KOEBERG 2 INTEGRATION PROJECT

VISUAL IMPACT ASSESSMENT

REPORT 3 - LOOP-IN ACACIA-MULDERSVLEI LINE TO KOEBERG 2 AND ACACIA-MULDERSVLEI LINE TO OMEGA SUBSTATION

Produced for:
Eskom Holdings Limited

Transmission power lines near the new Omega Substation site

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Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant for the visual assessment. Neither the author, nor MetroGIS will benefit from the outcome of the project decision-making.

1. INTRODUCTION AND BACKGROUND

Eskom Holdings Limited intends to construct a new 400kV transmission power line between the HV-yard at the new Nuclear Power Station site (known as Koeberg 2) and the Acacia-Muldersvlei 400kV transmission power line and to loop-in the Acacia-Muldersvlei 400kV line into the Omega Substation. The loop-in line, linking the Omega Substation with the Acacia Substation, will require a relatively short (4.5km) section of additional power line to be constructed as it will utilise the existing power line from the loop-in point to the Acacia Substation (i.e. no new transmission lines will be constructed along this (Omega-Acacia) development corridor).

Figure 1: Location of the Acacia-Muldersvlei line to Koeberg 2 HV-yard 400kV transmission line and Acacia-Muldersvlei line to Omega Substation loop-in 400kV transmission line.

This forms part of a number of new transmission power lines Eskom intend to construct as part of the Koeberg Integration Project. The components (proposed transmission line development corridors) of this project are indicated on Figure 2 (Land Cover/Land Use Map).

The other Koeberg Integration Project components include the construction of three new 400kV transmission power lines between the HV-yard at the new Nuclear Power Station site and the Omega Substation (*see Visual Assessment Scoping Report 1*) and the construction of two new 400kV transmission power lines between the HV-yard at the new Nuclear Power Station site and the Stikland Substation (*see Visual Assessment Scoping Report 2*).

The study area for the Koeberg Integration Project covers an area of approximately 1 258km^2 in the Western Cape Province, including the Koeberg Nuclear Power Station in the north-western corner to Stellenbosch in the south-eastern corner.

The land uses within the study area, in terms of surface area, primarily consist of wheat and maize farming to the north and east of the study area. The overall study area for the Koeberg Integration Project includes a number of conservation or protected areas but these are relatively far (>5km) from the proposed loop-in line and can thus be considered to be largely unaffected by the development.

Some areas to the north-west of the study area are still in a natural state (undisturbed/untransformed) and are described as *Thicket, Bushland, Bush Clumps* and *High Fynbos*. Remnants of this land cover type, as well as *Shrubland and Low Fynbos* also occur as scattered patches across the rural parts of the study area.

The topography (see Figure 3) is described as predominantly *Plains* and *Moderately Undulating Plains and Hills*, with a number of *Low Mountains* (e.g. Koeberg Hill adjacent to the N7 national road.

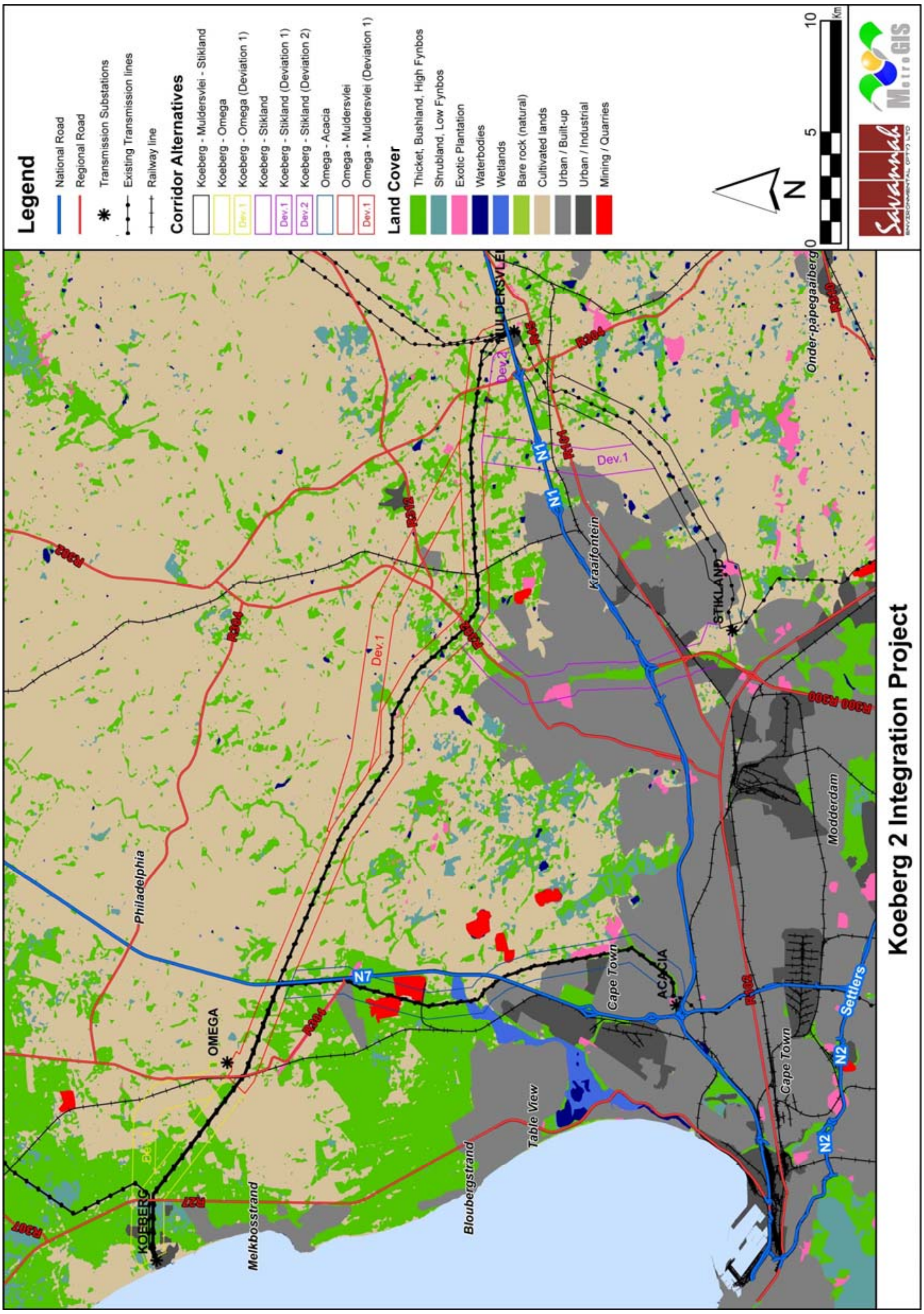

Figure 2: Land use/land cover map.

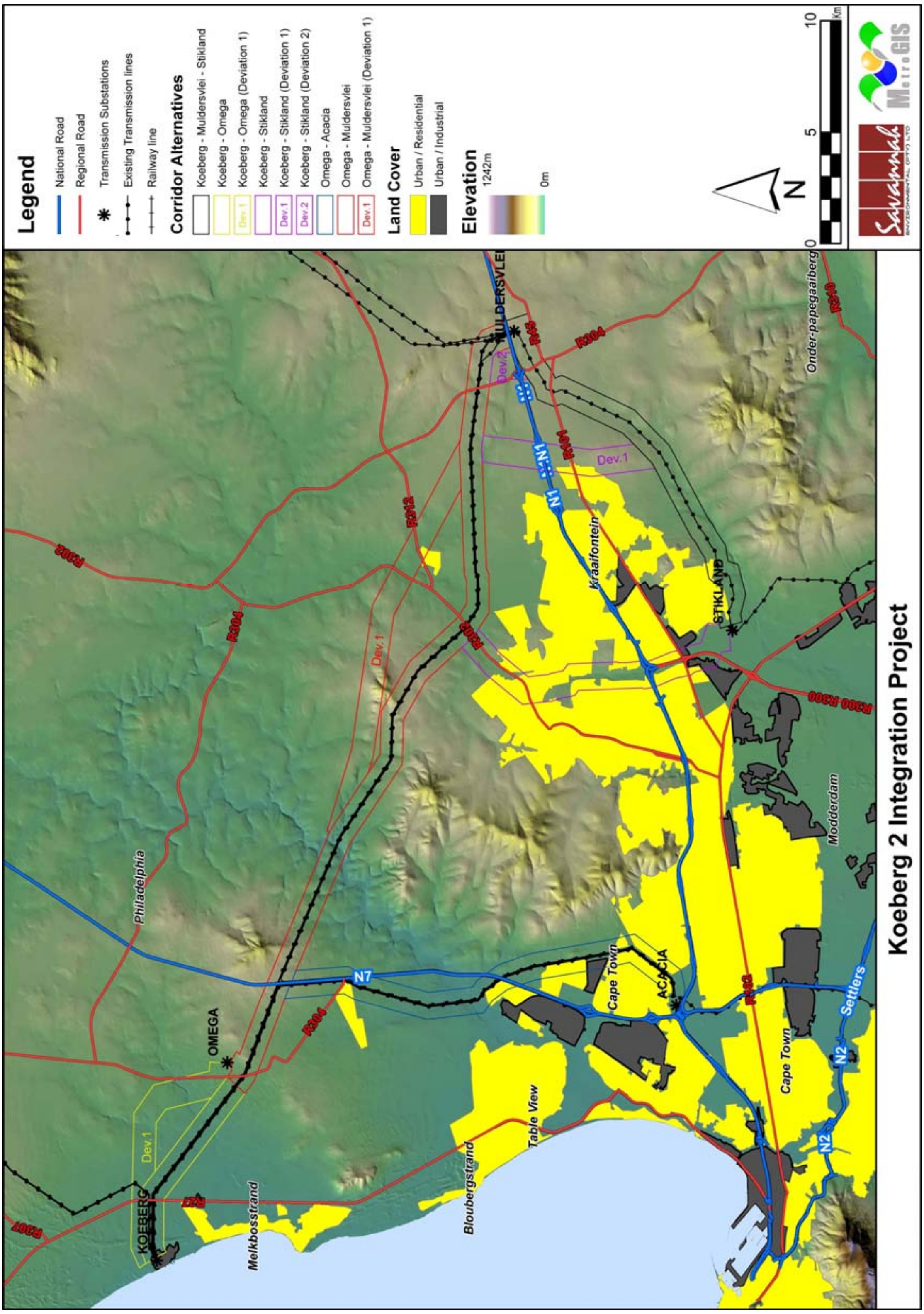

Figure 3: Shaded relief map indicating topography and elevation above sea level.

2. SCOPE OF WORK

The scope of work includes the determination of the potential visual impacts in terms of nature, extent, duration, magnitude, probability and significance of the construction and operation of the proposed infrastructure. In this regard specific issues related to the visual impact were identified during a site visit to the affected environment. Issues related to the proposed Koeberg-2 Integration Project include:

- Visual distance/observer proximity to the proposed infrastructure (apply the principle of reduced impact over distance)

- Viewer incidence/viewer perception (identify areas with high viewer incidence and negative viewer perception)

- Landscape character/land use character (identify conflict areas in terms of existing and proposed land use)

- Visually sensitive features (scenic features or attractions)

- General visual quality of the affected area

- Visual absorption capacity of the natural vegetation

- Potential mitigation measures

3. METHODOLOGY

3.1. General

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed infrastructure. A detailed Digital Terrain Model (DTM) for the study area was created from 5m interval contours supplied by the Surveyor General.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The methodology utilised to identify issues related to the visual impact included the following activities:

- The creation of a detailed digital terrain model of the potentially affected environment.

- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.

- The identification of sensitive environments upon which the proposed infrastructure could have a potential impact.

- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

- The creation of sensitivity analyses of areas surrounding the developments in order to identify potential conflicting land uses.

3.2. Potential visual exposure

The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed infrastructure, or evidence thereof, weren't visible, no impact would occur.

Viewshed analyses of the proposed infrastructure, based on a 5m contour interval digital terrain model of the study area, indicate the potential visual exposure (i.e. areas from where the infrastructure could theoretically be visible). The visibility analyses were undertaken at an offset of 35m (for the transmission line alternatives) in order to simulate a worst-case scenario. The viewshed analyses do not include the visual absorption capacity of natural vegetation in the study area. The visual absorption capacity of the vegetation is however addressed as a separate issue within this report and does form part of the visual impact assessment criteria.

Transmission Line – ACACIA Loop-in Line

The viewshed analysis of the proposed loop-in line is shown in Figures 4. The visibility of the transmission line towers were calculated at a maximum offset of 35m above ground level for a radius of 5km (i.e. the expected sphere of visual influence of the transmission line infrastructure). Viewshed analyses do not include the potential visual absorption effect of the natural vegetation or other structures and therefore signify a worst-case scenario in terms of visibility.

It becomes clear that the proposed transmission line infrastructure has the potential to be visually exposed to large areas. This is due mainly to the relatively tall (35m) transmission line towers associated with 400kV power linesand the predominantly flat topography of the area between the Omega Substation and the point where the Acacia-Omega transmission line turns southwards.

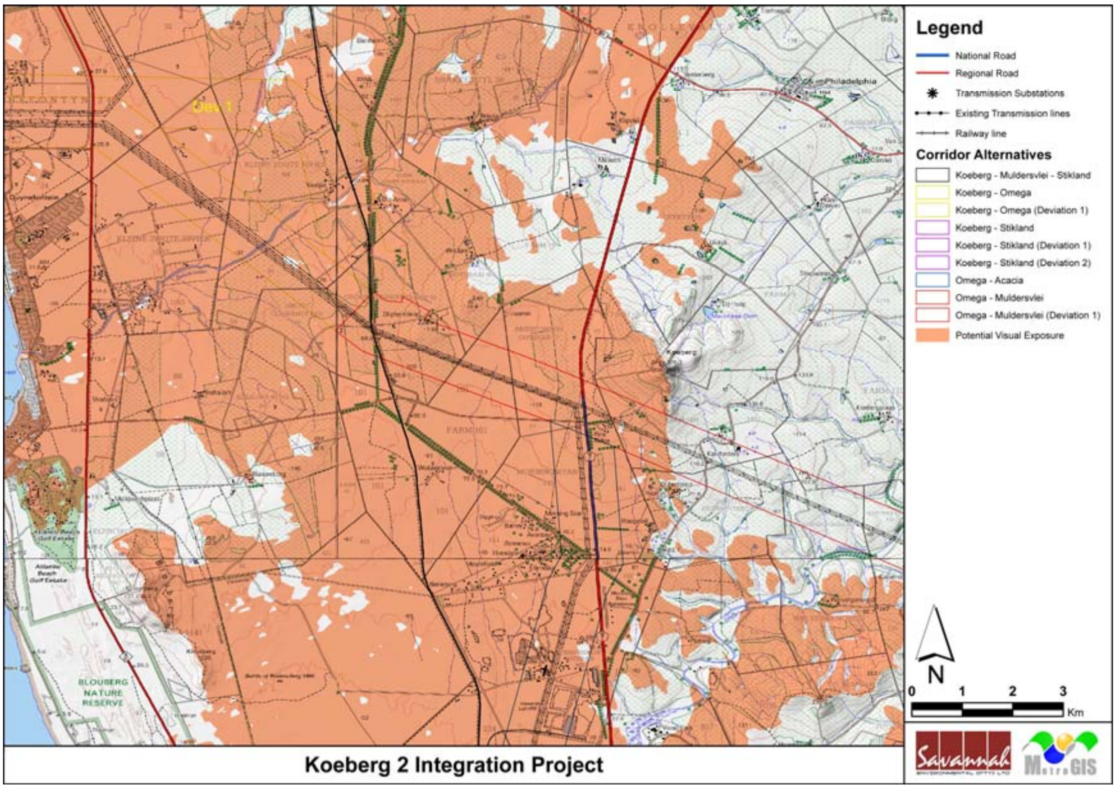

Figure 4: Potential visual exposure - proposed Omega turn-in line.

The construction of a new transmission power lines adjacent to the existing power line infrastructure already present (an existing vertical disturbance) is preferred, from a visual impact point of view, to the creation of a new ("green fields") development corridor. The utilisation of the existing power line corridor will aid in consolidating the potential visual impact of the proposed Koeberg 2 to Omega power lines, although it may contribute to the increase in cumulative visual impact of the existing lines. The utilisation of a proposed deviation route will spread the visual impact over a larger geographical area.

The preferred alternative is the Koeberg 2 to Omega Sub Station corridor and not the Deviation 1 alternative.

It must be borne in mind that the area of potential visual exposure is just one criteria related to the visual impact. It is important to assess the areas that will potentially be exposed to the infrastructure in terms of a number of additional criteria (e.g. the scenic quality of an area, potential conflicting land uses, the presence of sensitive visual receptors, potential cumulative visual impacts, etc.) that are discussed under the next heading.

3.3. Visual distance / observer proximity to the project infrastructure

The principle of reduced impact over distance is applied in order to determine the core area of visual influence for these types of structures. It is envisaged that the type of structures (transmission lines) and the predominantly undeveloped nature of the receiving environment could create a significant contrast.

The proximity radii for the proposed project infrastructure were created in order to indicate the scale and viewing distance of the structures and to determine the prominence of the structures in relation to their environment.

The proximity radii chosen, based on the dimensions (size) of the proposed project infrastructure, are:

- 0 - 500m. Short distance view where the project infrastructure would dominate the frame of vision and constitute a very high visual prominence.

- 500 - 1000m. Medium distance view where the structures would be easily and comfortable visible and constitute a high visual prominence.

- 1000 - 2000m. Medium to longer distance view where the structures would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.

- Greater than 2000m. Long distance view of the project infrastructure where the structures could potentially still be visible thought not as easily recognisable. This zone constitutes a medium to low visual prominence.

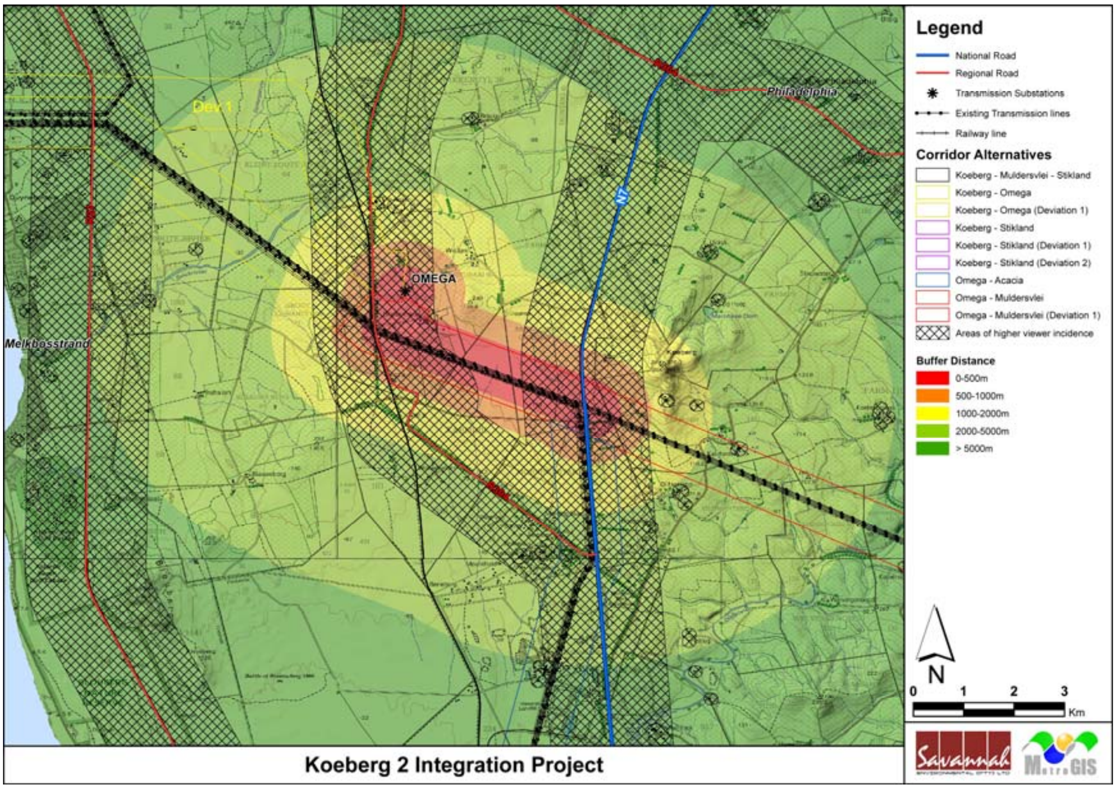

Figure 5: Observer proximity and viewer incidence of loop-in line.

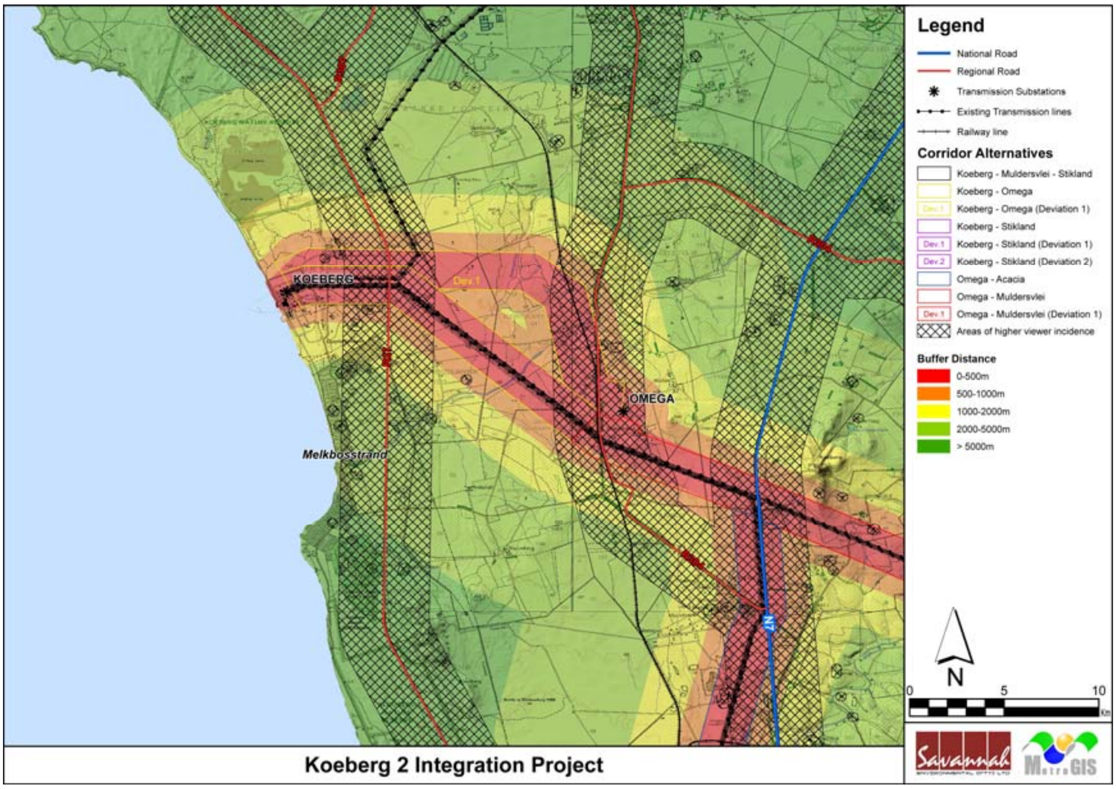

Figure 6: Observer proximity and viewer incidence of Koeberg-Omega lines.

The visual distance theory and the observer's proximity to the project infrastructure are closely related, and especially relevant, when considered from areas with a high viewer incidence and a predominantly negative visual perception of the proposed structures.

3.4. Viewer incidence / viewer perception

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.

It is necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the infrastructure associated with the proposed Koeberg Integration Project. It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; i.e. regularity of sighting, cultural background, state of mind, purpose of sighting, etc. which would create a myriad of options.

Four areas of higher viewer incidence and/or potentially negative viewer perception of the proposed project infrastructure were identified for the study area. The **first area** includes individual homesteads/farm residences scattered throughout the study area. The farms are not expected to contain a high viewer density.

Please consult the Public Participation Process (PPP) report for a comprehensive database of the consulted landowners.

The **second area** includes a 1000m buffer zone along the arterial/main roads (R27, R304, N7) 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 Figure 5.

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 are predominantly agricultural in function. 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 vegetation

It has become apparent from site inspections that the visual absorption capacity of the natural veld (thicket, bushland, bush clumps, high fynbos) is not particularly effective in mitigating the impact of the proposed project infrastructure. However, a significant extent of the land cover is classified as agricultural fields. While this land cover type does not generally contribute to visual absorption capacity, trees planted on the borders of these fields as windbreaks do offer intermittent screening of the proposed developments. The observer is also effectively shielded from the structures by dense vegetation adjacent to roads and in the vicinity of residences and lodges.

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.

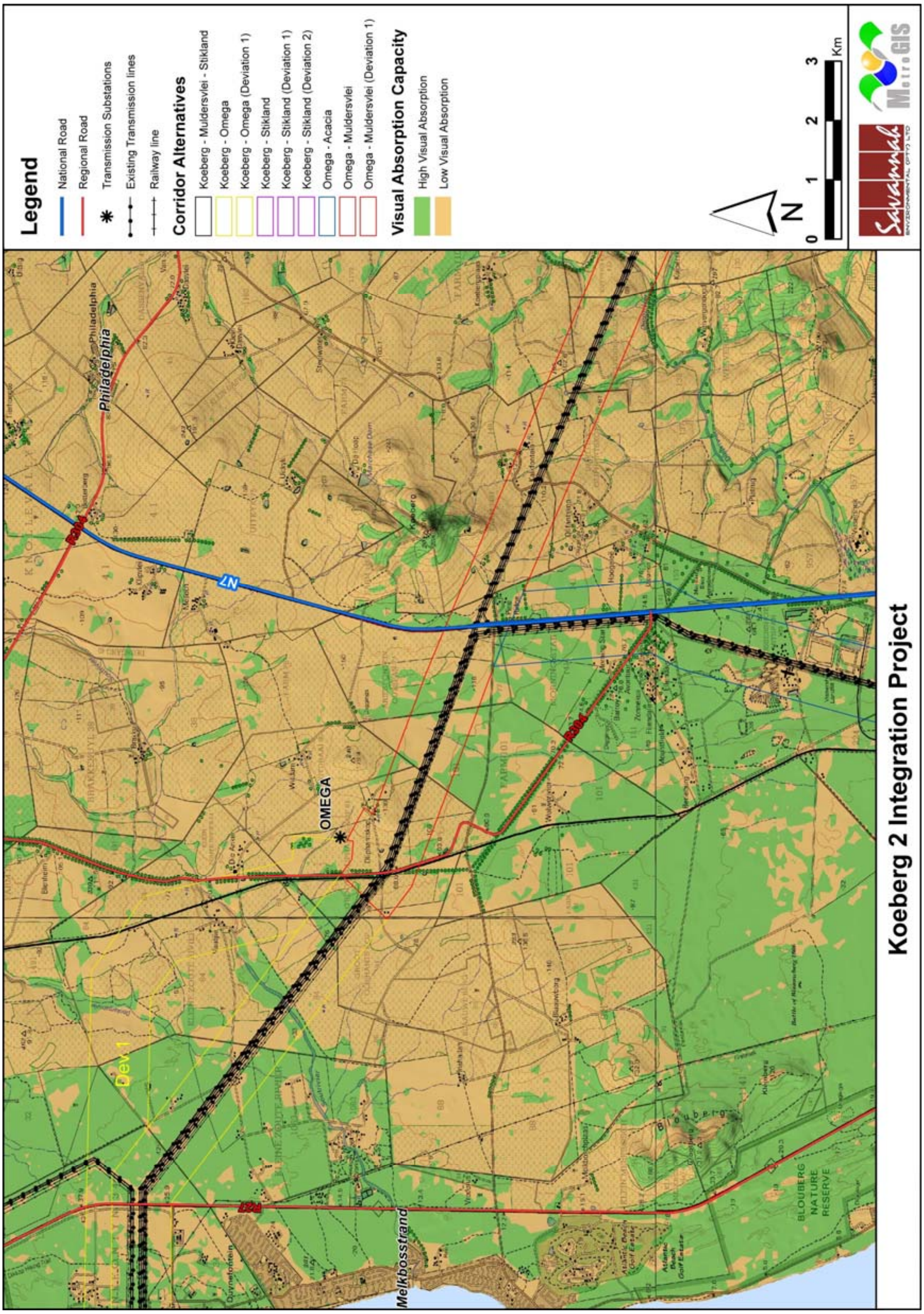

Figure 7: Visual absorption capacity (VAC) of the different vegetation types within the study area.

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 agricultural fields and some patches of natural fynbos (Thicket, Bushland, and High Fynbos).

The topography is described as predominantly *Plains* and *Moderately Undulating Plains and Hills*, with a number of *Low Mountains* (e.g. Koeberg Hill adjacent to the N7 national road). No prominent river valleys occur in the vicinity of the proposed development.

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 proposed transmission corridor alternatives are displayed on the following maps (Figures 8 and 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 helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

Visual impact index – Acacia-Muldersvlei to Omega loop-in line

The 4.5km transmission line has the potential to have a **moderate to high** visual impact on observers within a 500m buffer radius. The only discernable concentration of visual receptors is a cluster of farmsteads (Oliphantskop) immediately south east of the Omega Substation, and road users of the N7 and R304.

It is notable that almost the entire length of this option follows numerous existing power line servitudes and thus has the potential to consolidate the visual impact with existing impacts of a similar nature to one area, although this may also contribute to an increase in cumulative impact.

Visual impact index – Koeberg to Omega line

The transmission line Alternative 1 corridor has the potential to have a **moderate to high** visual impact. Only a few isolated pockets of observers in rural settlements and farmsteads within the 500m buffer radius can be considered to have a **very high** impact although the relative frequency of observers is expected to be low. The high-impact zone closer to the Omega substation crosses the R304, which presents an increased frequency of observers but at a low sensitivity (observers view the impact only briefly).

It is notable that the entire length of this option follows numerous existing servitudes and thus has the potential to consolidate the visual impact with existing impacts of a similar nature, although it may also contribute to the cumulative visual impact of the existing lines.

Visual impact index – Koeberg to Omega line deviation 1

The transmission line Alternative 2 corridor has the potential to have a **high** visual impact on observers within a 500m buffer radius along most of the length of the alignment. The impact east east of the R27 is likely to be similar to that of the primary alignment. Towards the east, however, a greater portion of its length falls within the 1km buffer of the R304 and thus presents a greater degree of visual impact.

It is important to note that the farmsteads and structures to the north and north-west of the Omega substation, namely those of Die Anker and Vaatjie respectively, would experience a new visual impact as the alignment does not follow existing servitudes.

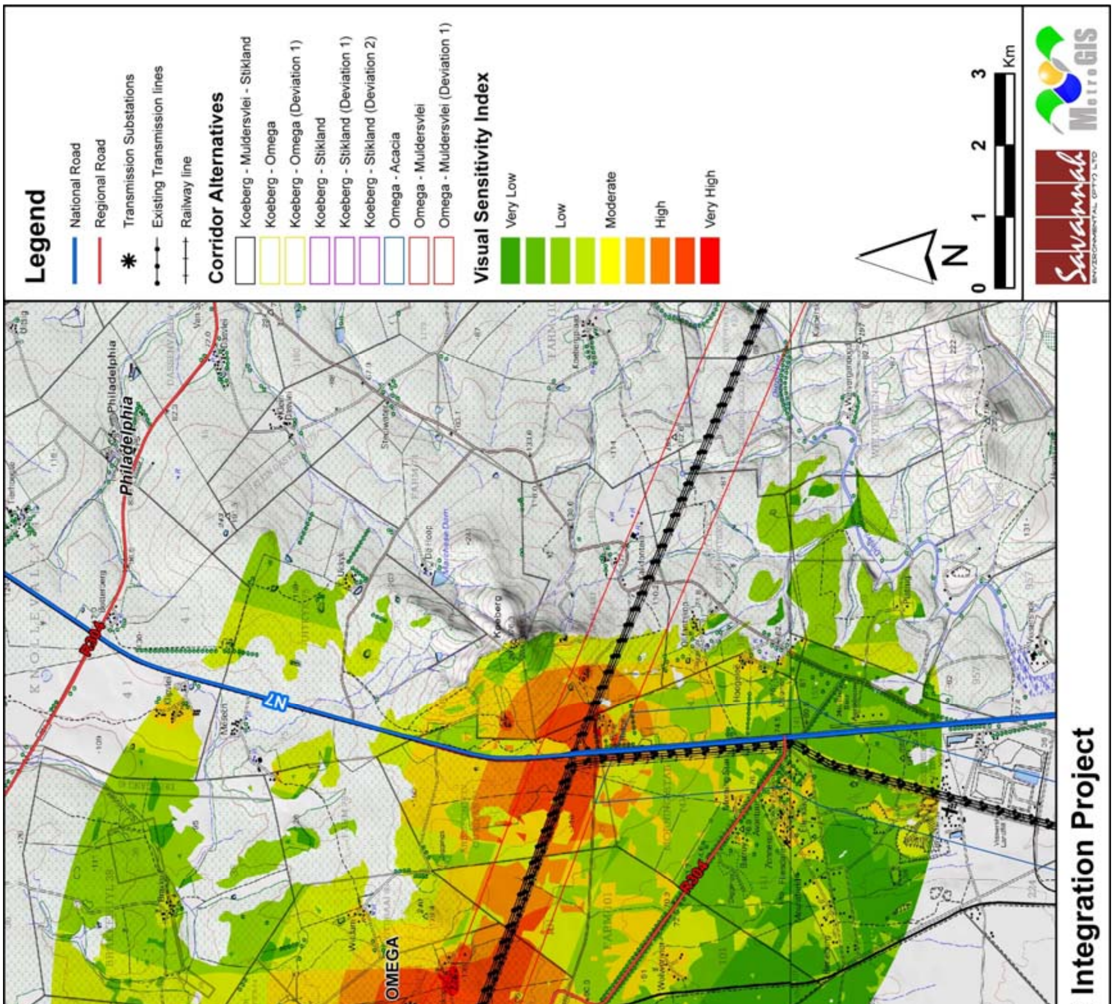

Figure 8: Visual impact index – Acacia-Omega loop-in line.

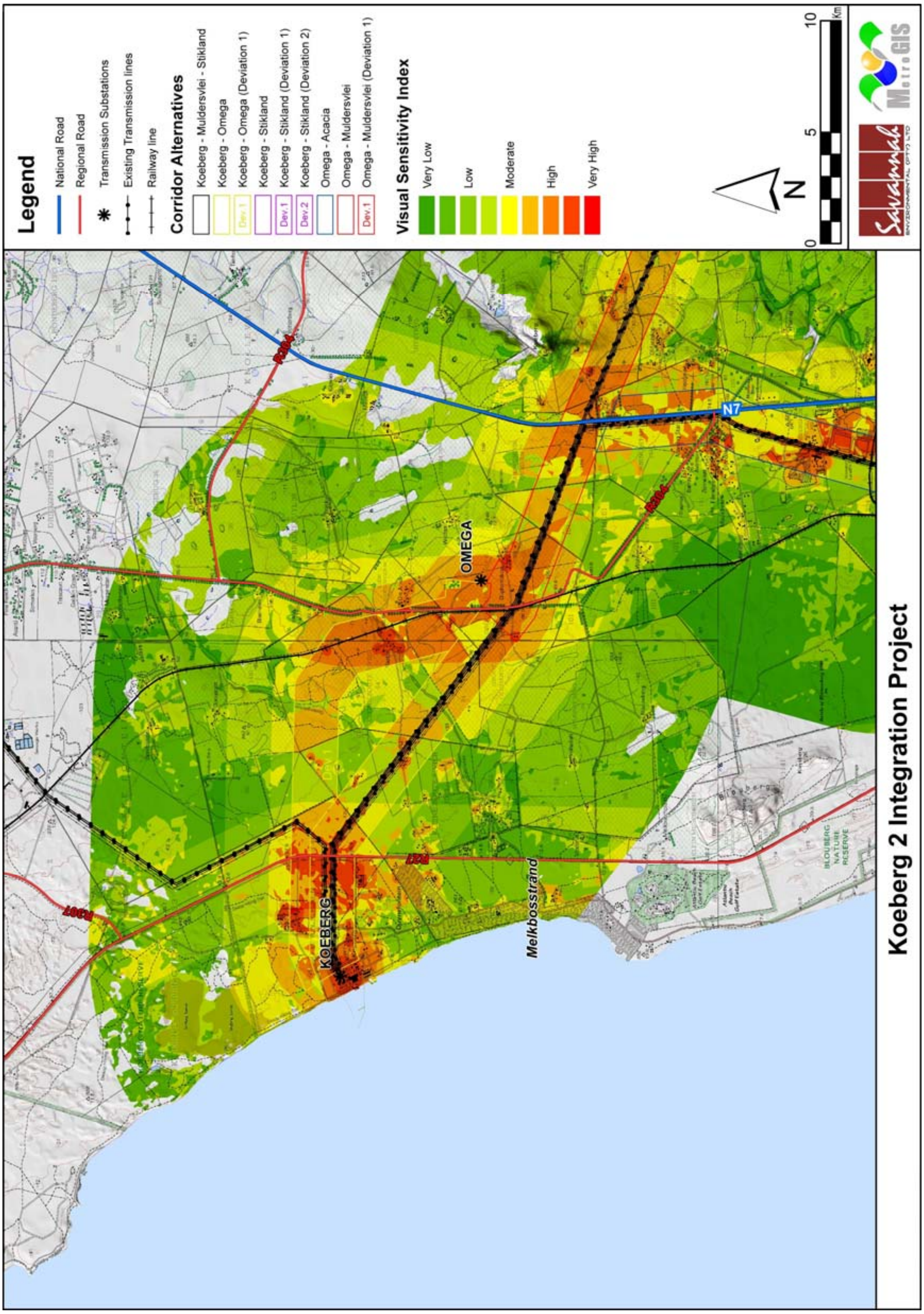

Figure 9: Visual impact index – Koeberg 2 to Omega transmission line alternatives.

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 loop-in line. 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.*

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 *residential areas* in the vicinity of the proposed transmission lines

Table 1: Impact table summarising the significance of visual impacts – residential areas

Nature of Impact: Potential visual impact on residents and visitors in close vicinity of the proposed transmission line/s.			
	Acacia-Muldersvlei to Omega loop-in line	**Koeberg-2 to Omega**	**Koeberg-2 to Omega deviation 1**

Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(2)**	Low **(2)**	Moderate **(3)**
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	Moderate **(52)**	Moderate **(52)**	Moderate **(56)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: N.A.			
Cumulative impacts: The placement of numerous power lines into one servitude can increase the potential cumulative visual impacts associated with existing power lines, especially at a local scale.			
Residual impacts: N.A.			

Potential visual impact on users of *main roads* in the vicinity of the proposed transmission lines

Table 2: Impact table summarising the significance of visual impacts – main roads

Nature of Impact: Potential visual impact on users of main roads (N7, R304, R27) in close vicinity of the proposed transmission line.			
	Acacia-Muldersvlei to Omega loop-in line	**Koeberg-2 to Omega**	**Koeberg-2 to Omega deviation 1**
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(2)**	Low **(2)**	Moderate **(3)**
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	Moderate **(52)**	Moderate **(52)**	Moderate **(56)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: N.A.			
Cumulative impacts: The placement of numerous power lines into one servitude can increase the potential cumulative visual impacts associated with existing power lines, especially at a local scale.			
Residual impacts: N.A.			

Potential visual impact on statutory (formal) conservation/protected areas of the proposed transmission lines

Only the Koeberg-Omega lines traverse the West Coast Biosphere Reserve and thus have an additional table of significance with regards to visual impact. The two alternative contact the West Coast Biosphere reserve in roughly the same place and in the same manner. Neither alternative contacts with core zones and both are within the buffer and transitional zones to an approximately equal degree.

Table 3: Impact table summarising the significance of visual impacts – conservation and protected areas

Nature of Impact: Potential visual impact on conservation and protected areas in close proximity of the proposed transmission lines.		
	Koeberg-2 to Omega	**Koeberg-2 to Omega deviation 1**
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(3)**	Moderate **(3)**
Probability	High probability **(4)**	High probability **(4)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Significance	Moderate **(56)**	Moderate **(56)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: N.A.		
Cumulative impacts: The placement of numerous power lines into one servitude can increase the potential cumulative visual impacts associated with existing power lines, especially at a local scale.		
Residual impacts: N.A.		

5.3. Preferred transmission line alternative

Table 4: Total significance of visual impacts – Koeberg-2 to Omega transmission lines

	Koeberg-2 to Omega	**Koeberg-2 to Omega deviation 1**
Table 1 significance	52	56
Table 2 significance	52	56
Table 3 significance	56	56
Total significance	160	168
Average significance	53.3 (Moderate)	56 (Moderate)

The above table indicates a marginal mathematical preference in favour of the primary alternative. This alternative is also the shorter of the two and has a high potential to consolidate the visual impact of linear infrastructure. However, the true benefit of consolidating the visual impact as a mitigation measure will only be achieved if the additional lines are placed directly parallel to the existing lines.

The construction of a new transmission power lines adjacent to the existing power line infrastructure already present (an existing vertical disturbance) is preferred, from a visual impact point of view, to the creation of a new ("green fields") development corridor. The utilisation of the existing power line corridor will aid in consolidating the potential visual impact of the proposed Koeberg 2 to Omega power lines, although it may contribute to the increase in cumulative visual impact of the existing lines. The utilisation of a proposed deviation route will spread the visual impact over a larger geographical area.

The primary alternative (**Koeberg-2 to Omega**) is therefore preferred above Deviation 1 as a transmission line development corridor for the Koeberg-2 Integration Project.

5.4. Other issues related to the visual impact of the proposed power line infrastructure

Potential visual impacts associated with the construction phase

The construction phase of the Koeberg Integration Project is 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 might frequent the roads 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 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 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 lines in natural areas with potential conflicting land uses will always be problematic from a visual impact point of view. The study area for the Acacia-Muldersvlei to Omega loop-in line of the Koeberg Integration Project covers mostly transformed agricultural lands but some pockets of fynbos are still in a natural state.

Almost the entire length of the loop-in line runs adjacent to existing transmission lines and thus consolidates the visual impact, although it may also contribute to the cumulative visual impact of the existing lines. Nevertheless, such impact consolidation is usually regarded as preferable to “greenfields” developments. The primary alignment for the Koeberg-Omega line is the preferred option for the same reason.

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 5: 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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CSIR/ARC, 2000. *National Land-cover Database 2000 (NLC 2000)*