Mongatane	Ga-Tshba	Ga-Mabusela	Sebora
Mathlati	Kgopeng	Jupiter	Ramorulana
Setateng	Ga-Malope	Diana	Ga-Mabuela
Ga-Monare	Diphitshi	Ga-Malokwa	Ga-Tshaba
Sepobe	Lenkwane	Ga-Ramu	Mapela
Vianen	Matebeleng	Manyapye	Segoahleng
Segole 1	Ga-Monene	Ga-Mangou	Mmahlogo
Nong	Ga-Malapila	Glen Roy	Ga-Motlana
Ga-Rapadi	Ga-Mokwena	Ga-Molaka	Ga-Matlapa
Senita	Ga-Molekwa	Makekengf	Mmamatlakala
Ga-Mathekga	Dibeng	Sepharane	Ga-Masenya 2
Mosira	Thutlane	Utjane	Ga-Molekana
Sandsloot	Vlakfontein B	Lyden	Ga-Masenya 1

The **second area** includes a 1000m 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 road buffer zones are shown on Figures 14 to 17.

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 UNESCO (United Nations Educational, Scientific and Cultural Organization) biosphere reserves namely: D'Nyala, Kwalata, Lapalala, Touchstone, Moepel Farms, Wonderkop, Bellevue, Wit Vinger, Percy Fyfe, Kuschke and the Waterberg Biosphere Reserve (**core and buffer areas**).

The core and buffer areas represent *"securely protected sites for conserving biological diversity, monitoring minimally disturbed ecosystems, and undertaking non-destructive research and other low-impact uses"* and *"surrounds or adjoins the core areas, and is used for co-operative activities compatible with sound ecological practices, including environmental education, recreation, eco-tourism and applied and basic research"*, respectively. Fragmentation of visual landscapes by development could be a problem, both within the immediate vicinity (core areas) as well as within surrounding areas (buffer areas).

The transition area may *"contain a variety of agricultural activities, settlements and other uses"* and is therefore not included in the third zone.

Source: Cape Nature, 2008. (Joint statement by biosphere reserve managers/coordinators regarding developments within the core, buffer and transition areas).

An additional sensitive visual receptor was also identified due to its inherent aesthetic quality or potential as a scenic tourist attraction. The rationale being that the proposed project infrastructure might negatively influence the tourism development potential of these areas. This **fourth area** includes the mountainous terrain within the study area that is delineated (rather

conservatively) as all areas with slope gradients greater than 20% (1:5 slope ratio).

The rest of the study area, **excluding the abovementioned 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 random observers, an assumed neutral viewer perception of the proposed power line infrastructure.

3.5. Visual absorption capacity of the natural vegetation

It is 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).

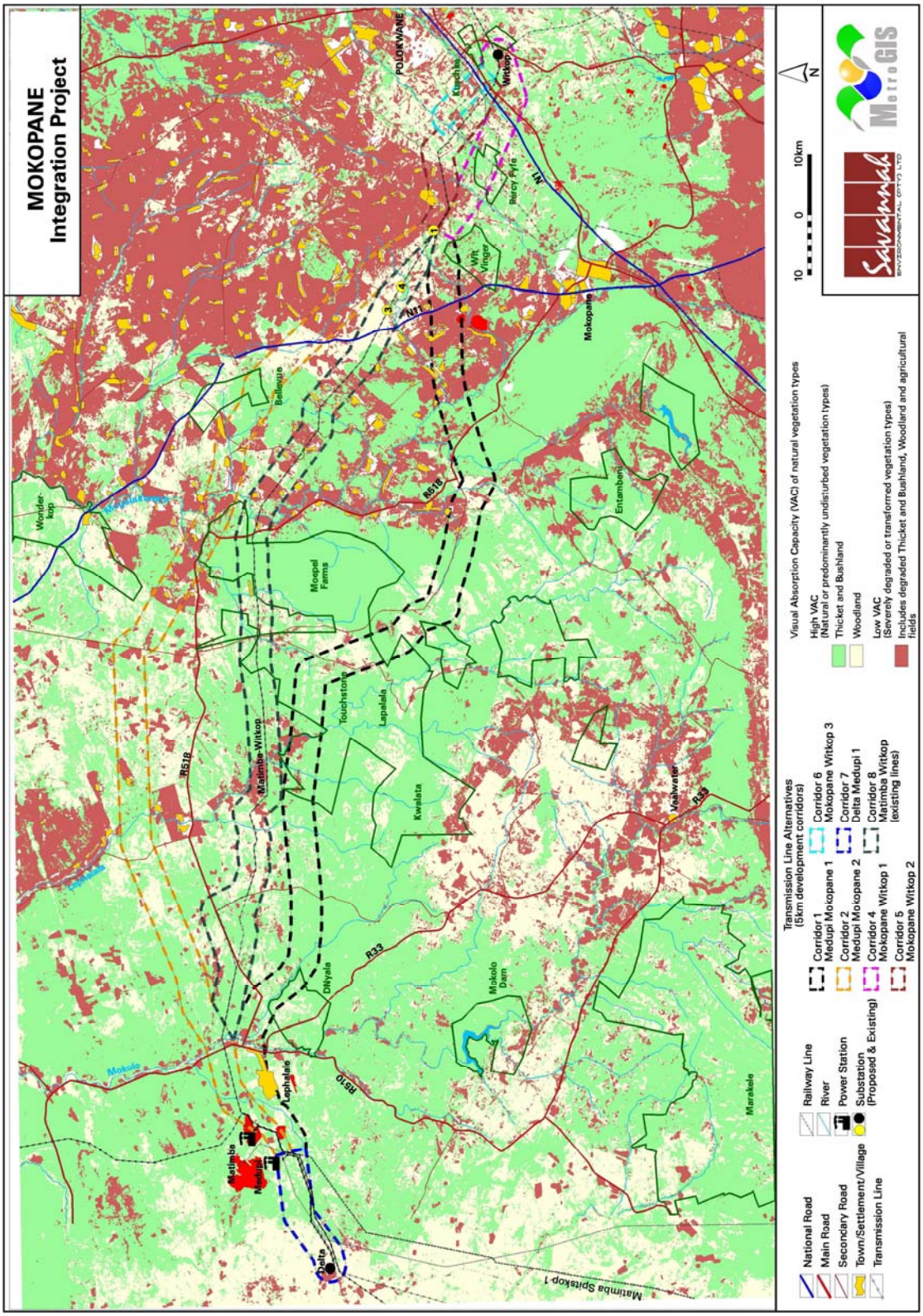

Figure 18: Visual absorption capacity (VAC) of the natural vegetation types within the study area.

3.6. Visual impact index

The results of the above analyses were merged in order to determine where the areas of likely visual impact would occur. These areas were further analysed in terms of the previously mentioned issues (related to the visual impact) and in

order to judge the severity of each impact. The Visual Impact Index for both the substation alternatives and the transmission line alternatives are discussed in Chapter 5 (RESULTS).

4. THE AFFECTED ENVIRONMENT

The land uses within the study area, in terms of surface area, primarily consist of cattle and game farming to the west and subsistence farming east of the R518 and the N11. The study area includes a number of conservation or protected areas (both provincial and private nature reserves) as well as the Waterberg Biosphere Reserve core, buffer and transitional zones. Some of the reserves in the study area include; D'Nyala, Kwalata, Touchstone, Lapalala, Moepel Farms, Wit Vinger, Percy Fyfe, Kuschke, etc. Industrial and mining land uses occur west of Lephalale in the form of the Groottegeluk coal mine, and the two coal-fired power stations (Matimba and Medupi). Platinum mining activities takes place north-west of Mokopane between the R518 and the N11 national road.

Large tracts of land within the study area are still in a natural state (undisturbed) with some areas in and along the Waterberg escarpment in a virtually pristine condition. This is due mainly to the low population density (less than 10 people per km^2) of the Waterberg plateau and escarpment and the relative remoteness and inaccessibility of the terrain. The population density increases eastwards with a great number of settlements occurring along the Mogalakwena River (between the R518 and N11). Here the population density is between 100 to 200 people per km^2 and 50 to 100 people per km^2 east of the N11.

The land cover types of the study area primarily include Woodland (tall trees higher than 5m) and Thicket and Bushland (trees and bushes 2 to 5m tall). These land cover types are relatively undisturbed for large sections in the west of the study area, but are largely degraded to the east of the R518 due to agricultural activities and settlement patterns.

The Waterberg plateau (table land) and escarpment dominate the topography of the study area that ranges from less than 850m (elevation) above sea level to the north to 1950m above sea level for the mountains east of Mokopane. The terrain north of the Waterberg escarpment is described as plains with even slopes, while the rest of the study area is lowlands with mountains, distinct escarpments and mountains.

Prominent river valleys carving their way through the Waterberg Mountains towards the Limpopo River include the Mokolo and Lephalala rivers. The Mogalakwena River runs east of the Waterberg escarpment.

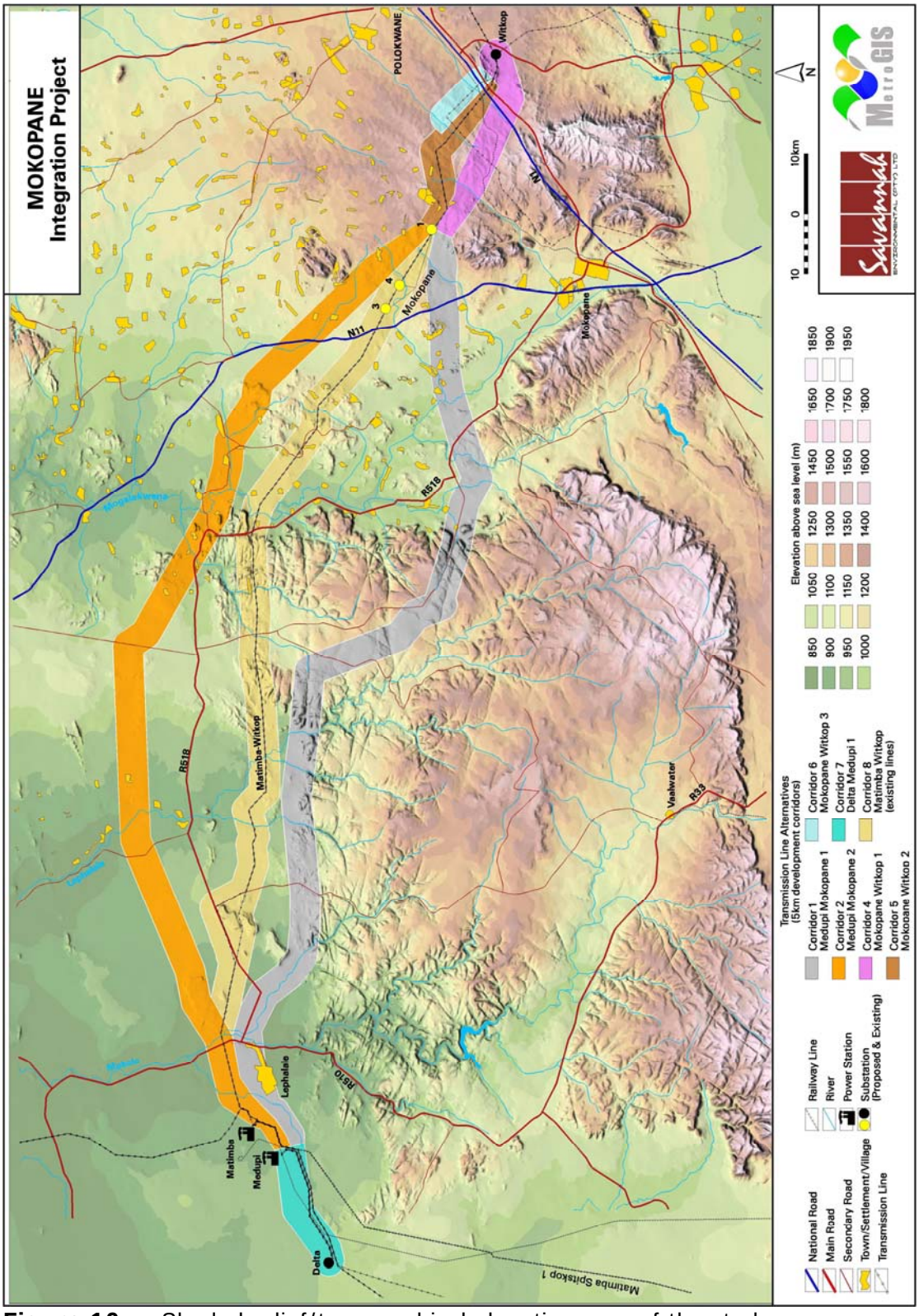

Figure 19: Shaded relief/topographical elevation map of the study area.

5. RESULTS

5.1. Visual impact indexes

The combined results of the visual exposure, viewer incidence/perception, visual distance and the visual absorption capacity of the two proposed substation

alternatives and the seven transmission corridor alternatives are displayed on the following maps (Figures 20 to 23). 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 helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

Visual impact index – substation Alternative 1

The visual impact index for substation Alternative 1 indicates an area of **high to very high** visual impact within a 500m radius of the proposed substation structures. This area includes a section of one of the secondary access roads to Morwasethula/Segoahleng/Ga-Mashashane from the N11 national road. The substation is not expected to have a significant visual impact (where visible) on the aforementioned settlements, but residents will have to pass the substation to reach their homes. Potential nighttime lighting impacts may occur along this section of road and to a lesser degree from the abovementioned settlements.

This location could have a **moderate** visual impact on north facing slopes of the Witvinger Nature Reserve.

The Alternative 1 substation site is not expected to have any visual impact on observers travelling along the N11 national road.

Visual impact index – substation Alternative 3

The visual impact index for substation Alternative 3 indicates an area of **high to very high** visual impact within a 500m radius of the proposed substation structures. This area includes a section of the secondary access road to the Suid Holland homestead and the Jupiter settlement/village from the N11 national road. The substation is expected to have a **moderate to high** visual impact on residents at Suid Holland, but is not expected to visually influence residents of Jupiter. Residents will however have to pass the substation to reach their homes and will be exposed, at short distance, to the substation infrastructure. Potential nighttime lighting impacts may occur along this section of road and at the Suid Holland residence.

The Alternative 3 substation site is expected to have a **moderate to low** visual impact on observers travelling along the N11 national road.

Visual impact index – substation Alternative 4

The visual impact index for substation Alternative 4 indicates an area of **high** visual impact within a 500m radius of the proposed substation structures. The relatively remote (by comparison) location of this site option, results in most of the potentially exposed areas beyond 1km from the site, experiencing a low to negligible visual impact. This includes the N11 national road, Sekuruwe (south-west of the site) and other homesteads in the area.

Residents of the Noord Braband homestead (located just under 2km from the site) may experience a **moderate to high** visual impact of the substation infrastructure, which may include potential nighttime lighting impacts.

The Alternative 4 substation site is not expected to have any visual impact on observers travelling along the N11 national road.

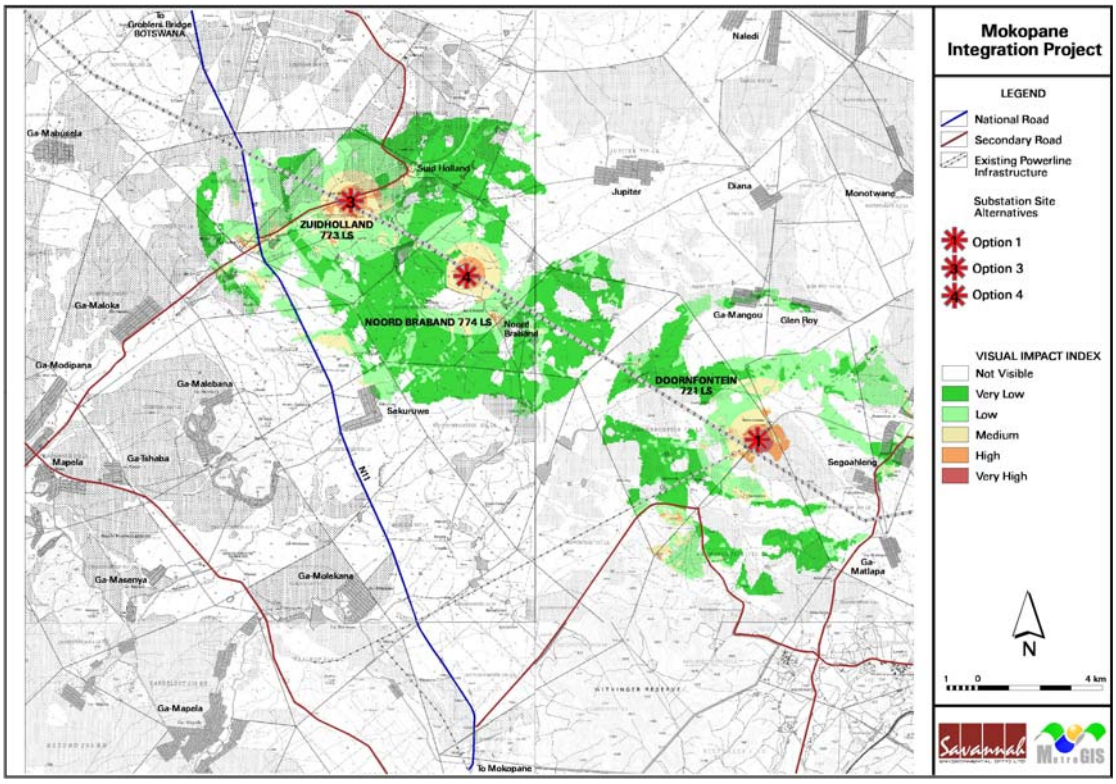

Figure 20: Visual impact index - substation Alternatives 1, 3 and 4.

Visual impact index – transmission line Alternative 1

The transmission line Alternative 1 corridor has the potential to have a **high** visual impact on observers within a 500m 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: Spektakel, Drakensberg, New Belgium, Hanover, Rivierplaats, Zwellendam, Poeskopdrift, De Koop, Colesberg, Uitvlugt, Duikerfontein, Norfolk, Rivierplaats, Eyzerbeen, 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 traverse north of the town of Lephalale (where it crosses over the R310) and where the line runs parallel to the R518 for almost 9km. The transmission lines 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 Alternative 1 corridor 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 – transmission line Alternative 2

The transmission line Alternative 2 corridor has the potential to have a **high** visual impact on observers within a 500m 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: 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 7km at the northern extremity of the Waterberg escarpment, where it includes a section of the Waterberg Biosphere Reserve core area (Moepel Farms).

The Alternative 2 corridor predominantly spans across 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 – transmission line Alternative 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 Alternatives 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 posses the greatest potential to consolidate the linear infrastructure within the region due to the vertical disturbance brought about by the existing lines.

The visual impact index of the Alternative 8 corridor 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: Johannisberg, 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 10km, 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 Alternative 4

The visual impact index of transmission line corridor Alternative 4 indicates potentially **high to very high** visual impacts within a 500m 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 – transmission line Alternative 5

The proposed Alternative 5 development corridor is similar to the Alternative 8 corridor 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 Sebora) within the corridor, as well as the section where the two new lines cross the R101 and N1 roads.

Visual impact index – transmission line Alternative 6

The Alternative 6 development corridor deviates from the Alternative 5 corridor where it follows the two Warmbad-Witkop 275kV transmission lines. Potential cumulative visual impacts (ranging from **high to very high**) may occur within a 500m 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 – transmission line Alternative 7

The 20km 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 within the region.

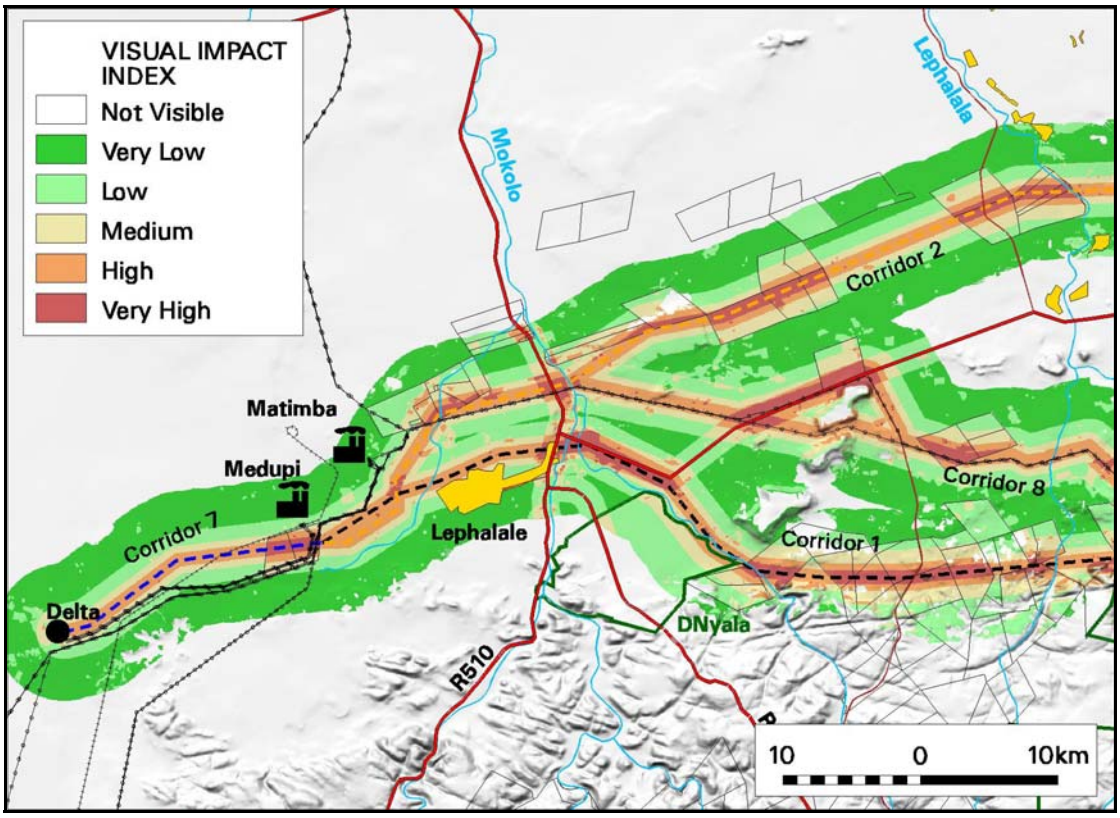

Figure 21: Visual impact index - transmission line Alternatives 1, 2, 7 and 8 (western section).

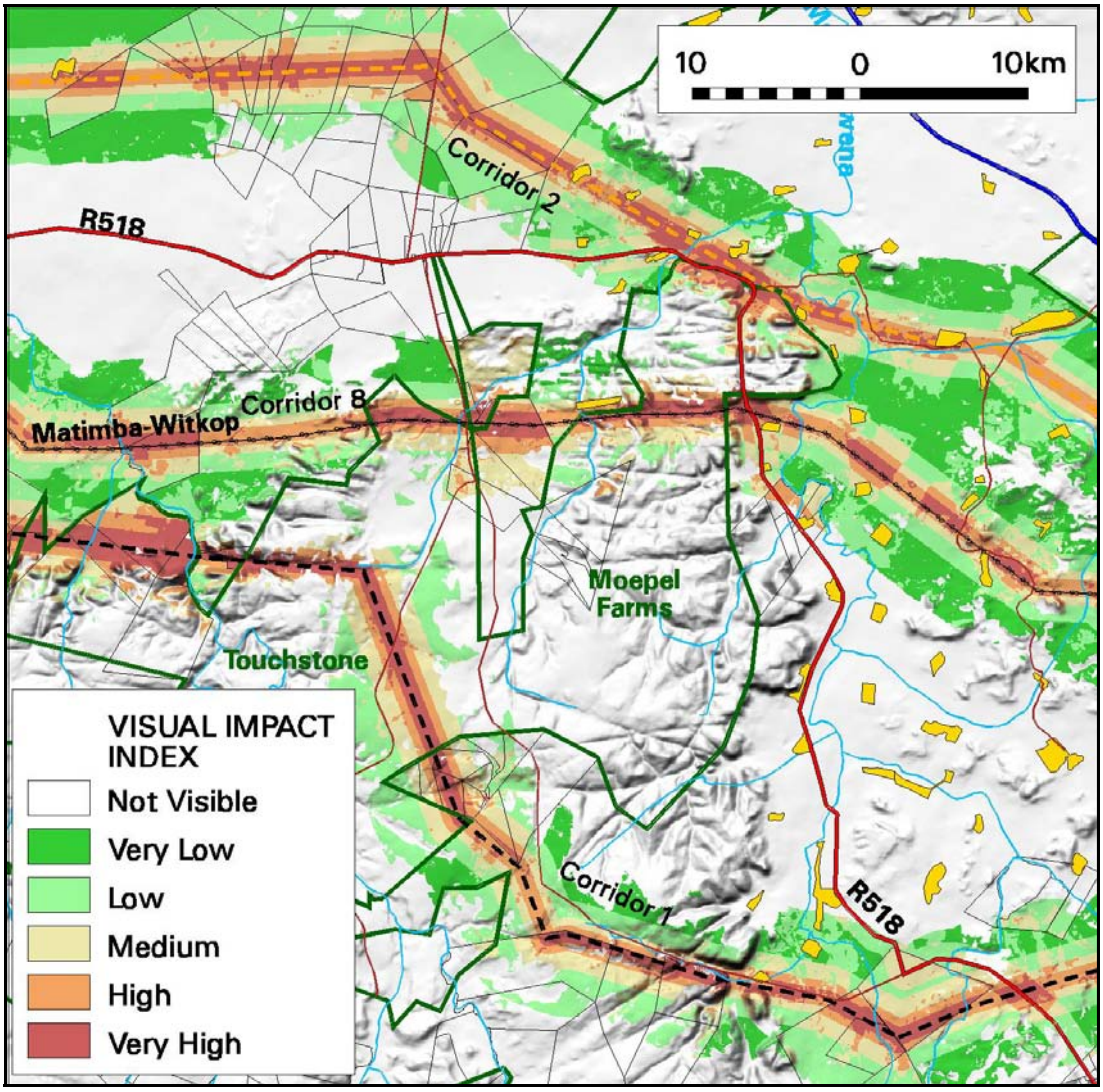

Figure 22: Visual impact index - transmission line Alternatives 1, 2, and 8 (central section).

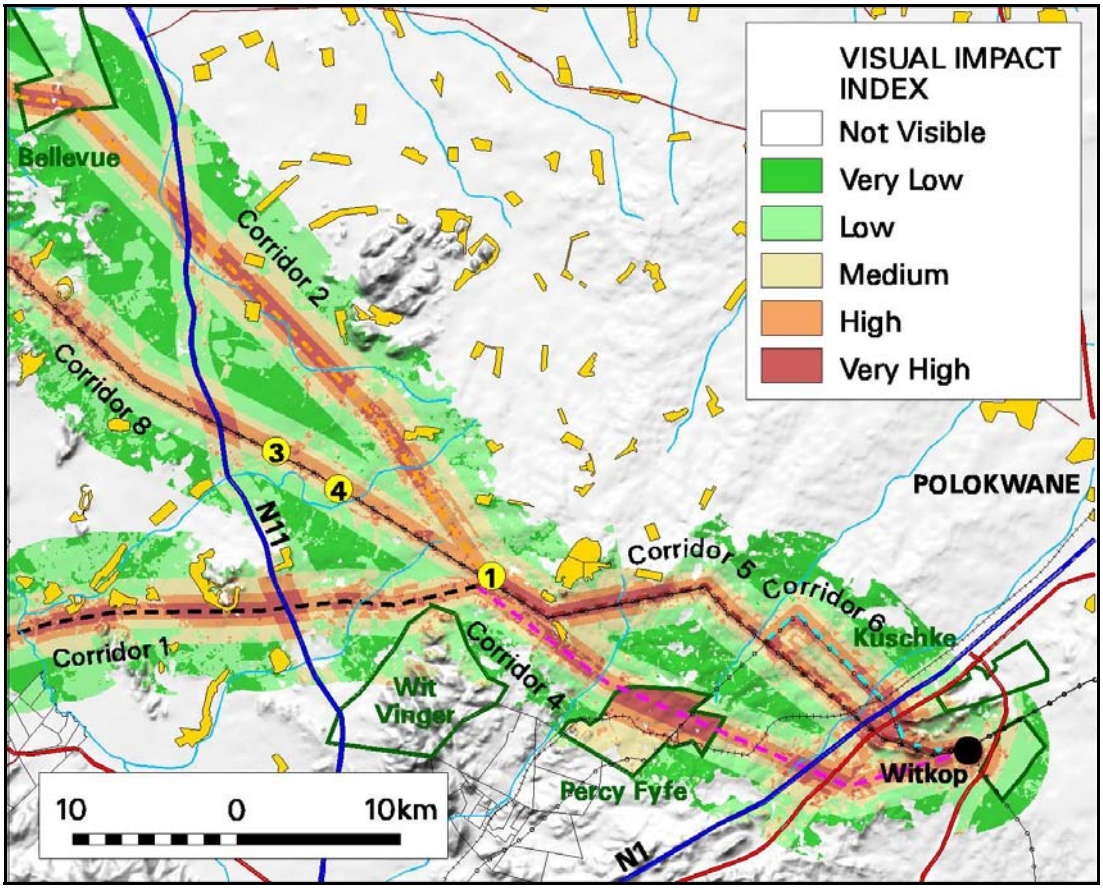

Figure 23: Visual impact index - transmission line Alternatives 1, 2, 4, 5, 6 and 8 (eastern section).

5.2. Visual impact assessment

The previous section of the report identified specific areas where likely visual impacts would occur as a result of the proposed Mokopane Integration Project. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 2: SCOPE OF WORK) related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g. the visual impact on users of major roads in the vicinity of the proposed substation/transmission line infrastructure) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude** - None (= 0), minor (= 1), low (= 2), medium/moderate (= 3), high (= 4) and very high (= 5)
- **Probability** - none (= 0), improbable (= 1), low probability (= 2), medium probability (= 3), high probability (= 4) and definite (= 5)
- **Status** (positive, negative or neutral)
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5)
- **Significance** - low, medium or high.

The **significance** of the potential visual impact is equal to the **consequence** multiplied by the **probability** of the impact occurring, where the consequence is determined by the sum of the individual scores for magnitude, reversibility, duration and extent (i.e. **significance = consequence (magnitude + reversibility + duration + extent) x probability**).

The significance weighting for each potential visual impact (as calculated above) is as follows:

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium/moderate (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

*Please note that due to the declining visual impact over distance, the **extent** (or spatial scale) rating is reversed (i.e. a localised visual impact has a higher value rating than a national or regional value rating). This implies that the visual impact is highly unlikely to have a national or international extent, but that the local or site-specific impact could be of high significance.*

The impact tables for the substation alternatives are populated with the results for the three options in order to aid in rating the proposed alternative based on the envisaged significance of the potential visual impact.

The impact tables for the transmission line alternatives are respectively populated with the results for Alternatives 1, 2 and 8 (the Medupi to Mokopane section), Alternatives 4, 5 and 6 (the Mokopane to Witkop section) and separately for Alternative 7 (the Delta to Medupi section) in order to aid in rating the proposed alternatives based on the envisaged significance of the potential visual impact. As there is little opportunity to mitigate the visual impact associated with the proposed substation and power lines, the impacts are only assessed prior to mitigation.

Potential visual impact on users of *main roads* (primarily the N11 national road) in the vicinity of the proposed substation alternatives

Table 1: Impact table summarising the significance of visual impacts - substation alternatives

Nature of Impact: Potential visual impact on users of main roads in close vicinity of the substation alternatives.			
	Alternative 1	**Alternative 3**	**Alternative 4**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Low **(2)**	Moderate **(3)**	Low **(2)**
Probability	Improbable **(1)**	Medium probability **(3)**	Improbable **(1)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	Low **(13)**	Moderate **(42)**	Low **(13)**
Irreplaceable loss of resources?	No	No	No
Can impacts	No	No	No

be mitigated during operational phase?			
Mitigation: N.A.			
Cumulative impacts: N.A.			
Residual impacts: N.A.			

Potential visual impact on residents in close proximity to the proposed substation alternatives (including access roads and potential night time visual impacts)

Table 2: Impact table summarising the significance of visual impacts - substation alternatives

Nature of Impact: Potential visual impact on residents in close vicinity of the substation alternatives.			
	Alternative 1	**Alternative 3**	**Alternative 4**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	Moderate **(3)**
Probability	High probability **(4)**	High probability **(4)**	Medium probability **(3)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	Moderate **(60)**	Moderate **(60)**	Moderate **(42)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: N.A.			
Cumulative impacts: N.A.			
Residual impacts: N.A.			

Potential visual impact on users of *main roads* (N11, R33, R510 and R518) in the vicinity of the proposed transmission line Alternatives 1, 2 and 8

Table 3: Impact table summarising the significance of visual impacts - transmission line Alternatives 1, 2 and 8

Nature of Impact: Potential visual impact on users of major roads in close vicinity of transmission line Alternatives 1, 2 and 8.			
	Alternative 1	**Alternative 2**	**Alternative 8**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(5)**	Very high **(5)**	Very high **(5)**
Probability	High probability **(4)**	High probability **(4)**	High probability **(4)**

Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	High **(64)**	High **(64)**	High **(64)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: The Alternative 8 corridor has a higher potential to consolidate the transmission line infrastructure by placing the proposed lines adjacent to existing power lines.			
Cumulative impacts: 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.			
Residual impacts: N.A.			

Potential visual impact on residents and visitors (settlements, individual homesteads and private game lodges/farms) in close proximity of the proposed transmission line Alternatives 1, 2 and 8

All three alternatives have the potential to visually impact on residents and visitors in close proximity to the proposed infrastructure. Alternative 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 Alternatives 1 and 2's comparatively "greenfields" alignments being considered more visually sensitive.

Table 4: Impact table summarising the significance of visual impacts - transmission line Alternatives 1, 2 and 8

Nature of Impact: Potential visual impact on residents and visitors in close proximity to the transmission line Alternatives 1, 2 and 8.			
	Alternative 1	**Alternative 2**	**Alternative 8**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(5)**	Very high **(5)**	Very high **(5)**
Probability	High probability **(4)**	High probability **(4)**	High probability **(4)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	High **(64)**	High **(64)**	High **(64)**
Irreplaceable loss of resources?	No	No	No
Can impacts	No	No	No

be mitigated during operational phase?			
Mitigation: The placement of Alternative 8 adjacent to existing power line infrastructure.			
Cumulative impacts: Alternative 8 will potentially increase the cumulative visual impact of viewing four transmission lines parallel to each other.			
Residual impacts: N.A.			

Potential visual impact on statutory (formal) conservation/protected areas and scenic topographical features of the proposed transmission line Alternatives 1, 2 and 8

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.

Table 5: Impact table summarising the significance of visual impacts - transmission line Alternatives 1, 2 and 8

Nature of Impact: Potential visual impact on scenic topographical features and statutory conservation areas of the transmission line Alternatives 1, 2 and 8.			
	Alternative 1	**Alternative 2**	**Alternative 8**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(5)**	High **(4)**	Very high **(5)**
Probability	High probability **(4)**	High probability **(4)**	High probability **(4)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	High **(64)**	Moderate **(60)**	High **(64)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	Yes	No
Mitigation: 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.			
Cumulative impacts: 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.			
Residual impacts: N.A.			

Potential visual impact on users of *main roads* (N1 and R101) in the vicinity of the proposed transmission line Alternatives 4, 5 and 6

Table 6: Impact table summarising the significance of visual impacts - transmission line Alternatives 4, 5 and 6

Nature of Impact: Potential visual impact on users of major roads in close vicinity of transmission line Alternatives 4, 5 and 6.			
	Alternative 4	**Alternative 5**	**Alternative 6**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(5)**	High **(4)**	High **(4)**
Probability	High probability **(4)**	High probability **(4)**	High probability **(4)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	High **(64)**	Moderate **(60)**	Moderate **(60)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: 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.			
Cumulative impacts: 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.			
Residual impacts: N.A.			

Potential visual impact on residents (both settlements and individual homesteads) in close proximity of the proposed transmission line Alternatives 4, 5 and 6

All three alternatives have the potential to visually impact on residents in close proximity to the proposed infrastructure. Alternatives 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. Ultimately this is preferable due to Alternatives 4's comparatively "greenfields" alignments being considered more visually sensitive.

Table 7: Impact table summarising the significance of visual impacts - transmission line Alternatives 4, 5 and 6

Nature of Impact: Potential visual impact on residents in close proximity to the transmission line Alternatives 4, 5 and 6.			
	Alternative 4	**Alternative 5**	**Alternative 6**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(5)**	Very high **(5)**	Very high **(5)**
Probability	High probability **(4)**	High probability **(4)**	High probability **(4)**

Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	High **(64)**	High **(64)**	High **(64)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: The placement of Alternatives 5 and 6 adjacent to existing power line infrastructure.			
Cumulative impacts: Alternatives 5 and 6 will potentially increase the cumulative visual impact of viewing three or four transmission lines parallel to each other.			
Residual impacts: N.A.			

Potential visual impact on conservation / protected areas of the proposed transmission line Alternatives 4, 5 and 6

Alternative 4 traverses the Percy Fyfe Nature Reserve.

Table 8: Impact table summarising the significance of visual impacts - transmission line Alternatives 4, 5 and 6

Nature of Impact: Potential visual impact on conservation areas of the transmission line Alternatives 4, 5 and 6.			
	Alternative 4	**Alternative 5**	**Alternative 6**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very high **(5)**	Low **(2)**	Low **(2)**
Probability	High probability **(4)**	Improbable **(1)**	Improbable **(1)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Significance	High **(64)**	Low **(13)**	Low **(13)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: N.A.			
Cumulative impacts: N.A.			
Residual impacts: N.A.			

Overall potential visual impact of the proposed transmission line Alternative 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).

Table 9: Impact table summarising the significance of visual impacts - transmission line Alternative 7

Nature of Impact: Overall potential visual impact.	
	Alternative 7
Extent	Local **(4)**
Duration	Long term **(4)**
Magnitude	High **(4)**
Probability	High probability **(4)**
Status (positive or negative)	Negative
Reversibility	Recoverable **(3)**
Significance	High **(60)**
Irreplaceable loss of resources?	No
Can impacts be mitigated during operational phase?	No
Mitigation: 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.	

5.3. Preferred substation alternative

Table 10: Total significance of visual impacts - substation alternatives

	Alternative 1	**Alternative 3**	**Alternative 4**
Table 1 significance	13	42	13
Table 2 significance	60	60	42
Total significance	73	102	55
Average significance	36 (Moderate)	51 (Moderate)	27.5 (Low)

The substation Alternative 4 fared considerably better than Alternatives 1 and 3 in the above ratings, due to its relatively remote location away from major roads and sensitive visual receptors. **Alternative 4** is therefore the preferred alternative for the placement and operation of the proposed Mokopane substation from a visual impact perspective.

5.4. Preferred transmission line alternative - Alternatives 1, 2 and 8

The proposed transmission line Alternatives 1, 2 and 8 respectively averaged 64, 62.6 and 64 significance ratings (see Table 11 below).

Table 11: Total significance of visual impacts - transmission line Alternatives 1, 2 and 8

	Alternative 1	Alternative 2	Alternative 8
Table 3 significance	64	64	64
Table 4 significance	64	64	64
Table 5 significance	64	60	64
Total significance	192	188	192
Average significance	64 (High)	62.6 (High)	64 (High)

The above table indicates a marginal mathematical preference for Alternative 2. This alternative however has a low potential to consolidate the visual impact of linear infrastructure within the region. Alternative 8 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 5km transmission line development corridors indicated for the Mokopane Integration Project are however considered (from a visual assessment perspective) too broad to effectively consolidate the visual impact (i.e. it allows too much leeway to spread the visual impact within the corridor). 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. Eskom holdings indicated that this would not be possible for the entire length of this alignment due to both technical (topographical) considerations and conditional agreements reached with land owners during the establishment of the existing Matimba-Witkop transmission lines. A number of deviations, some within potentially critical visually sensitive features (i.e. along the Waterberg escarpment and within the Waterberg Biosphere Reserve), are therefore envisaged. This effectively nullifies the potential to consolidate the linear infrastructure and may aggravate the visual impact in highly sensitive areas.

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

5.5. Preferred transmission line alternative - Alternatives 4, 5 and 6

Table 12: Total significance of visual impacts - transmission line Alternatives 4, 5 and 6

	Alternative 4	Alternative 5	Alternative 6
Table 6 significance	64	60	60
Table 7 significance	64	64	64
Table 8 significance	64	13	13
Total significance	192	137	137
Average significance	64 (High)	45.6 (Moderate)	45.6 (Moderate)

Transmission line Alternative 4, a "greenfields" alignment that traverses the Percy Fyfe Nature Reserve, fared considerably worse on average (64) than Alternatives 5 and 6 (45.6). Both Alternatives 5 and 6 will follow existing power line infrastructure, but Alternative 4 will increase the length of the alignment by 2km.

The preferred development corridor for the proposed Mokopane substation to Witkop substation section of the Mokopane Integration Project is **Alternative 5**.

5.6. Other issues related to the visual impact of the proposed Mokopane Integration Project

Lighting impacts

The sites proposed for the placement of the Mokopane substation are all located in relative close proximity to sensitive visual receptors that may experience nighttime visual impacts in the form of sky glow or glare. Careful planning and sensitive placement of security and operational light fixtures for the substation, designed to contain rather than spread the light, is therefore imperative.

Potential visual impacts associated with the construction phase

The construction phase of the Mokopane Integration Project is approximated at three years for the substation and two years for the transmission lines. 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.

The potential to mitigate visual impacts

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 above the conventional self supporting strain towers that are more obtrusive.

Figure 24: Examples of monopole distribution power line towers.

The mitigation of secondary visual impacts, such as security and functional lighting, construction activities, etc. may be possible and should be implemented and maintained on an ongoing basis (see Chapter 7: Management Plan).

6. CONCLUSION

The construction of power line and substation infrastructure in natural areas with potential conflicting land uses will always be problematic from a visual impact point of view. 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.

The preferred transmission line alternatives for this project, Alternatives 2, 5 and 7 manage to avoid (or can avoid with minor deviations) the Waterberg plateau and escarpment as well as the protected areas (i.e. the Waterberg Biosphere Reserve and Bellevue Nature Reserve) along its respective alignments. It does however create a new transmission line 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 utilisation of existing servitudes (such as the existing Matimba-Witkop power lines) would have served the ideal of consolidating the linear power line infrastructure of the Mokopane Integration Project and concentrate the visual impact along one route. The appropriateness of the existing Matimba-Witkop power line alignment, especially where it traverses conservation land use areas and the escarpment, is debateable, and due to the inability to effectively utilise this corridor (see *5.4. Preferred transmission line alternative - Alternatives 1, 2 and 8*) it is not deemed to be a suitable development corridor.

Sub station Alternative 4 appears to be an acceptable site, from a visual impact perspective, for the construction and operation of the proposed Mokopane substation. Localised visual impacts may still occur, but are envisaged to be less significant than the potential visual impacts that may be encountered at site Alternatives 1 and 3.

7. MANAGEMENT PLAN

The management plan table aims to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts.

Table 13: Management plan - Mokopane substation

OBJECTIVE: The mitigation and possible negation of the additional visual impacts associated with the construction and operation of the Mokopane substation.	
Project component/s	Substation construction site and access roads.
Potential Impact	The potential scarring of the landscape due to the creation of new access roads/tracks or the unnecessary removal of vegetation causing the increased visual exposure of the substation to sensitive visual receptors.
Activity/risk source	The viewing of the substation and abovementioned visual scarring by observers (residents and road users) in the vicinity of the substation.
Mitigation: Target/Objective	Minimal disturbance to vegetation cover in close vicinity to the proposed substation site.

Mitigation: Action/control	Responsibility	Timeframe
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural and/or planted vegetation to the minimum.	Eskom/contractors.	During construction.
Limit access to the substation site (during both construction and operational phases) along existing access roads.	Eskom/contractors.	Construction/operational phases
Maintain the general appearance of the facility in an aesthetically pleasing way.	Eskom.	Operational phase

Performance Indicator	Vegetation cover that remains intact with no new access roads or erosion scarring in close proximity of the substation. The effective utilisation of existing vegetation cover to shield the substation from observers.
Monitoring	Monitoring of vegetation clearing during the construction phase.

Table 14: Management plan - Mokopane substation (lighting impacts)

OBJECTIVE: The mitigation and possible negation of the potential visual impact of lighting at the substation.	
Project component/s	Substation lighting fixtures.
Potential Impact	The potential nighttime visual impact of lighting fixtures on observers traveling along roads in the vicinity of the substation or on residents in close proximity to the substation.
Activity/risk source	The effects of sky glow and glare on motorist and observers.
Mitigation: Target/Objective	The containment of light emitted from the substation in order to eliminate the risk of additional nighttime visual impacts.

Mitigation: Action/control	Responsibility	Timeframe
Ensure that proper planning is undertaken regarding the placement of lighting structures and that light fixtures only illuminate areas inside the substation site. Undertake regular maintenance of light fixtures.	Eskom/lighting engineer.	Construction/operation.

Performance	The effective containment of the light to the substation site.

Indicator	
Monitoring	The monitoring of the condition and functioning of the light fixtures during the operational phase of the project.

Table 15: Management plan - 400kV transmission power lines

OBJECTIVE: The mitigation of potential visual impacts caused by the unnecessary removal (clearing) of vegetation cover for the power line servitude or the creation of new access roads during the construction phase.

Project component/s	Transmission line servitudes.
Potential Impact	The potential scarring of the landscape due to the creation of cleared cut-lines and new roads/tracks, especially where the servitudes traverse elevated topographical features with natural vegetation.
Activity/risk source	The viewing of the abovementioned cutlines/roads by observers.
Mitigation: Target/Objective	Minimal disturbance to vegetation cover in close vicinity of the proposed transmission lines.

Mitigation: Action/control	Responsibility	Timeframe
Avoid the unnecessary removal of vegetation for the power line servitudes and limit access to the servitude (during both construction and operational phases) along existing access roads.	Eskom	Construction/operation.
Utilise existing power line servitudes where possible.	Eskom	Construction/operation.

Performance Indicator	Vegetation cover that remains intact with no visible cutlines, access roads or erosion scarring in and around the power line servitudes.
Monitoring	The monitoring of vegetation clearing during the construction and operational phases of the project.

8. REFERENCES / DATA SOURCES

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