	-R22.93	-R21.95	-R4.82	-R11.13
Total	-R27.39	-R26.21	-R5.76	-R13.29

From the above table it appears that the construction of the power lines will have a negative impact on all four route options.

### **7.7.2. Results of the Cost Effectiveness Analysis**

The Cost Effectiveness Analysis for the four route options was performed in terms of the construction and maintenance cost involved for Eskom and added is the estimated negative impact on the existing economic activities in the each of the corridor options. These negative economic impacts are a cost to the system and therefore added to attain the total cost over a period of time to the system.

Table 7.4 provides the discounted Present Value (PV) for Eskom and the farms per corridor option.

**Table 7.4:** Cost effectiveness comparison for the four corridor options

Option	Present Value Eskom R Mil.	Present Value Farms R.Mil.	Total Present Value Rand Mil.
Option 1 (Corridors 7, 1 plus 4, 5 and 6)	R1247.44	R556.82	R1 804.25
Option 2 (Corridors 7, 2 plus 4, 5 and 6)	R1271.32	R532.86	R1 804.18
Option 3 (Corridors 7, 8 plus 4, 5 and 6)	R1315.41	R274.47	R1 589.88
Option 4 (Corridors 7, 8, 8dev, 2, 8dev, 8 plus 4, 5 and 6)	R1363.18	R270.12	R1 633.30

From the above table it appears that Corridor Options 3 and 4 are the more costly options to Eskom (as indicated in column 1), but once the negative impacts are taken into consideration (as indicated in column 4), it appears that Options 3 and 4 are in terms of cost to the system the preferable options.

### 7.7.3. Comparison of the four Corridor Options

Table 7.5 provides a comparison of various parameters for the corridor options.

**Table 7.5:** Comparison of the different Corridor Options using a number of Parameters (2009 prices)

	Option 1 (Corridors 7, 1 plus 4, 5 and 6)	Option 2 (Corridors 7, 2 plus 4, 5 and 6)	Option 3 (Corridors 7, 8 plus 4, 5 and 6)	Option 4 (Corridors 7, 8, 8dev, 2, 8dev, 8 plus 4, 5 and 6)
Annual Turnover (R. Mil.)	R99.28	R96.78	R68.18	R74.11
Annual Impact on Turnover (R.mil)	-R52.51	-R50.25	-R25.88	-R25.47
Total Annual GDP (R.mil)	R107.60	R101.36	R74.54	R80.54
Annual Impact on GDP (R.mil)	-R49.13	-R47.01	-R10.33	-R23.83
Direct Employment Losses	-613	-587	-129	-298
Overall Percentage Impact	-52.9%	-51.9%	-38.0%	-34.4%
Negative Impact (Rand/meter)	R208.81	R196.07	R97.61	R92.70
Total PV	R1 804.18	RR1 804.18	R1 589.88	R1 633.30

From the above table it appears that the various parameters considered indicate that of the four corridor options, Options 3 and 4 appear to be the more acceptable options, with Options 1 and 2 less acceptable. If the negative impact is expressed as an impact per meter of the respective corridor length, Options 3 and 4 are less than 50% of the impact on Options 1 and 2. The CEA analysis also shows that the PV for Option 3 and 4 is the less costly to the system

The results included in Table 7.5 indicates that the annual turnover on Corridor Option 3 (Corridors 7, 8 plus 4, 5 and 6), which consists mostly of Corridor 8, is the lowest of all four options, and it could be argued that the reason for less development is the presence of the existing power lines within this corridor. Although there might be truth in the argument, the counter argument is that by again utilising it Eskom would intrude less on present activities.

#### **7.7.4. Interpretation and Recommendation**

In terms of the above analysis, it is concluded that in terms of economic parameters the least impact will be in either Corridor Option 3 or 4. If it is accepted that the two options are defined as follows:

- **Option 3:** - Corridor 7 ► Corridor 8 ► Corridor 4, 5 and 6.
- **Option 4:** - Corridor 7 ► Corridor 8 ► Corridor 8 Deviation ► Corridor 2 ► Corridor 8 Deviation ► Corridor 8 ► Corridor 4,5 and 6

It must be noted however that in the case of both options there are potential negative impacts associated with the construction of the power lines, and that the final route determination will be of utmost importance.

#### **7.7.5. Recommended Mitigation**

All four route options include areas of commercial cattle and game farming as well as tribal areas where the inhabitants practise subsistence farming. Taking this into consideration, the following are recommended to mitigate the possible impacts of the construction and operation of the power lines:

- » The determination of the final route within a corridor must be done in consultation with the landowner.
- » Where tribal land is involved Eskom must involve the local chief structure in the determination of the final route.
- » Compensation must be determined through consultation with an appropriate independent valuator, and compensation must be in line with market value.
- » In the case of homesteads, Eskom must in the determination of the final route minimise the impact.
- » Where tourist facilities are involved the impact must be minimised.
- » On many of the properties hunting is practised and is it necessary that Eskom establish contact with the landowner before entering the property.
- » In the case of tribal land the lines must avoid house clusters and minimise impact on the lands and vegetable gardens.

## 7.8. Comparative Assessment and Nomination of Preferred Transmission Line Corridors

The transmission power line alternatives proposed for the 400kV transmission power lines cross various habitats sensitivity classes and potentially impact on numerous land uses, land owners and communities. From the specialist studies undertaken a number of impacts of high significance have been identified which will require extensive mitigation to be implemented.

### **7.7.1. Nomination of a Preferred Alternative between Medupi Power Station and the proposed Mokopane Substation (Corridors 1, 2, 8 and 8 Deviation)**

From the conclusions of the specialist studies undertaken, the following recommendations have been made:

	<b>Corridor 1</b>	<b>Corridor 2</b>	<b>Corridor 8</b>	<b>Corridor 8 Deviation</b>
Biodiversity	Least preferred	<b>Preferred</b>	Acceptable	Second preferred
Agricultural potential	<b>Preferred</b>	Least preferred	Second preferred	Acceptable
Avifauna	Least preferred	Acceptable, provided no go areas identified are avoided	Acceptable	<b>Preferred</b> , provided no go areas identified are avoided
Visual impacts	Least preferred	Second preferred	Acceptable	<b>Preferred</b>
Heritage sites	Least preferred	<b>Preferred</b>	Second preferred provided recommended conditions are met	<b>Preferred</b>
Social impact	Least preferred	Acceptable	Second preferred	<b>Preferred</b>
Economics	Least preferred	Least preferred	<b>Preferred</b>	<b>Preferred</b>

From the above table, it is clear that there are varying conclusions from the specialist studies undertaken. The majority of specialists nominated **Corridor 8 Deviation** as the preferred alternative. From the conclusions of the remaining specialist studies undertaken, this corridor is considered to be acceptable from an environmental perspective. Therefore, **Corridor 8 Deviation** is nominated as the **preferred alternative** from a holistic environmental perspective. However, it is considered vital that construction of the power line within this corridor take the recommended conditions identified by the specialist studies into account. In addition, should the project be authorised by DEA, the final routing of the power lines within this corridor should be undertaken in consultation with the affected landowners and the following specialists:

- » Biodiversity specialist

- » Avifauna specialist
- » Heritage specialist

In addition, once the final transmission power line alignment has been negotiated and the tower positions surveyed and pegged, a walk-through survey must be undertaken by these specialists in order to minimise potential environmental impacts associated with the proposed project.

***7.7.2. Nomination of a Preferred Alternative between the proposed Mokopane Substation and the existing Witkop Substation (Corridors 4, 5 and 6)***

From the conclusions of the specialist studies undertaken, the following recommendations have been made:

	<b>Corridor 4</b>	<b>Corridor 5</b>	<b>Corridor 6</b>
Biodiversity	Least preferred	<b>Preferred</b>	Second preferred
Agricultural potential	No preference	No preference	No preference
Avifauna	Least preferred	Second preferred	<b>Preferred</b>
Visual impacts	Least preferred	<b>Preferred</b>	Second preferred
Heritage sites	<b>Preferred</b>	<b>Preferred</b>	Least preferred
Social Impact	Least preferred	<b>Preferred</b>	Second preferred

From the above table, it is clear that there are varying conclusions from the specialist studies undertaken. The majority of specialists nominated Corridor 5 as the preferred alternative. From the conclusions of the specialist workshop undertaken, it was concluded that Corridor 4 is not preferred and development within this corridor should be avoided. **Corridor 5** was nominated as the preferred alternative from a holistic environmental perspective. However, it is considered vital that construction of the power line within this corridor take the recommended conditions identified by the specialist studies into account. Should the project be authorised by DEA, the final routing of the power lines within this corridor should be undertaken in consultation with the affected landowners and the following specialists:

- » Biodiversity specialist
- » Avifauna specialist
- » Heritage specialist

In addition, once the final transmission power line alignment has been negotiated and the tower positions surveyed and pegged, a walk-through survey must be undertaken by these specialists in order to minimise potential environmental impacts associated with the proposed project.

## CONCLUSIONS AND RECOMMENDATIONS

## CHAPTER 8

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

### 8.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - K provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This chapter concludes the EIA process by providing a summary of the conclusions of the assessment of the proposed substation site and alternative transmission line corridors identified for the 400kV transmission power lines. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental consultants during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Plan (EMP) included within Appendix N.

#### ***8.1.1. Conclusions and Recommendations drawn from the Assessment of the Proposed Substation Sites and Associated Turn-in Lines***

The following conclusions were drawn from the specialist studies undertaken:

- » Substation **Site Option 1** has the lowest ecological sensitivity (moderate sensitivity) from a terrestrial fauna and flora perspective.
- » Substation **Site Option 1** is transformed compared to Substation Site Options 3 and 4, and is therefore considered to be the preferred alternative from an avifaunal perspective.
- » **Substation Site Option 4** is preferred from an agricultural perspective as it is completely comprised of shallow soils.
- » **Substation Site Option 4** is the furthest removed from sensitive visual receptors and is preferred from a visual perspective.
- » No heritage resources with outstanding significance were observed near any of the three substation site options.
- » **Substation Site Option 4** is preferred from a social perspective as it avoids potential negative impacts on health and safety and settlement developments.

Overall Substation Site Options 1 and 4 are both considered suitable locations for the proposed substation. **Substation Site Option 4** and associated turn-in lines is nominated as the preferred option, largely due to the lower potential social and visual impacts.

### ***8.1.2. Conclusions and Recommendations drawn from the Assessment and Comparison of the Transmission Power Line Alternatives***

#### **Nomination of a Preferred Alternative from Medupi Power Station to the Proposed Mokopane Substation (Corridors 1, 2 and 8)**

- » In terms of impacts on biodiversity, **Corridor 2** is regarded as the least sensitive in terms of ecological attributes and is therefore recommended. Corridor 8 Deviation is regarded as the second preferred with a moderate ecological sensitivity.
- » In terms of Agricultural Potential the preferred route would be the **Corridor 1** (potentially fewer high potential soils) followed by the existing Matimba-Witkop corridor (Corridor 8).
- » **Corridor 8 Deviation** is considered to hold the least risk from a bird-interaction perspective, provided that deviations indicated in Figure 7.2 are:
  - \* the only areas where the proposed lines will deviate from the existing lines
  - \* the deviation distances are kept short and
  - \* the deviations denoted in Figure 7.2 of this report are still located within the 5km corridor that was originally assessed during the EIA phase of the project.

The proposed Medupi-Mokopane power lines alongside the nature reserve indicated in Figure 7.2 cannot be placed anywhere within the 5 km corridor. It is highly recommended that the proposed line be placed to the north of the existing lines, on the outer side of reserve's northern boundary as indicated in Chapter 7, Figure 7.3.

- » The Visual Impact Assessment indicated a marginal mathematical preference for **Corridor 8 Deviation and Corridor 2** over Corridor 1 and 8. Corridor 2 however has a low potential to consolidate the visual impact of linear infrastructure within the region. Corridor 8 (utilising the proposed deviation) has a higher potential to succeed should this principle be followed in order to prevent the spreading of power line infrastructure across the region. The true benefit of this visual impact mitigation measure will only be achieved if the additional lines are placed directly parallel to the existing lines. **Alternative 8 Deviation** is therefore preferred from a visual perspective.

- » From a heritage perspective, construction of the proposed power lines within **Corridor 2 or Corridor 8 Deviation** will affect the lowest number of heritage resources, the least types and ranges of heritage resources, as well as no outstanding significant heritage resources. Corridor 08 Deviation will be required to be constructed to the north of Tafelkoppe and Ga Mabula (along the R518) in order to avoid impacting on significant heritage resources in these areas.
- » From a Social perspective, **Corridor 8** followed by **Corridor 2** are expected to have lower impacts on the social environment. Corridor 8 should follow the existing line without deviation, except for the alternative around Tafelkop and the deviation where it joins Corridor 2 for some distance (i.e. **Corridor 8 Deviation**).
- » From an economic perspective, **Corridor 8 or Corridor 8 Deviation** are expected to have lower impacts.

From the conclusions of the specialist studies undertaken it was concluded that Corridor 1 is not preferred and development within this corridor should be avoided. The majority of specialist studies nominate Corridor 8 Deviation as the preferred alternative, while all specialist studies consider this alternative as acceptable for development. Therefore, **Corridor 8 Deviation** is nominated as the preferred alternative for the construction of the proposed 400kV power lines between the Medupi Power Station and the proposed Mokopane Substation. However, it is considered vital that construction of the power line within this corridor take the recommended conditions identified by the specialist studies into account. In addition, should the project be authorised by DEA, the final routing of the power lines within this corridor should be undertaken in consultation with the affected landowners and the following specialists:

- » Biodiversity specialist
- » Avifauna specialist
- » Heritage specialist

In addition, once the final transmission power line alignment has been negotiated and the tower positions surveyed and pegged, a walk-through survey must be undertaken by these specialists in order to minimise potential environmental impacts associated with the proposed project.

**Nomination of a Preferred Alternative from the Proposed Mokopane Substation to the Existing Witkop Substation (Corridors 4, 5 and 6)**

- » In terms of impacts on biodiversity, **Corridor 5** is regarded as the least sensitive in terms of ecological attributes and is therefore recommended. Corridor 6 is the second preferred option in this regard.
- » In terms of Agricultural Potential, there is **no preference** for any of the Mokopane – Witkop corridors based on soils.
- » **Corridor 6** presents itself as the preferred alternative in terms of avifauna. This is directly attributed to the presence of an existing transmission line within the corridor. This placement of the proposed Mokopane-Witkop 400kV power line within this corridor will partially mitigate for all of the impacts on avifauna.
- » The Visual Impact Assessment indicated that both Corridor 5 and 6 will follow existing power line infrastructure, but Corridor 4 will increase the length of the alignment by 2km. The preferred development corridor for the proposed Mokopane substation to Witkop substation section is therefore **Corridor 5**.
- » **Corridor 5** is the preferred corridor from a social perspective.

The majority of specialists nominated Corridor 5 as the preferred alternative. From the conclusions of the specialist workshop undertaken, it was concluded that Corridor 4 is not preferred and development within this corridor should be avoided. **Corridor 5** was nominated as the preferred alternative from a holistic environmental perspective. However, it is considered vital that construction of the power line within this corridor take the recommended conditions identified by the specialist studies into account. Should the project be authorised by DEA, the final routing of the power lines within this corridor should be undertaken in consultation with the affected landowners and the following specialists:

- » Biodiversity specialist
- » Avifauna specialist
- » Heritage specialist

In addition, once the final transmission power line alignment has been negotiated and the tower positions surveyed and pegged, a walk-through survey must be undertaken by these specialists in order to minimise potential environmental impacts associated with the proposed project.

### **Delta – Medupi (Corridor 7)**

- » No significantly sensitive faunal habitat or outstanding landscape features were observed within this corridor.
- » Impacts on avifauna are considered to be relatively low in contrast with the larger Medupi-Mokopane and Mokopane-Witkop corridors and can be mitigated where necessary.
- » Corridor 7, from Delta substation, should follow the existing lines in the corridor to consolidate the impact on sense of place
- » No significant environmental impacts are expected to be associated with Corridor 7.

## **8.2. Overall Conclusion (Impact Statement)**

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

- » **Corridor 1** is considered to be a **no-go option** from the conclusions of the majority of the specialist studies undertaken. This option was only preferred from an agricultural potential perspective. However, it was noted that most agricultural activities can be undertaken underneath power lines and therefore this issue is not considered to be significant.
- » **Corridor 8 Deviation** is considered to be the **preferred overall alternative** for the Medupi-Mokopane section of the power line.
- » **Corridor 5** is considered to be the **preferred alternative** for the Mokopane-Witkop section of the power line.
- » No issues of significance were identified to be associated with **Corridor 7** (Delta-Medupi). This corridor should follow the existing lines in the corridor to consolidate the impact on sense of place.
- » Sites 1 or 4 are considered suitable for the construction of the proposed substation. Either site could be selected from an environmental perspective. Substation **Site Option 4** is nominated as the preferred site for the construction of the substation due to the lower potential social impacts associated with the site.
- » Although some impacts of potential high significance are associated with the transmission lines and substation, there are no environmental fatal flaws that should prevent these proposed lines and substation from being constructed within the nominated preferred corridors and the proposed substation site respectively, provided that the recommended no-go areas are adhered to and the recommended mitigation measures are implemented.
- » The significance levels of the majority of identified negative impacts can be minimised by implementing the recommended mitigation measures.

### 8.3. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the substation and transmission power lines, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Mokopane Integration Project be authorised by the DEA to include the following (refer to Figures 8.1 and 8.2):

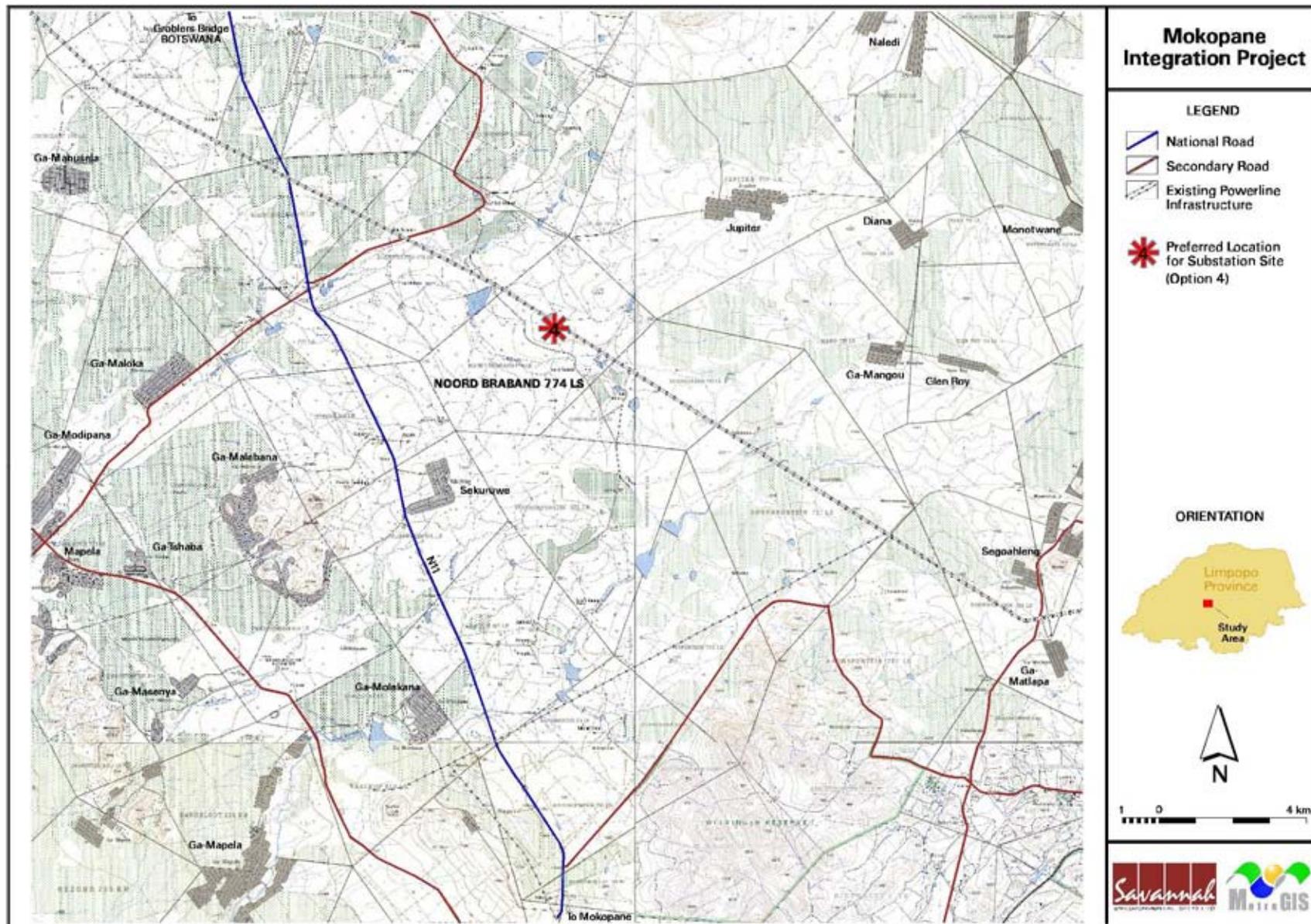
- » Construction of the new **substation** at proposed **Site Option 4**.
- » Construction of **two new 400kV transmission power lines in parallel** between the Delta Substation (a new substation to be located near the Medupi Power Station) and the existing Witkop Substation (near Polokwane), as follows:
  - \* Within **Corridor 7** and **Corridor 8 Deviation** between the Delta Substation and the new Mokopane Substation.
  - \* Within **Corridor 5** between the new Mokopane Substation and the Witkop Substation.
- » **Associated works** to integrate the proposed new substation and transmission power lines into Eskom's electricity Transmission grid.

The following conditions of this recommendation must be included within the authorisation issued:

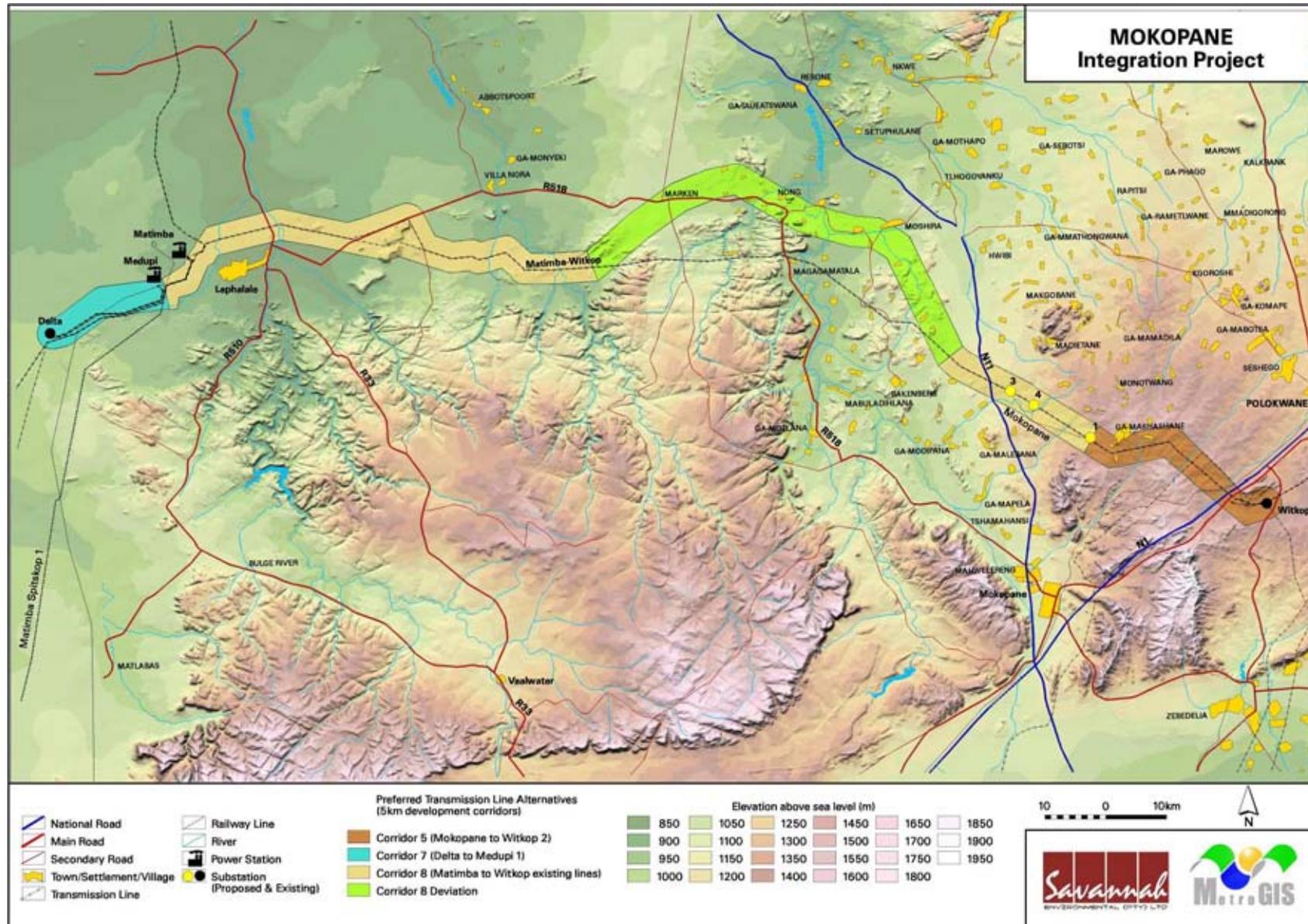
- » All mitigation measures detailed within this report and the specialist report contained within Appendices F to K must be implemented.
- » The draft Environmental Management Plan (EMP) as contained within Appendix N of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed Mokopane Integration Project, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMP for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
- » Applications for all other relevant and required permits required to be obtained by Eskom must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site and disturbance of protected vegetation.
- » An ornithologist must identify the exact power line spans requiring marking in order to minimise the risk of collision of birds with the earth wire. Recommendations must be made regarding the installation of Bird Guards on all self-supporting towers according to the existing Eskom guidelines. This will prevent birds from perching in high risk areas on the towers directly

above live conductors. It is likely that extensive marking will be required within Corridor 2 owing to the open nature of the vegetation and its ability to support the large terrestrial bird species recorded in the area.

- » Avoid construction in the no go areas within Corridor 2 (Refer to Section 7.3 of this report, Figures 7.4 – 7.9).
- » An ecological specialist must conduct a final walkthrough before construction in order to identify and relocate any possible plant species of conservation importance.
- » A heritage specialist must conduct a final walkthrough before construction in order to identify any important heritage resources. Transmission lines can be rerouted or realigned in order to avoid heritage sites and heritage resources can be conserved unaffected underneath power lines.
- » The EMP for construction must be updated to include site-specific information and specifications resulting from the final walk-through surveys. This EMP must be submitted to DEA for approval prior to the commencement of construction.
- » The transmission line towers should, in spatially constrained sections of the development corridors (i.e. in built-up areas), consist of monopole structures that are less bulky (albeit slightly taller) and less visually intrusive than conventional power line towers. Where space and technical considerations permit, the utilisation of cross rope suspension tower structures is recommended above the conventional self supporting strain towers that are more obtrusive.
- » During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.
- » It is highly recommended that Eskom investigates the general use of wide service corridors between all major power generation areas that can accommodate further development in the future in order to avoid the “spider web” effect often associated with short term focused planning of economic development.
- » Finally, to ensure that social impacts are mitigated during construction and operation it is recommended that the following be implemented and monitored by a Social Engagement Officer:
  - \* A Social Management Plan during construction and operation;
  - \* A social Impact Assessment during construction and operation;
  - \* A Local Labour and Workforce Plan;
  - \* An Influx Management Plan;
  - \* A Decommissioning and Closure Plan;
  - \* A Grievances Mechanism for the construction and operational phases; and
  - \* A Stakeholder Engagement and Education plan for construction and operation.



**Figure 8.1:** Nominated preferred alternative for the proposed Mokopane Substation



**Figure 8.2:** Nominated preferred alternative transmission line corridors for the proposed Mokopane Integration Project

## REFERENCES

## CHAPTER 9

- Africon and Environomics Joint Venture, 2004. Limpopo State of the Environment Report.
- Aganang Local Municipality Final Adopted IDP Review (2007/2008).
- Aganang Local Municipality Spatial Development Framework (undated).
- Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.
- Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington D.C.
- Barnes, K.N. (ED.) 1998. The Important Bird Areas of southern Africa. Birdlife South Africa: Johannesburg.
- Barnes, K.N. (ED.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa: Johannesburg.
- Bergh, J.S. (red.) 1998. Geskiedenisatlas van Suid Afrika. Die vier noordelike provinsies. J.L. van Schaik: Pretoria.
- Biemond, W.M. 2002. The Iron Age sequence around a Limpopo river floodplain on Basinghall Farm, Tuli Block, Botswana. Unpublished: University of Pretoria M.A. research proposal.
- Bohlweki Environmental (2005). Environmental Scoping Report for the proposed establishment of a new Coal-Fired Power Station in the Lephalale Area, Limpopo Province.
- Bohlweki/SSI Environmental (2009). Dinokeng Environmental Management Framework
- Blouberg Local Municipality Approved IDP (2005/2006).
- Botha, M.J. Land types of the map 2328 Pietersburg. Field information. Mem. Nat. Agric. Res. S. Afr. No. 19. ARC-Institute for Soil, Climate and Water, Pretoria.
- Breutz, P.L. 1986. A history of the Batswana and origin of Bophuthatswana. Margate, Natal: Thumbprint.
- Cape Nature (Ruida Stanvliet), 2008. Joint statement by biosphere reserve managers/coordinators regarding developments within the core, buffer and transition areas of Biosphere Reserves.
- Capricorn District Municipality IDP (2005).
- Coetzee C.B. 1976. Delfstowwe van die Republiek van Suid-Afrika. Geologiese Opname. Departement van Mynbou. Pretoria: Die Staatsdrukker.
- Chief Director of Surveys and Mapping, varying dates. 1:50 000 Topo-cadastral Maps and Digital Data.
- CSIR/ARC, 2000. National Land-cover Database 2000 (NLC 2000)

- De Beer, F. C. 1986. Groepsgebondenheid in die familie-, erf- en opvolgingsreg van die Noord Ndebele. Universiteit van Pretoria: Pretoria.
- Department of Environmental Affairs and Tourism, 2001. Environmental Potential Atlas for the Limpopo Province (ENPAT Limpopo).
- Dunsmore, S. (2007). 294-01 SR-Addendum Mmamabula-Delta 11-03-07v3.doc 8 Mmamabula-Delta DEAT Ref: 12/12/20/852, PBA International/Margen Industrial Services.
- Emalahleni Municipality Integrated Development Plan (2007/2008).
- Eskom (2009) Transmission Ten Year Plan, 2009 - 2018
- Eskom Transmission (2002). Gamma-Omega 765kV Transmission power line, Draft Environmental Impact Report, Main Report.
- Evans, M.R. and H. Malone (1992). People and plants: A case study in the hotel industry. In: D. Relf (ed.). The role of horticulture in human well-being and social development: A national symposium. Timber Press: Portland.
- Geological Survey, 1984. Geological map of the Republic of South Africa. Department of Mineral and Energy Affairs, Pretoria.
- Erasmus, B.P.J. 1995. Oppad in Suid Afrika. 'n Gids tot Suid Afrika, Streek vir Streek. Jonathan Ball Uitgewers Bpk.
- Esterhuysen, A.B. 2008. Ceramic alliance: pottery and the history of the Kekana Ndebele in the old Transvaal. In: Swanepoel, N., Esterhuysen, A. & Bonner, P. (eds). Five hundred years rediscovered: southern African precedents and prospects: 197-214. Johannesburg: Wits University Press.
- Farnum, J., Hall, T., Kruger, L.E. (undated). Sense of Place In Natural Resource Recreation and Tourism: An Evaluation and Assessment of Research Findings: Gallopin, G. (2003). Systems approach to sustainability and sustainable development. ECLAC/ Government of the Netherlands Project NET/00/063 "Sustainability Assessment in Latin America and the Caribbean.
- Geiger, S. 2004. Environmental Impact Assessment for the proposed Matimba-Witkop No. 2 transmission line, Limpopo Province. Specialist study. Heritage Impact Assessment. Prepared by Archaeo Info Northern Province for Bholwheki Environmental (Pty) Ltd.
- Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V and Brown, C.J. (EDS). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa: Johannesburg.
- Harrison, J.A. & Harebottle, D. 2002. Co-ordinated Waterbird Counts (CWAC) – Information Sheet No.1. Avian Demographic Unit, Cape Town.
- Hobbs, J.C.A. and Ledger J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. (Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986).
- Hobbs, J.C.A. and Ledger J.A. 1986B. "Power lines, Birdlife and the Golden Mean." Fauna and Flora, 44, pp 23-27.
- Howell, B. (2003). Cultural Attachment to Place: A Framework for Identifying and Working with Traditionally Associated Peoples in Southern Appalachia, The University of Tennessee.

- Huffman, T.N. 1990. The Waterberg research of Jan Aukema. *South African Archaeological Bulletin*, 45:117-119.
- Inskeep, R.R. 1978. *The peopling of Southern Africa*. David Philip: Cape Town.
- Jackson, A. O. 1969. *The history and political structure of the Mapela Chiefdom of the Potgietersrus district*. Unpublished manuscript.
- Jackson, A. O. 1982. *The Ndebele of Langa*. Ethnological publications no. 54. Department of Co-operation and Development.
- Kaplan, S. (1992). *The restorative environment: Nature and human experience*. In D. Relf (Ed.). *The role of horticulture in human well being and social development*. Portland, OR: Timber Press (pp. 134-142).
- Koch, F.G.L., 2005. Climate data. In: *Land types of the maps 2326 Ellisras and 2328 Pietersburg*. Mem. Agric. nat. Res .S. Afr. No.19. ARC-Institute for Soil, Climate and Water, Pretoria.
- Kruger, R. and Van Rooyen, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: the Molopo Case Study. (5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.)
- Kruger, R. 1999. *Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa*. M. Phil. Mini-thesis. University of the Orange Free State. Bloemfontein. South Africa.
- Laue, G.B. 2000. *Taking stance: posture and meaning in the rock art of the Waterberg, Northern Province South Africa*. Unpublished M.Sc. University of the Witwatersrand.
- Ledger, J. 1983. *Guidelines for Dealing with Bird Problems of Transmission Lines and Towers*. Escom Test and Research Division Technical Note TRR/N83/005.
- Ledger, J.A. 1984. "Engineering Solutions to the problem of Vulture Electrocutions on Electricity Towers." *The Certificated Engineer*, 57, pp 92-95.
- Ledger, J.A. AND ANNEGARN H.J. 1981. "Electrocution Hazards to the Cape Vulture (*Gyps coprotheres*) in South Africa". *Biological Conservation*, 20, pp15-24.
- Lephalale IDP (2006/2007 and 2008/2009).
- Limpopo Provincial Growth and Development Strategy (LPGDS). 2004-2014.
- Limpopo Tourism and Parks (undated). Know Limpopo.
- Loubser, J.H.N. 1994. *Ndebele archaeology of the Pietersburg area*. Unpublished MA dissertation. University of the Witwatersrand.
- MacVicar, C.N., de Villiers, J.M., Loxton, R.F, Verster, E., Lambrechts, J.J.N., Merryweather, F.R., le Roux, J., van Rooyen, T.H. & Harmse, H.J. von M., 1977. *Soil classification. A binomial system for South Africa*. ARC-Institute for Soil, Climate & Water, Pretoria.
- Mason, R. 1962. *Prehistory of the Transvaal*. Johannesburg: Witwatersrand University Press.
- Mason, R. J. 1958. *New prehistoric paintings in the Brandberg, S.W.A. and the Waterberg, N. Tvl. Lantern* 7(4):357-368.

- MasterQ Research (2007). Post hoc study: social impacts in constructing high voltage transmission power lines.
- MasterQ Research (2007). Proposed 4x400kv Mmamabula-Delta Transmission power lines, Socio-economic survey report for the Social Impact Assessment as part of the Environmental Impact Assessment.
- MasterQ Research (2005-2009). SIA for the 4x400kV for the Mmamabula-Delta (Masa) Transmission Power lines, for the 6x765kV Delta (Masa)-Epsilon (Selomo) Transmission Power Lines, for the 3x400kV Medupi-Dinaledi and Marang Transmission Power Lines.
- Maquire, J.S.A. A guide to the Makapansgat valley sites.
- Mogalakwena IDP 2008/09.
- Moore, M. P. J. 1981. The Iron Age of the Makapan valley area. Unpublished M.A. dissertation. University of the Witwatersrand.
- National Botanical Institute (NBI), 2004. Vegetation Map of South Africa, Lesotho and Swaziland (Unpublished Beta Version 3.0)
- Naude, M. 1990. Die Transvaalse Boerewoning. *Africana Society of Pretoria* (8): 46-49.
- Naude, M. 2004. Oral evidence on the construction of vernacular farm dwellings in the Waterberg (Limpopo Province). *South African Journal of Cultural History*. 18(1): 34-61
- Nel, H. & Erasmus, J. (2004). The contribution of Tourism to the economy of Lephalale.
- Paterson, D.G. & Haarhoff, D, 1989. Land types of the map 2326 Ellisras. Field information. *Mem. Nat. Agric. Res. S. Afr. No. 19*. ARC-Institute for Soil, Climate and Water, Pretoria.
- Petrich, C.H. (1993). Science and the inherently subjective: The evolution of aesthetic assessment since NEPA. In Hildebrand, S.G & Cannon, J.B (Eds). *Environmental Analysis: The NEPA Experience* (pp. 294-273).
- Pistorius, J.C.C. 1997. Relocation of Langa Ndebele from Ga-Mapela: An assessment of the archaeological potential of the farm Sterkwater (229KR) and proposal for a cultural heritage management programme in the former sphere of influence of the Langa-Ndebele chiefdom. Unpublished report for Steffen, Robertson and Kirsten and for Amplats.
- Pistorius, J.C.C. 2002. A Cultural Heritage Impact Assessment for Eskom's proposed new power line between the Sandsloot Substation and the 400kV transmission line crossing the farm Noord Brabant 774LR in the Limpopo (former Northern) Province of South Africa. Unpublished report prepared for Eskom.
- Pistorius, J.C.C. 2002. A Phase II investigation of cultural heritage remains in or near the proposed new open pit for Potgietersrust Platinums Mine (PPRust) on the farm Zwartfontein 818LR in the Limpopo Province of South Africa. Unpublished report for SRK Consulting and the South African Heritage Resources Agency.

- Pistorius, J.C.C. 2002. A cultural heritage assessment of Eskom's new Rebone (Gilead) project in the Limpopo (former Northern) Province of South Africa. Unpublished report prepared for Eskom, Pietersburg.
- Pistorius, J.C.C. 2002. An archaeological impact assessment study for the proposed new transmission lines between the Sandsloot Substation and the Overysel Substation and between the Witkop Substation and the Overysel Substation in the Northern Province of South Africa. Unpublished report prepared for Eskom.
- Pistorius, J.C.C. 2002. A cultural heritage impact assessment for the proposed Overysel Zwartfontein Project. Amendment to Potgietersrust Platinums Ltd's (PPRust) Environmental Management Programme Report (EMPR) Unpublished report prepared for SRK Consulting Engineers.
- Pistorius, J. C. C. 2002. A cultural heritage impact assessment for the proposed new open pit for PPRust on the farm Zwartfontein 818LR in the Northern Province of South Africa. Amendment to the PPRust Environmental Management Programme Report (EMPR). Unpublished report prepared for SRK Consulting Engineers.
- Pistorius, J.C.C. 2004. A Phase I Heritage Impact Assessment (HIA) study for the proposed new Tambotie Private Game Rererve on the farms Jonkershoek 580LQ and Bellevue 582LQ in the Limpopo Province of South Africa. Unpublished report for Landscape Dynamics
- Pistorius, J.C.C. 2005. A Phase I Heritage Impact Assessment (HIA) study for four eco-type residential developments on the farms Wolmunster 108LQ, Rustenburg 105LQ, New Lands 109LQ and Alpha 103LQ near Lephalale (Ellisras) in the Limpopo Province of South Africa. Unpublished report for Landscape Dynamics.
- Pistorius, J.C.C. 2003 -2006. Various Phase I HIA studies for Eskom's rural power lines occurring on the following farms: Rob Roy 64LR, Other World 213LR, St Agnes, Dwars-in-de-Weg 351MR, Rhenosterhoek 609LQ, Groenland 349MR, Baviaanshoek 599LQ, Stinkkraal 195LR, Pic van Teneriffe 470LR, Willowmore 439LR, Rietfontein 45LQ, Grootfontein 501LQ, Boschpoort 551LQ, Witpoort 123LR, Windsor 499LQ, Touwfontein 528LQ, Bloemendal 991LQ, Hamburg 381LR, Boschkop 87IQ, Witfontein 86IQ, and others. Unpublished reports prepared for Eskom, Northern Region.
- Pistorius, J.C.C.. 2007. A Phase I Heritage Impact Assessment study for the Eskom Mmamabula Delta Project near Lephalale in the Limpopo Province of South Africa. Unpublished report for Eskom Megawattpark.
- Polokwane Local Municipality's IDP (2008-2011).
- Pretorius (2006). Electric and magnetic field from Overhead Power Lines. A summary of technical and biological aspects. Final Report. Empetus Close Corporation.
- Relf, D. (1992). HortTechnology April/June 1992 2(2).

- Slootweg, R., Vanclay, F. & Van Schooten, M. (2001). Function evaluation as a framework for the integration of social and environmental impact assessment. *Impact Assessment and Project Appraisal*. Volume 19:19-28.
- Snyman, I. (2002). Social Impact Assessment for the Medupi-Witkop No. 2 2x400kV Transmission Power Lines.
- Srinivasan, R. (undated). Operational policy 4.12. Involuntary Resettlement. World bank presentation
- Statistician General (2008). Statistician General's Response to the Star and other newspapers.
- StatsSA, Mid-year population estimates, 2007.
- StatsSA, Primary Tables, Limpopo, Census '96 and 2001 compared.
- StatsSA, Primary Tables, North West, Census '96 and 2001 compared.
- Taylor, P.B., Navarro, R.A., Wren-Sargent, M., Harrison, J.A. & Kieswetter, S.L. 1999. Coordinated waterbird Counts in South Africa, 1992-1997. Avian Demography Unit, Cape Town.
- Van Der Ryst, M. 1998. The Waterberg Plateau in the Northern Province, Republic of South Africa, in the Later Stone Age. BAR International Series 715.
- Van Der Ryst, M. 1996. The later Stone Age prehistory of the Waterberg, with special reference to Goergap shelter. Unpublished MA thesis. University of the Witwatersrand.
- Van Der Ryst, M., Lombard, M., & Biemond, W. 2004. Rocks of potency: engravings, cupules from the Dovedale Ward, southern Tuli Block, Botswana. *South African Archaeological Bulletin*, 59 (179), p1-11.
- Van Rooyen, C.S. and Ledger, J.A. 1999. "Birds and utility structures: Developments in southern Africa" in Ferrer, M. & G..F.M. Janns. (eds.) *Birds and Power lines*. Quercus: Madrid, Spain, pp 205-230
- Van Rooyen, C.S. 1998. Raptor mortality on power lines in South Africa. (5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.)
- Van Rooyen, C.S. 1999. An overview of the Eskom - EWT Strategic Partnership in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999, Charleston, South Carolina.)
- Van Rooyen, C.S. 2000. "An overview of Vulture Electrocutions in South Africa." *Vulture News*, 43, pp 5-22. Vulture Study Group: Johannesburg, South Africa.
- Van Rooyen, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In *The fundamentals and practice of Overhead Line Maintenance (132kV and above)*, pp217-245. Eskom Technology, Services International, Johannesburg.
- Van Rooyen, C.S. and Taylor, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina)
- Van Ryneveld, K., Van der Walt, J. & Walker, N.J. 2006. The Mmamabula Project – Phase I Archaeological Impact Assessment (AIA): Portion of transmission

- line routes from Phokoje (Phikwe) and from Mmamabula to Jwaneng, Botswana. Unpublished report to CIC Energy Corporation and Digby Wells Associates.
- Van Schalkwyk, J. 1985. Vaalpense: Verwarring en waarheid. Suid Afrikaanse Tydskrif vir Etnologie. 8(4), 146-153.
- Van Schalkwyk, J. 2005. A Phase Heritage Impact Assessment for Eskom's proposed new Matimba B Power Station near Lephalale in the Limpopo Province of South Africa. Unpublished report prepared for Bholweki Environmental and Eskom Megawatt Park.
- Van Warmelo, N. J. 1930. Transvaal Ndebele texts. Government Printer: Pretoria.
- Van Warmelo, N. J. 1944. The Ndebele of J. Kekana. Government Printer: Pretoria.
- Vanclay, F. (2002). 'Conceptualising social impacts.' Environmental Impact Assessment Review 22 (2002): 183– 211.
- Verdoorn, G.H. 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV power lines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. (2nd International Conference on Raptors: 2-5 October 1996. Urbino, Italy.)
- Viljoen, M.J. & Reinhold, W.U. 1999. An introduction to South Africa's geological and mining heritage. Randburg: Mintek.
- Waterberg District Municipality IDP (2008/09).
- Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D. and Colahan, B.D. (eds). 2003. Big Birds on Farms: Mazda CAR Report 1993-2001. Avian Demographic Unit. University of Cape Town, South Africa
- Zadik, M.H. (1985). Social perspectives in horticulture. Proceedings of the Longwood graduate program seminars 17:36-41. Longwood Gardens, PA.