B-V LINE

BRAAMHOEK TRANSMISSION INTEGRATION EIA

BRAAMHOEK-VENUS 400KV TRANSMISSION LINE

SCOPING REPORT

FINAL

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1. INTRODUCTION

In December 2002, the Department of Environment Affairs and Tourism (DEAT) awarded Eskom environmental authorisation for the construction of the Braamhoek Pumped Storage Scheme in the Drakensberg on the provincial border between the Free State and Kwa-Zulu Natal. A condition (no. 6.2.37) of the authorisation is that Eskom undertakes "a comprehensive Environmental Impact Assessment for all access roads and power lines that connects the scheme to the national transmission grid".

Eskom Transmission is tasked with connecting the scheme to the National Grid, and has assumed responsibility for the EIA for the power lines. The extent of the development to effect this connection includes:

- The construction of a 400kV Transmission Substation, to be called the Braamhoek Substation, near the scheme,
- Provide an initial connection to the National Grid via a 'turn-in' from the nearby Majuba-Venus #2 400kV Transmission line,
- Ensure the reliability of the network by linking Braamhoek Substation directly to the Venus Substation near Estcourt with a new 400kV Transmission line.

Location information and co-ordinates for all the main locations in this report are given in Appendix 1.

Following a Pre-feasibility Study completed in October 2004, applications for permission to undertake Environmental Impact Assessments (EIAs) were submitted to the Department of Environment Affairs and Tourism (DEAT) in November 2004. DEAT approval was granted for detailed Scoping Studies for each of the projects, and this report presents the findings of the Scoping Study for the Braamhoek-Venus 400kV Transmission Line. Separate reports are published for each of the three projects, but these need to be read in conjunction with the Public Participation Process report that covers all three projects.

A suite of reports are published in support of the Braamhoek Transmission Integration EIA:

- Braamhoek-Venus 400kV Line – Final Scoping Report *(This report)*
- Braamhoek Turn-in – Final Scoping Report
- Braamhoek Substation – Final Scoping Report
- Appendix A – Public Participation Process *(to be read in conjunction with all of the above)*

2. STUDY BACKGROUND

2.1. BRAAMHOEK PUMPED STORAGE SCHEME

Towards meeting predicted future electricity demand, Eskom is implementing its Integrated Electricity Plan (IEP) that considers combination of initiatives including:

- Demand side management – implementing energy saving measures and encouraging non-peak load use where possible in domestic, commercial and industrial sectors.
- Increasing base-load capacity - bringing previously mothballed power stations back into operation and the development of new base-load (= continuous load) power stations (hydro-power, coal and gas fired, nuclear power).
- Increasing peaking capacity – provision of generation capacity that can be 'turned-on and switched-off' at short notice to meet daily peak loads. These include combined-cycle gas turbines and pumped storage hydro schemes, such as the Braamhoek Pumped Storage Scheme (PSS).

It is understood that over the last two decades Eskom has investigated close to 90 possible pumped storage scheme sites across the country, including over 20 in Kwa-Zulu Natal. Between 1989 and 1995 a shortlist of sites was drawn up, including the Braamhoek PSS site. It was subsequently selected for implementation and an EIA was undertaken. Depending on peak demand capacity requirements, other sites may also be identified for development in the future. As mentioned above, environmental authorisation and Record of Decision (RoD) for the Braamhoek PSS was issued in December 2002.

It is clearly necessary for the Braamhoek PSS to be connected to the National Grid, and as such the 'need and desirability' of the three Transmission projects associated with the Braamhoek PSS is not questioned further. It has been noted during the public consultation process on this study that there has been considerable debate surrounding the Braamhoek PSS. **It is important to note here, therefore, that it is not within the focus of this EIA to question the need for the Braamhoek PSS nor its environmental authorisation**.

Instead, it is necessary to review the manner in which the Braamhoek will be connected to the National Grid, and the following sections set out the Transmission project proposals, and a Pre-feasibility study that was undertaken.

2.2. TIMEFRAMES

Based on the latest growth predictions, it is expected that power from Braamhoek PSS will be required by 2012. It is expected that the first unit of the scheme will be commissioned in 2011. The next three units will be commissioned every three months thereafter, with the last unit being commissioned in 2012. In order to meet this commissioning date, the design of the scheme commenced in 2004 and construction must begin in 2007.

The given timeframe for starting the construction of the Transmission infrastructure is 2007.

2.3. TRANSMISSION PROJECT PROPOSALS

The new power station will require two connections to the National Grid to provide the necessary reliability of supply. The three main elements required to achieve this are:

a) A new substation at the power station site = the Braamhoek Substation
b) Two independent links to the Transmission network (=National Grid). These could either be achieved by 'turn-ins' from existing lines, or by new lines connecting to nearby Transmission substations.

Appendix 3 presents an Eskom statement on the need for the 400kV Transmission lines to the National Grid. Two options for connecting to the grid are proposed, and these became the focus of a pre-feasibility study prior to the start of this EIA (see next section). It is understood that Eskom considered some 20 different options before arriving at the two options given in Appendix 3. These included different combinations of turn-ins and new lines within the existing Transmission Grid shown below.

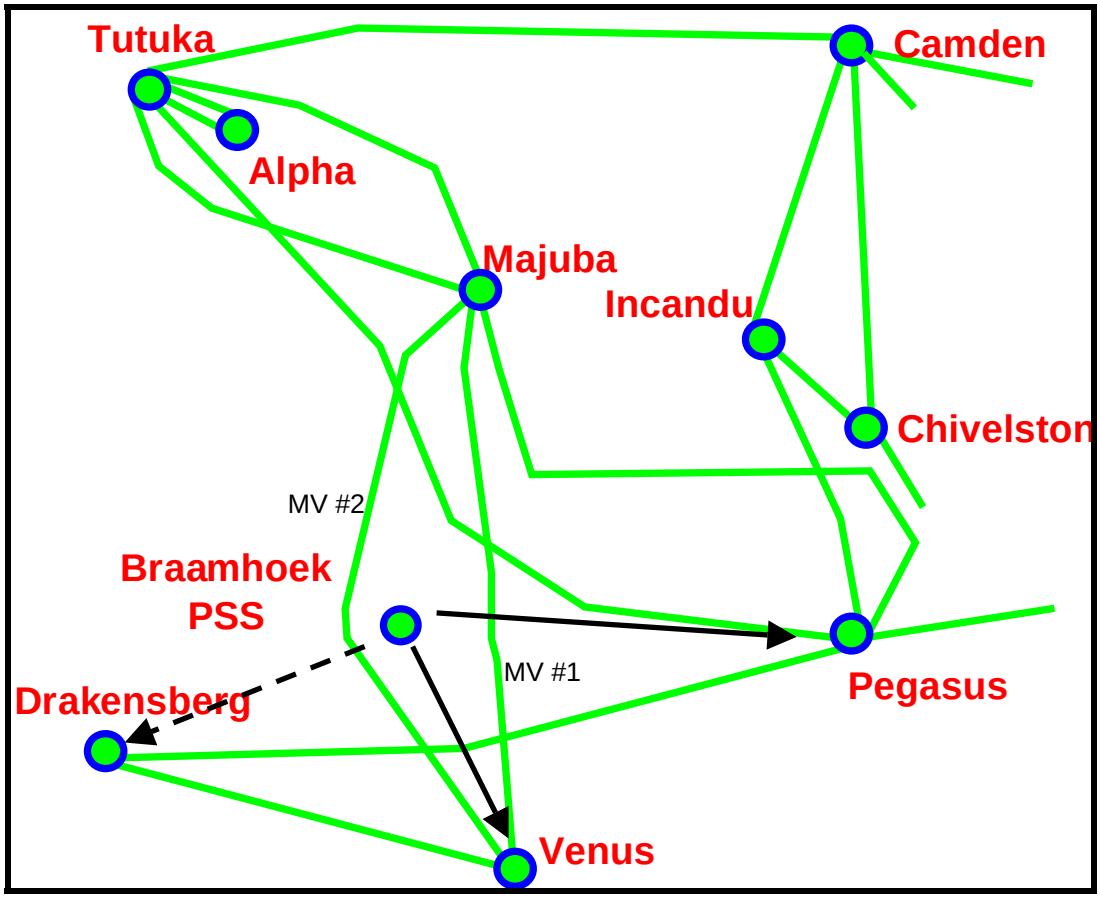


Figure 1: Location of Braamhoek PSS within the Transmission Grid

The two nearest 400kV Transmission lines that may be turned in to the Braamhoek substation are the Majuba-Venus #1 and Majuba-Venus #2 lines (MV #1 and MV #2 lines in Figure 1). The nearest point to the MV #1 line is 25km, while MV#2 is some 10km from Braamhoek. For

reasons of network stability only one of these may be considered for turning in to Braamhoek, and the shorter of the two has clear preference in this instance.

There are also three Transmission substations to connect to; Drakensberg, Venus and Pegasus, and are each a similar distance from Braamhoek at around 80km. However, Drakensberg Substation will require a substantial upgrade, making it considerably more expensive than the other two. Technical analysis of Venus and Pegasus showed both to have very similar electrical performance, and it was left to environmental considerations to determine which would be the preferred option. As a result, Eskom commissioned a pre-feasibility study on these two options prior to the start of the EIA, the outcome of which is summarised in the next section.

Therefore, prior to the pre-feasibility study, the three Transmission projects identified for the connection of the Braamhoek PSS to the Transmission Grid were:

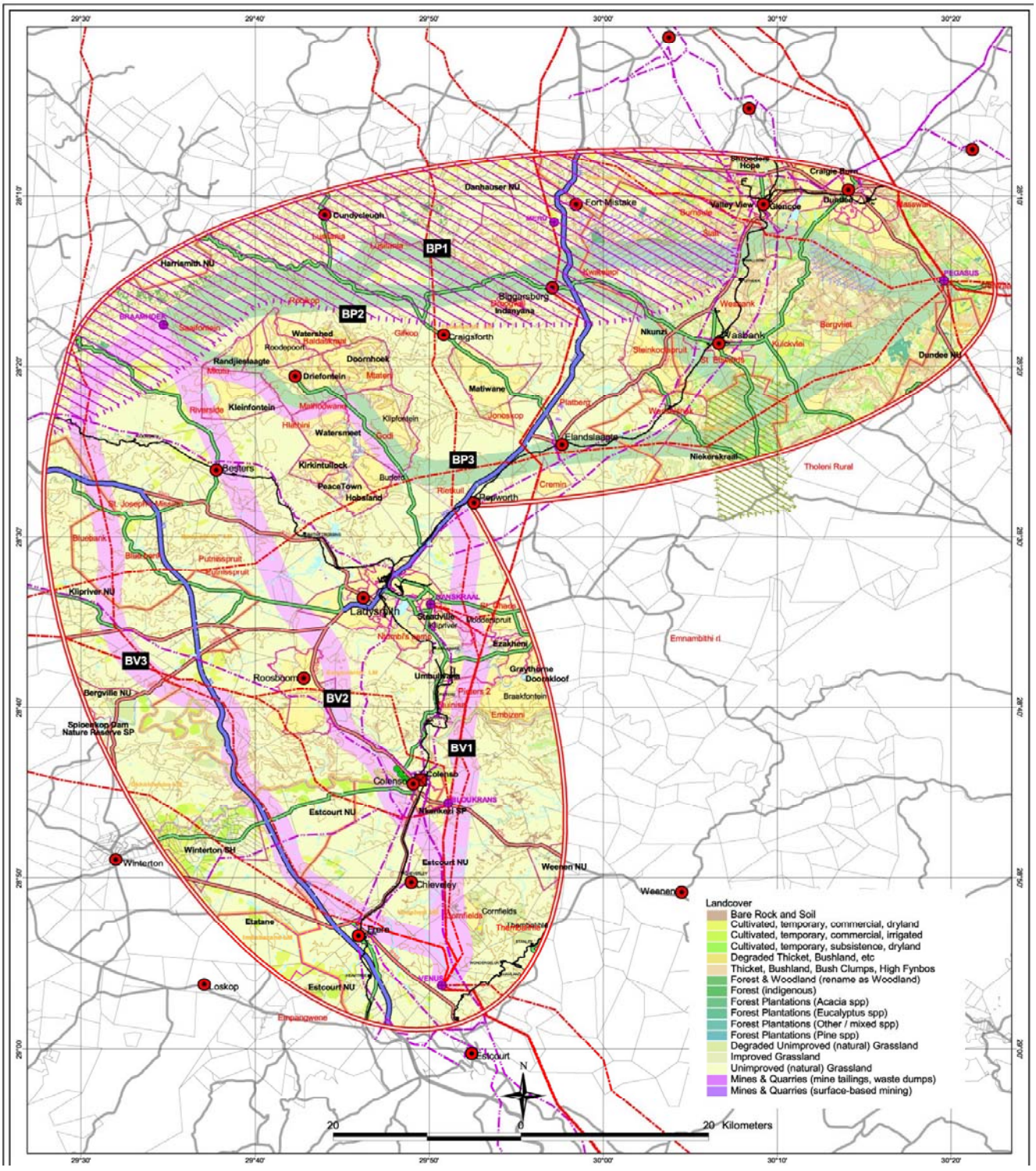
a) Braamhoek Substation
b) Turn-in from the Majuba-Venus #2 400kV Transmission line
c) A new 400kV Transmission line linking Braamhoek Substation to either Pegasus or Venus Substations

2.4. PRE-FEASIBILITY STUDY: BRAAMHOEK-PEGASUS OR BRAAMHOEK-VENUS?

To address item (c) above, Eskom commissioned a team of independent specialists to undertake a pre-feasibility study. The aim of the study was to establish whether it is possible to establish a clear preference for either the Braamhoek-Pegasus or Braamhoek-Venus study areas. The Pre-feasibility Study Report, dated October 2004, was submitted to DEAT and the DAEA as part of the EIA study application.

A study area around each direct route for each option was set out and is shown in the map below. A summary of the findings is given in the table below below. An indication of whether a clear preference is seen in each case. The implication is that where the 'Clear preference = No' there is similar potential in both study areas for that specialist issue.

	Environmental Issue	Preferred Option	Clear preference?
1	Economic	Braamhoek-Venus	No
2	Social	Braamhoek-Venus	No
3	Visual	Braamhoek-Venus	Yes
4	Natural environment	Braamhoek-Venus	Yes
5	Cultural and archaeological heritage	Braamhoek-Venus	Yes
6	Avifauna	Braamhoek-Venus	Yes
7	Construction	Braamhoek-Venus	Yes
8	Technical	Braamhoek-Venus	Yes
9	Cost	Braamhoek-Venus	Yes


BP1
BP2
BP3
BV1
BV2
BV3
Landcover
Bare Rock and Soil
Cultivated, temporary, commercial, dryland
Cultivated, temporary, commercial, irrigated
Cultivated, temporary, subsistence, dryland
Degraded Thicket, Bushland, etc
Thicket, Bushland, Bush Clumps, High Fynbos
Forest & Woodland (rename as Woodland)
Forest (indigenous)
Forest Plantations (Acacia spp)
Forest Plantations (Eucalyptus spp)
Forest Plantations (Other / mixed spp)
Forest Plantations (Pine spp)
Degraded Unimproved (natural) Grassland
Improved Grassland
Unimproved (natural) Grassland
Mines & Quarries (mine tailings, waste dumps)
Mines & Quarries (surface-based mining)
20 0 20 Kilometers
N

From both the economic and social perspectives, the potential impacts in the two study areas appeared similar. In both areas agriculture and eco-tourism would be similarly affected, and there is seen to be a similar risk of relocation of homesteads and dwellings. However, the greater extent of linear development (roads, rail and power lines) in the Braamhoek-Venus area offered greater opportunity to minimise these impacts. Hence this option was given the preferential edge.

In all other cases the preference for the Braamhoek-Venus option was stated with more confidence. The natural environment is more diverse and generally less disturbed along the Braamhoek-Pegasus area and therefore more difficult to mitigate. There is a greater area of wetlands and high altitude grasslands that are both sensitive in themselves and are valuable crane, secretary bird and bustard bird habitats; all these birds being particularly vulnerable to collisions with power lines. There is a very strong preference for the Braamhoek-Venus option in this regard.

The landscape of the Braamhoek-Venus area was seen to have a greater ability to absorb the visual intrusion of a new 400kV Transmission line. Again, here the existence of existing linear infrastructure is a significant factor in this aspect, but the relief of the area and nature of the landuse also contribute to this assessment. By contrast, the northern areas of the Braamhoek-Pegasus study area is considered a 'no-go' from a visual impact perspective.

The cultural and archaeological heritage is similar in both areas – for example the battle field sites, stone and iron-age sites. However, the landscapes of the Braamhoek-Pegasus area are considered to have important cultural heritage value, especially in the northern areas. Thus this assessment is closely associated with the visual impact assessment, and once again the greater occurrence of linear infrastructure in the Braamhoek-Venus study area was seen to give much greater opportunity to minimise the impacts in this issue.

The terrain and access makes the Braamhoek-Venus option a clear preference to the Braamhoek-Pegasus option. Technical issues are likely to be simpler, less expensive, and the likely environmental impact of construction are expected to be easier to manage and minimise.

It is fair to point out that the southern half of the Braamhoek-Pegasus area is similar in many respects to the environmental sensitivities of the Braamhoek-Venus area. However, preference remained with the Braamhoek-Venus area as having greater opportunity to minimise impacts and therefore a lower risk of long deviations. It was anticipated that an acceptable route through Braamhoek-Pegasus would be more than 10% longer than an equivalent line in Braamhoek-Venus.

Concluding Remarks

- There are no 'fatal flaws' in either study area that will effectively rule-out the entire study area.
- However, there is consensus among all the specialists that the Braamhoek-Venus option offers more opportunity for a new line with a lower environmental impact than the Braamhoek-Pegasus option.

- Furthermore, there are sufficient environmental concerns in the Braamhoek-Pegasus option that there is generally a strong view among the study team that the Braamhoek-Venus has clear preference for further environmental investigation.

2.5. VACANT SERVITUDES PARALLEL TO EXISTING LINES

In addition to the above, it became known at the end of the pre-feasibility study that both the Majuba-Venus #1 and #2 lines have vacant servitudes running parallel to the existing lines (on Majuba-Venus #2 the last 7km to Venus will require a new servitude). Though it is understood that these servitudes will need to be widened by up to 20m for a new 400kV line, their existence placed additional emphasis on the preference for the Braamhoek-Venus study area.

Though not a given condition, it is common for many of the environmental impacts of power lines to be minimised by running the new line immediately parallel to existing lines of similar magnitude. Such environmental issues include:

- Access – this is usually already established and would be used for the construction and operation of the new line, thereby minimising the need for new access roads,
- Visual – the added visual impact is usually less than for a new route,
- Birds – the increased risk of collision is much less than on new line on a new route,
- Erosion – there should be minimal additional disturbance, and there is the possibility of rehabilitating of existing problems,
- Relocations – are usually much less, and should be none if a vacant servitude exists
- Landuse planning – new land development or improvement plans should have already accounted for the vacant servitude and the associated possibility of a new line at some stage in the future.

It will be necessary for the EIA to establish whether these conditions apply in the cases of the Majuba-Venus #1 or #2 lines and associated vacant servitudes. However, given the circumstances above, an EIA study strategy was drafted for consideration by Eskom and the environmental authorities. The strategy is set out in Section 4.

2.6. FINAL TRANSMISSION PROJECT PROPOSALS

Following the pre-feasibility study, the development proposals were refined as follows:

a) Braamhoek Substation
b) Turn-in from the Majuba-Venus #2 400kV Transmission line
c) New Braamhoek-Venus 400kVTransmission line

The study area is presented in Map 1 (Appendix 1).

3. TECHNICAL DETAILS OF THE PROPOSED INFRASTRUCTURE

3.1. 400kV TRANSMISSION LINES AND TURN-INS

The proposed line, pylon type and servitude details are as follows:

- 400kV overhead Transmission line
- Pylon construction will typically be cross-rope suspension design, 35 – 40m high (Figure 2a), or a compact cross-rope suspension design (see Figure 2c below) of similar dimensions.
- Strain towers may be required on difficult terrain and on bends greater than 3° (Figure 2b),
- Single-pole lattice structures with anchor guys may also be used on bends as appropriate. These are much less visually intrusive and are cheaper than conventional strain towers (Figure 3).
- Conductor ground clearance between towers is 8.1m
- Maximum operational height under conductors of 4.0m
- Servitude width 55m (27.5m either side of centre line). It is to be noted that the anchor cables for cross rope towers usually fall outside the 55m servitude width.

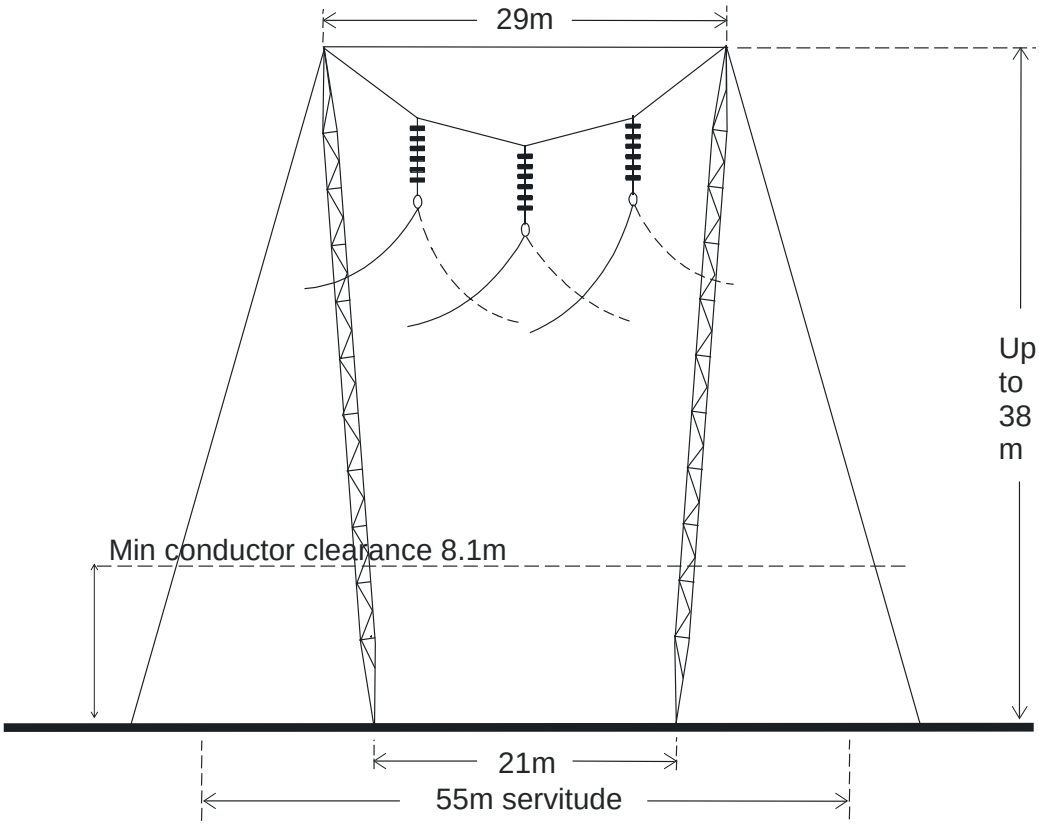


Figure 2a: Typical form of a Cross-rope Suspension Tower.

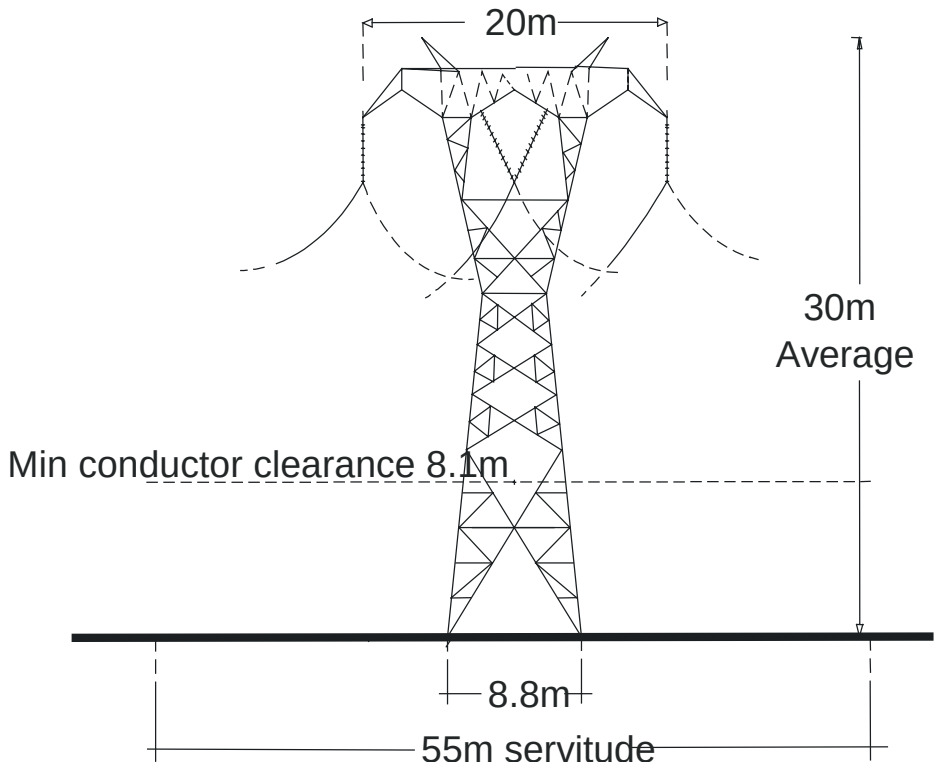


Figure 2b: Typical form of a Strain Tower

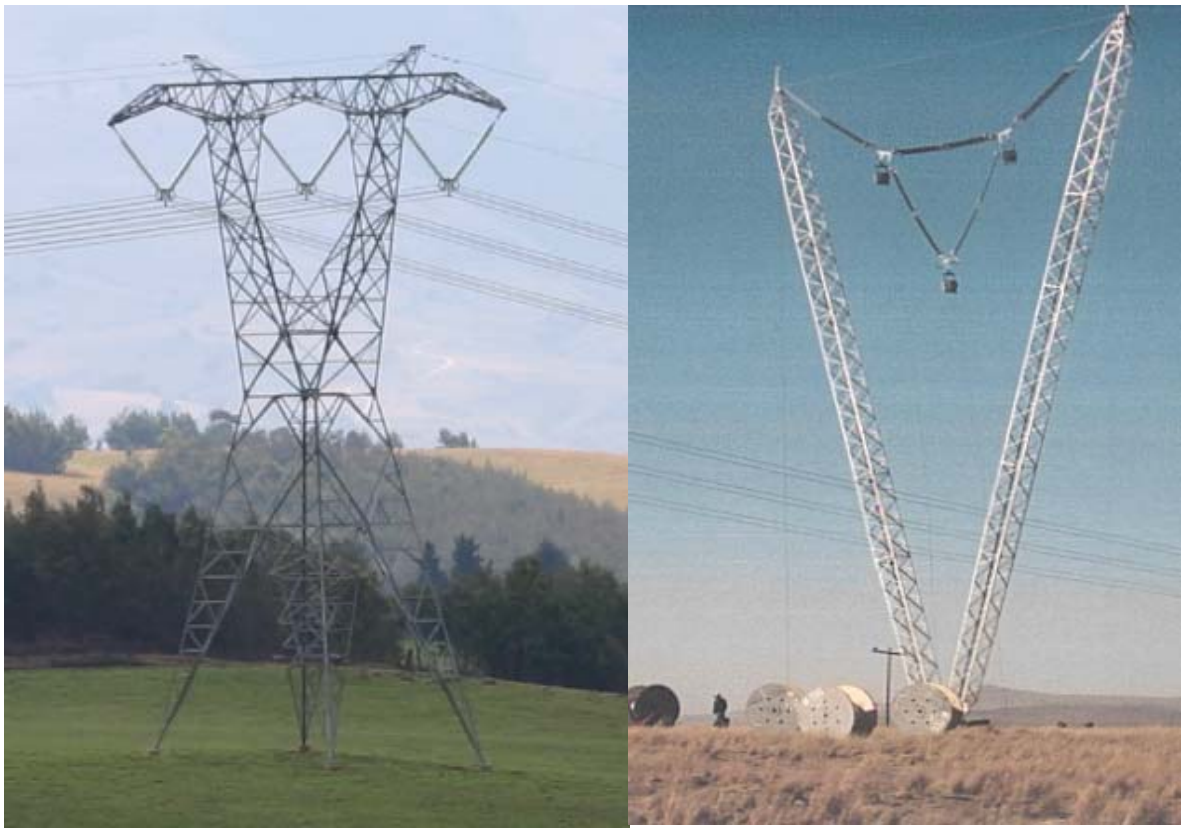


Figure 2c: Examples of both strain tower and compact cross rope suspension tower types

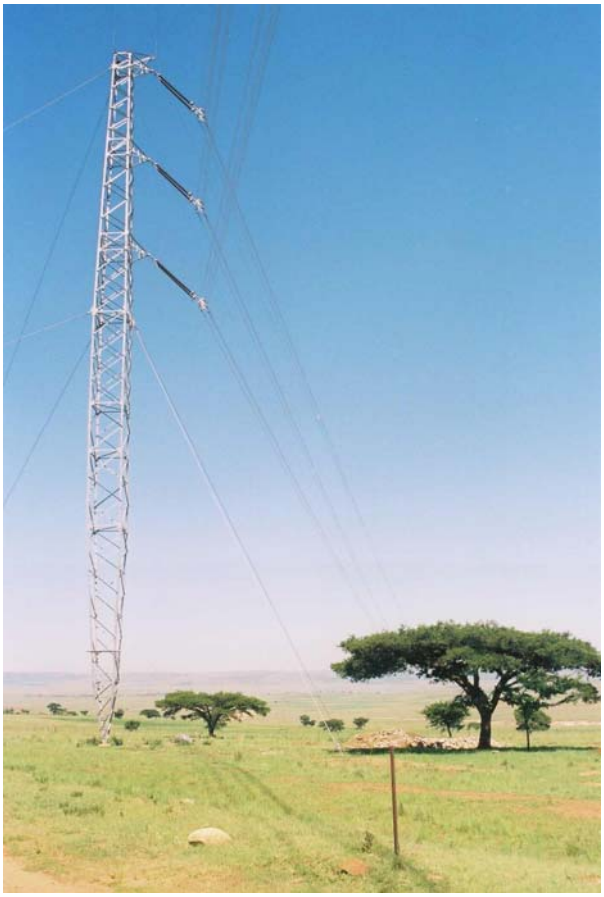


Figure 3: Example of a single pole steel lattice pylon

4. PROPOSED STUDY APPROACH

Due to the unusual circumstances pertaining to these projects, in particular the existing servitudes along the Majuba-Venus #1 and #2 400kV Transmission lines, and the location of the Braamhoek substation on ground that will have already been disturbed and used during the construction of the power station, it was considered reasonable to undertake a detailed Scoping Study for each of the three projects in the study. The Pre-feasibility Study Report was submitted to DEAT and the DAEA-KZN at the Pre-application Meeting and it was agreed to proceed on this basis. The application forms and Plan of Study were therefore prepared and submitted describing this approach, and these were approved by DEAT and the DAEA-KZN.

4.1. BRAAMHOEK-VENUS 400KV TRANSMISSION LINE

Three route alternatives have been considered for the new 400kV line connecting Braamhoek to an existing Transmission substation:

- Running parallel to Majuba-Venus #1 along the eastern side of the study area,
- Running parallel to Majuba-Venus #2 along the western side of the study area,
- Following a middle route between the first two.

Given that there are two vacant servitudes on the Majuba-Venus #1 and #2 lines, for the reasons given in Section 2.5 these options already have significant environmental advantages

over a new route through the area. Nevertheless, a middle route was identified during the pre-feasibility study and further refined after stakeholder consultation and specialist investigation, and this option has been addressed in the Scoping Study.

At the pre-feasibility stage there were already important differences between the options:

- Following the Majuba-Venus #1 line would still require the new line to divert across 'new' ground for a considerable distance, either through the settlements of Driefontein, Peace Town and Watersmeet (approximately 38km of new line) or around the western side of these areas (approximately 45km of new line).
- Following a middle route between Venus and Braamhoek would cross large irrigation lands near Colenso and would then have to divert around the new Qedusizi Dam that lies to the west of Ladysmith. This diversion would bring it closer to the Majuba-Venus #1 or #2 options depending on whether it runs east or west of the dam and it would therefore be best following either of these routes from that point on to Braamhoek. In this event it is seen to be preferable to follow either Majuba-Venus #1 or #2 from the start and avoid the middle route altogether. Nevertheless, this option has been considered in the Scoping Study in the event there are problematic areas on the other two options.
- Following the Majuba-Venus #2 line had the advantage of being the second shortest line (Western Route 94km, Middle Route 86km[1], Eastern Route 104km) has a vacant servitude for the greater part of the route, and would run parallel to other 400kV lines for the entire route (ie it would run parallel to the Majuba-Venus #2 Turn-in). It was also known there were concerns of bird interactions with the Western Route, and that other environmental aspects needed to be considered. Nevertheless, at the start of the study this option was seen to offer the potential for the least environmental impact.

4.2. PUBLIC PARTICIPATION

A comprehensive public participation programme has been undertaken in this study. It has been structured to encompass all four projects (including the access roads EIA) that are related to the Braamhoek P.S.S. This was thought to be a better process from the public's perspective in that they would not have to participate in two or more consultation programmes and that all issues raised could be collated into one report. Thus a separate report on the public participation process is published in support of this Scoping Report on the Braamhoek Substation. This is entitled *Appendix A – Public Participation Process*.

[1] The Middle Route assumes a direct crossing of the Quedusizi Dam, a span of over 2km at given full supply level. A span of this distance is not feasible, and a diversion of the line around the dam would be required. Though this was not investigated further in the study, any diversion would extend the distance quoted above.

5. DESCRIPTION OF THE STUDY AREA

The alignment of this option is approximately north-south from Braamhoek. The main towns in the area are Ladysmith, Colenso and Frere, and the settlements of Driefontein, Watersmeet, Peace Town to the north of Ladysmith, and Roosboom just northwest of Colenso, and Cornfields and Thembalihle northeast of Estcourt. Estcourt is just south of the study area. (See Map 1).

The Braamhoek – Venus zone lies in the in the Uthukela District Council and covers a number of municipal areas:

Umtshezi Local Municipality (Estcourt) - KZ234
Emnambithi Municipality (Ladysmith) – KZ232
Imbabazane Municipality – KZ236
Okhahlamba Municipality – KZ235
Indaka Municipality – KZ233

Until the late 1980's, the towns of Estcourt, Colenso and Ladysmith were on the main road route between Durban and Johannesburg and the passing trade was seen as an important element of their local economies. With the construction of the new N3 National Road this trade has been markedly reduced. As a result, in the published IDPs for these municipalities attention is given to the development of eco-tourism (mainly in neighbouring areas) to regenerate this element of the local economy. Visitors to the recently declared World Heritage Site of Ukhahlamba-Drakensberg to the west along the Lesotho border, and the Battlefields sites around Colenso, Ladysmith and Dundee are seen to be among the main opportunities. The IDPs for Umtshezi and Emnambithi Municipalities do not identify specific eco-tourism opportunities in the study area, though some potential is seen to exist in the north around Braamhoek and along the Tugela River valley that bisects the study area.

While the ecology of the area is generally seen to be disturbed by agriculture and land development, there are still important grasslands (mainly in the central areas), woodland bushveld (mainly in the western areas) and wetlands (mainly in the northern areas, see Map 2). However, with the exception of the wetland areas, these environments are seen to be fairly robust, with good chances of recovery after disturbances if these are properly managed.

Arable agriculture is more prevalent in the middle and southern parts of the study area, with active irrigation along many of the main watercourses (Bushmans, Tugela, Sand/Kliprivier). These include centre-pivot and dragline systems. (see Map 2.1).

Linear infrastructure is prevalent in the Braamhoek-Venus area (Map 1). The N3 National Road runs through the western sections of the area, and the planned De Beers Pass route of the N3 is proposed to pass close to the site of the Braamhoek Pumped Storage Scheme. Other major roads include the N11 (Ladysmith – Newcastle) and R103 (Estcourt – Colenso – Ladysmith). Both Transmission and Distribution lines are present, including:

Majuba-Venus #1 400kV line (running just east of Ladysmith)
Majuba-Venus #2 400kV line (running parallel to the N3)
Ingagane-Bloukrans #2 275kV line

Ingagane-Danskraal #1 275kV line (parallel to the above)
Drakensberg-Pegasus #1 400kV line (running to the north of Ladysmith)
Tugela-Venus #1 275kV
Bloukrans-Tugela #3 275kV
Numerous Distribution lines (approximately 8) at 132kV or lower.

There is also the Danskraal substation near Ladysmith, Bloukrans substation near Colenso, and the decommissioned Colenso power station. The density of the infrastructure is mainly in the southern half of the Braamhoek-Venus study area.

The social makeup of the area is varied (see Map3). The eastern half of the study area is significantly more densely populated than the western half, with the conurbation of Ladysmith and surrounding settlements of Steadville, Modderspruit, Ezakheni and Braakfontein being central to the developed areas in the east. Other significantly populated areas include Driefontein, Watersmeet and Peacetown in the north, and Colenso, Cornfields and Thembelihle in the south. Along the central alignment there is Roosboom, western edges of Colenso and western outskirts of Ladysmith and Driefontein that occur along the route. Along the western sections of the study area, the main settlement area is Bluebank in the north, while the rest of the area are mainly scattered farmsteads and farm workers cottages. It appears that dwellings may have encroached into the vacant servitudes along the Majuba-Venus #1 and #2 lines, though those along the Majuba-Venus #2 (Western Route) line are limited to a few properties along the N3 (see Map 3), and again a few just north of the N3 crossing near Besters. Along the Majuba-Venus #1 (Eastern Route) the situation is quite different, where encroachment of dwellings is threatening the vacant servitude near Cornfields, Peters and Modderspruit.

Tourism is also more developed in the eastern sections of the study area. This is partly due to the Battlefields corridor that passes through Colenso, Ladysmith and then turns east towards Dundee (Map 3). However, there are also notable ecotourism initiatives in the areas. These include the Umsuluzi Game Reserve near Boukrans (just north of Cornfields). This is an established game reserve that attracts both local and international clients, but it is also part of a land restitution programme that has the support of both the Regional Land Claims Commissioner and Ezemvelo KZN Wildlife. Called the Weenen-Umsuluzi Project, ecotourism has been identified as being one of the more economically viable landuses under the new ownership, and Phase I of the project is understood to link Umsuluzi and Mtontwane with Weenen Game Reserve. Phase 2 is expected to incorporate farms to the north as far as the Tugela River (see Map 3).

Further north, the farms Rietfontein and Dansekraal are the subject of ecotourism development proposals that have been submitted for Town Planning approval. It is understood from Emnambithi Municipality that it is possible the development could link up with a proposed Windsor Dam biosphere development that is also under planning application. The municipality sees these developments as broadening the Battlefields corridor.

The middle and western sections of the study area have much less tourist activity. There are a couple of Battlefield sites near the Middle Route, and there is the Vaalkrans Battlefield along the Western Route. However, the only main tourist development in these areas is the proposed Zimele Tourist Junction situated approximately midway along the N3 in the study area. This will

include chalets, a hotel, winery and music school, with views over the Tugela River valley to the west (see Map 3).

A possible tourist attraction for the future is the Quedusizi Dam just northwest of Ladysmith. Constructed as a flood attenuation facility on the Klip River, it is understood there are considerations to enhancing its capacity to include a water resource reservoir and recreation facility. Planning progress in this regard is uncertain, but the resulting flooded width of the dam would be difficult to span with a 400kV power line and any such Middle Route would need to be diverted around the dam.

In contrast to the eastern areas, the western side of the study area is characterised by undulating grasslands, primarily under extensive grazing landuse. With a relatively high drainage density the grasslands are broken up by wetlands in the drainage lines (see Map 2). Areas of cultivation occur in the grasslands (especially in the south), and the more wooded bushveld areas occur in the central sections. Map 2-1 shows the agricultural potential while Map 2-5 shows land cover and geology.

The ecology of the study area is varied, and closely associated with the grasslands and wetlands. Highland Sourveld, Northern tall grassveld and Southern tall grassveld occur (Map 2-4). A number of Red data plant species and priority medicinal plants may occur in the study area (see Appendix 6). Similarly a number of Red Data fauna may also occur, including:

- The Dobson's rough haired golden mole - likely to occur in the undisturbed grassland areas of the study area,
- The Natal leaf folding frog and the long-toed tree frog are possible habitants of some of the wetland areas. Though they are mobile, care will need to be taken during construction so as not to disturb these species and their habitats.
- Two reptiles need to be avoided; the Natal midlands dwarf chameleon and the Black headed dwarf chameleon. Habitat destruction during construction is possible without due care.
- A number of possible Red data butterfly species may also exist in the area of the Turn-ins; *Metisela meninx, Capsys penningtoni, Chrysoritis lyncurnium, Lepidochrysops pephredo* and *Lepidochrysops hypopolia* (the latter is thought to be extinct).

A more comprehensive description is provided in Appendix 6. In all cases careful placing of towers and access roads will avoid damage.

The visual quality of the study area is more complex to describe and a specialist account is given in Appendix 5. Key differences occur across the study area and by way of summary the following key points are noted here:

Eastern Route:

- The southern landscape (south of the Tugela River near Colenso) is considered to have a moderate visual quality due to the largely intact natural landscape and relatively few human intrusions.
- The northern landscape (north of the Tugela) is considered to have a low to moderate visual quality in areas where rural settlements are present, but high nearer Braamhoek where human intrusion is minimal and the mountain backdrop is significant.

Middle Route:

- Southern sections (up to Roosboom/Ladysmith) have a moderate to low visual quality due to the visually cluttered landscape due to roads, railway lines, power lines, towns, centre pivots, etc.
- North of Ladysmith a landscape with an estimated moderate visual quality occurs due to the less cluttered and more extended pastoral views. Again, closer to Braamhoek the visual quality is seen to be high with the mountain backdrop.

Western Route:

- A moderate visual quality is perceived for much of this route. The landscape is relatively featureless and has limited visual diversity. However, the area imparts a rural character that is visually attractive.
- As with the other routes the sections near Braamhoek are considered to have a high visual quality.

Based on the above, and the reports provided by the specialists, an evaluation of alternatives was undertaken and is discussed in the next section.

6. DISCUSSION ON ALTERNATIVES

6.1. UNDERGROUND POWER LINES

The question about the use of underground cabling of power lines is frequently raised. Specific mention has been made in this study to practices in Europe and Australia where it is reported that extensive 'undergrounding' programmes are in operation, and that Eskom should be considering the same here. The following is a brief summary of research undertaken in this regard.

6.1.1. Technical issues

Overhead cables are only insulated at the pylons or posts that support them. Provided there is sufficient distance between the exposed cable and any earthed object, the air provides sufficient insulation. The air also cools the cable that gives off heat as current passes through it.

Underground cables need to be insulated against the surrounding soil. On low voltage reticulation networks (11kV & 22kV) the heat generated by the cable is low enough for standard insulation to be used. But on larger lines the methods of electrical and heat insulation become more onerous. For 400kV lines, each conductor needs to be encased in oil filled sleeves. It is also understood that each conductor is placed in a 2m deep trench, resulting in up to 12 trenches for a 400kV line. Width of excavation may be anything between 15 and 30m depending on the technology used. In a recent case in the UK (see below) pressurised oil insulated cabling was used requiring a 30m width buried area.

6.1.2. Cost

Reports on cost vary between countries and are very dependent on terrain and size of line. However, all agree that underground cabling is orders of magnitude greater than overhead cables. Guideline figures are:

Underground 22kV is 2 to 5 times more expensive
Underground 132kV is 3 to10 times
Underground 400kV is quoted as being between 10 to 20 times
Underground 765kV is estimated at over 30 times.

Given that the costs of overhead 400kV lines are quoted at between R0.75 – R1.5 million/km, the markup for 'undergrounding' is significant. International reports indicate that the recovery on this investment is only achieved on increased tariffs or through community commitment (taxes), though the latter refers to distribution networks (typically below 22kV). In South Africa, Eskom is a public utility and is answerable to the Public Finance Act in which all costs need to be declared and justified. Additional costs for undergrounding are subject to the same scrutiny and the costs would need to be recovered in some way. It is understood this is likely to be either by a general increase in tariffs or by direct contributions by those requiring underground cables.

6.1.3. Maintenance

A mixed result arises here. Underground cables are reported to be more reliable, but outages are more difficult to fix as it is harder to find the fault, and therefore the outages last much longer on underground cables[3]. Also, routine maintenance of underground cables is much lower in the initial years of operation (first 10 years appears to be the time span most regularly referred to), but maintenance costs can rise steeply thereafter. The lifespan of underground cabling is also shorter, in some cases it is reported to be half that of overhead cables. Nevertheless, there seems to be general agreement that the maintenance and operation of underground cabling is cheaper than overhead cabling. It has been reported that in the UK overhead line maintenance is estimated at £600/circuit-km/year (approx. R6600) while underground cable maintenance is at around £70/circuit-km/year (approx. R770).

6.1.4. Visual benefits of 'undergrounding'

It is commonly stated that there are distinct visual impact benefits in using underground cables. In the main this is seen to be true, especially in the urban environment where the observer is closer to the line and the land cover is largely disturbed from its natural state. However, in the natural environment, especially wooded and thornveld areas, root management may require that trees are kept out of the servitude and a 15-30m wide strip is cleared. Such strips in woodland areas are normally more noticeable at a distance than a power line (servitude management guidelines for overhead lines now allow small trees to remain under 400kV lines). Hence, it is not automatic that visual impacts are avoided by using underground cables. This would need to be assessed in each case.

6.1.5. Trends in 'undergrounding'

Underground electricity cables are typically only used in developed countries such as in the US, Europe and Australia. Some of these have adopted policies on undergrounding (eg Netherlands and France, and some states in Australia), but these focus on low and medium voltage networks (200V to 50kV). The Netherlands, for example, adopted an underground cabling policy in the 1970's and has 100% of its low to medium voltage network underground. Next best is Belgium and the UK at 85% and 81% respectively. The average for Europe is estimated at around 50% to 60%[2].

The picture for high (60kV to 150kV) to extra high voltages (220kV and above) is quite different. Some countries have achieved in undergrounding between 10% and 20% of their high voltage cables, while other European countries are less than 10%. For extra high voltage the average is around 2%, with only 0.5% of the 400kV network underground. In the high and extra high voltage categories the underground sections are special projects in urban or highly sensitive environmental areas.

In the US some 50% of capital expenditure on power lines is for underground lines, though still 80% of the infrastructure is overhead[3].

Hence, in developed countries there is a growth in underground cabling of low voltage distribution systems, the undergrounding of high voltage lines is rare and limited to highly sensitive areas. However, while there appears to be no policy development towards undergrounding high voltage lines, it is fair to report that the EU has given more attention to this in recent years as the interconnection between countries to reinforce national networks is being met with growing opposition.

There is little information on underground electricity cables in developing countries. Though it is known that it does occur in some city areas, it is expected the practice of undergrounding is well behind that of developed nations. In South Africa, new 11kV lines in residential areas are more regularly buried. However, though undergrounding of higher voltage lines has been considered at sensitive sites, it is understood that none have been constructed.

Underground cables are not being considered as an alternative on the Braamhoek Transmission integration project. Cost will be a primary concern, but given the existence of 400kV and other lines in the study area, the potential environmental sensitivity of the area is seen to be considerably reduced.

[2] Commission of European Community, December 2003. Background Paper: Undergrounding of Electricity Lines in Europe.

[3] Brad Johnson, January 2004. Out of Sight, Out of Mind? A study of the costs and benefits of undergrounding overhead power lines. Edison Electric Institute.

6.1.6. Case example: Middlesbrough-York 400kV line (UK)[4].

The Middlesbrough-York Line (United Kingdom) The 70 km long overhead line with two 400 kV circuits (each with a capacity of 2,000 MW) connects the cities of Middlesbrough and York. Significant public concern was raised over the decision to put overhead lines, rather than cables, through the Vale of York. An application to construct the line was made in 1991. Following several years of public enquiries and hearings it took 10 years for all consents and wayleaves to be put in place. National Grid was not in favour of an underground cable on the grounds of cost (the overhead line was expected to cost £540,000/km *(approx R6m/km)* and the cable £8.9 million/km *(approx. R98m/km)*, a cost factor multiple of 16 times) and environmental concerns over a 15-30 metre swathe of sterilised land through the countryside. The UK government took the view that the additional cost could not be justified and the aerial route was eventually given the go-ahead with the exception of a 5.7 km cable section in the middle of the English countryside. The technology used is a pressurized oil-insulated cable. The buried part covers a total ground area of 30 m of width and cost about 100 million (Euro) *(Approx R130million/km). Please note, these are UK costs and are affected by local technical costs (eg terrain difficulties) and differences in the economies between two countries. However, this provides a good example of the scale of costs and decisions that have been made elsewhere in the world.*

6.2. OVERHEAD ALTERNATIVES

From the discussions in the Sections above, there are two clear alternatives to be considered. These are routes following the existing Majuba-Venus #1 and #2 400kV lines, utilising vacant servitudes parallel to these lines. These are referred to as the Eastern and Western Routes respectively. A third alternative through the middle of the study area (the Middle Route) has also been considered.

The routes shown in Map 1 have been identified as the most acceptable routes in each case based on environmental considerations, specialist input and information gained via the public consultation process. A summary of the evaluation process in identifying the preferred environmental route is given below.

6.2.1. Social Issues

- Despite the vacant servitude along the Eastern Route, the population density between Venus and Ladysmith will have potentially significant social impacts. These will include relocation of dwellings and construction related social disruption.
- Further north, the settlements of Driefontein, Watersmeet and Peace Town will require that the Eastern Route be diverted south and west around these densely settled areas. This will be a new route and a new servitude – a distance of some 45km (approximately 45% of the total distance).

[4] REVOLT News, November 2004. Issue 174.

- Additionally, the Eastern Route will cross more areas of existing or planned tourism and eco-tourism than the other routes.
- An entirely new servitude will be needed for the middle route. There is some potential for disruption of landuse activities along this route (especially centre pivot irrigation).
- There is likely to be some relocation of dwellings along the Western Route, but these are much less in number than that of the Eastern Route.
- Landuse impacts are generally seen to be low along the Western Route provided the line and servitude is well maintained. However, this provision will apply equally to the other routes.
- Overall, the preferred route from a social perspective is the Western Route and the least preferred is the Eastern Route where the potential for social impact is significant. (See Appendix 4).

6.2.2. Ecology (excluding birds)

- Despite the varied topography in the study area, it is considered that there are no significant differences in the potential ecological impacts of the three alternatives.
- Apart from the steeper slopes in the middle sections of the study area and near Braamhoek, much of the existing ecology is seen to be robust in terms of the nature of power line construction and development.
- Careful construction methods will be required for any of the routes, and a walk-thru survey will be required to check for Red Data species (fauna and flora) once detailed design is undertaken. However, in all cases the levels of significance of impact is predicted to be low for each alternative if proper design and construction control is implemented.
- One difference between the routes is the potential mitigation offered by the existence of parallel power lines. In these areas the environment will already have been damaged to some extent and a new line parallel would not normally be as damaging, especially where previous access routes may be used. Furthermore, there is opportunity to rectify damage under existing lines if the new line runs parallel to it.
- The Western Route offers the greatest mitigation in this respect as the new line will run parallel to an existing line of the same magnitude for most of it's length.
- Though efforts have been made to run the Middle Route along existing power lines, these tend to be small (Distribution) lines and will offer limited ecological mitigation.
- As mentioned above, at least 45% of the Eastern Route will be over new territory.
- Hence the preferred route in terms of ecology (excluding bird impacts) is the Western Route, with the Eastern Route being the least preferred option. (See Appendix 6)

6.2.3. Avifauna

- There are a number of issues relating to interactions between power lines and birds. These include electrocution, impact of bird streamers, destruction of habitat and collisions. These are addressed in some detail in Appendix 7, but in terms of this summary the primary impacts affecting route selection are collisions and destruction of habitat.

- 73 species of birds that interact with power lines are noted for the study area. Some 16 of these are Red Data species. Of these, those that are particularly sensitive to the larger Transmission lines include; the Black Stork, Yellow-billed stork, Greater Flamingo, Bald Ibis, Secretary Bird, Cape Griffon, Martial Eagle, Ground Hornbill, Blue Crane, Grey Crowned Crane, Denims Bustard, White-bellied Korhaan and Blue Korhaan (13 species). Mention is made of the critically endangered Wattled Crane and the White-winged flufftail, but these are not seen to be common in the study area (they are more significant on top of the escarpment).
- The specialist study shows bird sensitive areas to be widespread throughout the study area, but with greater density in the middle and western areas. Despite this, the Western Route is identified as the least impacting option as the new line will be running parallel to an existing line of similar magnitude. Therefore the net increase in collision risk is lower. Furthermore, collision risk on the existing line may be reduced if the new line is marked (eg flappers or pig-tails) in critical areas.
- Damage of habitat is less likely next to areas where development has already taken place, particularly with regard to access routes. In the case of the Western Route it is expected that access to the existing Majuba-Venus #2 line will be used for the construction and maintenance of the new line, and this is therefore again the preferred option. The Middle and Eastern Routes will break new ground, increasing the risk of both habitat damage and bisecting habitats.
- In terms of the bird impacts, it is also relevant that the Western Route will be able to run parallel to the proposed Turn-in along the last 10-12km to Braamhoek. These northern areas of the whole study area are among the more sensitive habitats for birds, and it is seen to be important mitigation for bird habitat and collision impacts that the new Braamhoek-Venus 400kV line and the 400kV Turn-ins are confined to a common corridor.

6.2.4. Visual Impact

- The evaluation of visual impact is a complex matter and the reader is referred to Appendix 5 for a more comprehensive explanation.
- The western areas of the study area is described as having a moderate visual quality due to a lack of visual diversity, but the area has a distinctive tranquil rural character and a low to moderate visual absorption capacity (a measure of the ability of a landscape to visually accept a land change or development).
- By contrast the landscapes of the Middle and Eastern Routes are seen to have greater capacity to absorb power line developments, the Eastern Route areas in particular.
- Hence, the Eastern Route is the preferred route from a Visual impact perspective, while the Western Route is the least preferred option.
- However, the visual impact of the Western Route is seen to be of a moderate significance as the new line will follow an existing line of similar magnitude, and that there are a number of other lines in the area.

6.2.5. Archaeology and Heritage

- It is understood from the specialist study (Appendix 8) that the most likely archaeological sites in this area of the province would be Late Stone Age, but that some Iron Age sites may occur. However, these are all expected to be small localised sites and can be avoided by careful pylon placement. Hence the archaeology of the area has not been used to determine the best power line route.
- Historic sites are important in the area as the Battlefields sites of the Anglo-Boer war are prevalent in the southern and eastern areas of the study area, and they are a critical element of the tourism industry in the area. In this regard the Western Route is seen to have the least impact on the Battlefields corridor, though the latter already has a significant number of power lines through it, and the introduction of a new line is expected to have a negative impact with a moderate to low significance.
- In contrast the cultural landscape presents a slightly different picture. This issue recognises that the landscape is an important part of the history of an area, and changes to that landscape therefore threatens to minimise any sense of history. In this exercise the assessment closely follows the visual impact assessment, and the due to the nature of the terrain and visual absorption capacity the Eastern Route is seen to have a lesser impact on the cultural landscape of the area than the Western Route.
- Overall, it is considered that the two routes are very similar in significance, with the Western Route given the preferred status due to the importance of the Battlefields corridor from Venus through to Ladysmith. The Middle Route is the least favoured option.

6.2.6. Technical and cost considerations

- Given that the Western Route will run parallel to an existing 400kV line for at east 85% of the route, and that a vacant servitude exists for almost 80% of the route, preference is given to the Western Route in both cases.
- In addition, terrain conditions are easier (undulating) on the Western Route and fewer self supporting (or strain) towers are anticipated. Therefore, more cross-rope suspension towers will be used and will have beneficial visual implications, will remove the potential for bird streamer impacts on the line (due to a lack of perch points on the tower) and lower cost implications.

6.2.7. Summary

The table below gives a summary of the evaluation. While it is somewhat simplistic, it provides a useful visual overview of the scale of preference within each specialist field. It does not indicate the relative importance of each specialist field, however, and this is further discussed below.

Cost issues are seen to have peripheral significance in this study. As a public utility, Eskom needs to recover costs through the consumer and it is understood that at Transmission level these costs are distributed nationally. Hence, higher cost of the development will ultimately have bearing on the end cost of electricity, though the differences are expected to be relatively

small. On the other hand, 'undergrounding' the line would have major impacts on the cost of electricity supply, and would need further investigation. In this study, cost is given a low weighting.

	Social	Avifauna	Fauna & Flora	Visual	Heritage	Technical	Cost
Most preferred	West	West East	West	East	West East	West	West
	Middle		Middle	Middle		East	East
Least preferred	East	Middle	East	West	Middle	Middle	Middle

Technical issues have more environmental significance as generally the more technical problems on a new line the higher the risk of environmental damage. The first that is affected is the visual impact (strain towers are needed instead of the visually lighter cross-rope towers), but others will follow as construction on more difficult terrain progresses. Technical issues are given a medium weighting in the route selection process.

Two of the issues that are often affected by technical implications are the ecology and archaeology. In most cases, power lines can be constructed with minimal damage to the local ecology and archaeology on a route **provided adequate surveys are undertaken in the detailed design stage**. Apart from avoidance of Battlefield sites in the wider study area, archaeological sites can be avoided by careful placement of tower pylons. Similarly, the ecology of the wider study area in its current state is seen to be robust and will recover provided the construction process is properly managed and localised sensitive habitats are avoided by careful pylon placement or plants are relocated. Hence, given the broader understanding gained of the archaeology and ecology gained in this study, and on the provision that detailed surveys are undertaken in the detailed design stage of the project, these issues are given medium weighting in the route selection process.

Avifauna, social and visual issues have each been given a high weighting in this study. In these issues the routing of the line could result in significant negative environmental impacts. That the visual preference is contrary to the others has required careful review. In the southern half of the study area, the significance of the social issues give clear preference to the Western Route. In the northern half, the visual impacts are seen to gain greater significance as one approaches Braamhoek. However, that the Western Route follows an existing line and that the other options will be new routes in this northern half is an important factor in each of the three issues (social, avifauna and visual) and it is considered by the EIA consultant team that on balance the preferred route is the Western Route in this area.

6.2.8. Concluding remarks

The Western Route has been identified as the overall preferred route in this study, and the Middle Route as the least preferred option. The key factors in this assessment has been the Majuba-Venus #2 line that will run next to the new line for much of the way, and the existence of the vacant servitude next to this line (though this servitude will need to be widened by some 20m). This Scoping study has therefore given further consideration to the detail of the impacts and these are set out in the next section.

7. IMPACT ASSESSMENT

The detail of the impact assessment is given in the Impact Tables in Appendix 2. This section presents a summary of the Impact Tables and address certain key aspects that may have arisen during the public consultation process.

7.1. UTILISATION OF LOCAL GOODS AND SERVICES

Due to the specialised skills required in the construction and operation of Transmission infrastructure, and the highly specialised equipment used (much of it imported), opportunities for local suppliers, services and the labour market is usually limited. Although this is still seen to be the situation in the case of this development, there is seen to be greater opportunity to optimise on local input with the support of the local authorities. The following conditions have influenced this observation:

- Meetings with local authorities in the course of the public consultation programme have shown that the authorities are willing to assist Eskom in identifying local contractors in all sectors of the work. In particular Emnambithi Local Municipality has specifically requested Eskom to provide them with a list of works, goods and services that will be required in the construction of both the Transmission infrastructure and the Braamhoek PSS as a whole.
- Eskom is also seen to be changing the construction contracts to encourage the main contractor to utilise local input. This is still developing with experience on other Transmission developments in the country. However, with the expected support of the local authorities in this study area, this is seen to be an opportunity to develop the management of the contracts even further.

The profile of this issue has been raised in this study because of the enthusiasm and participation of the local authorities. The full potential has not been investigated here, and it will require dedicated effort from both the authorities and Eskom to succeed. It will also require that advanced planning be undertaken to allow for any training time that may be required. However, to caution against raised expectations, it is emphasised that the specialised nature of Transmission infrastructure will still limit opportunity for local input (opportunities within the construction of other elements of the Braamhoek PSS are not considered here).

7.2. ELECTROMAGNETIC FIELDS AND HEALTH HAZARDS

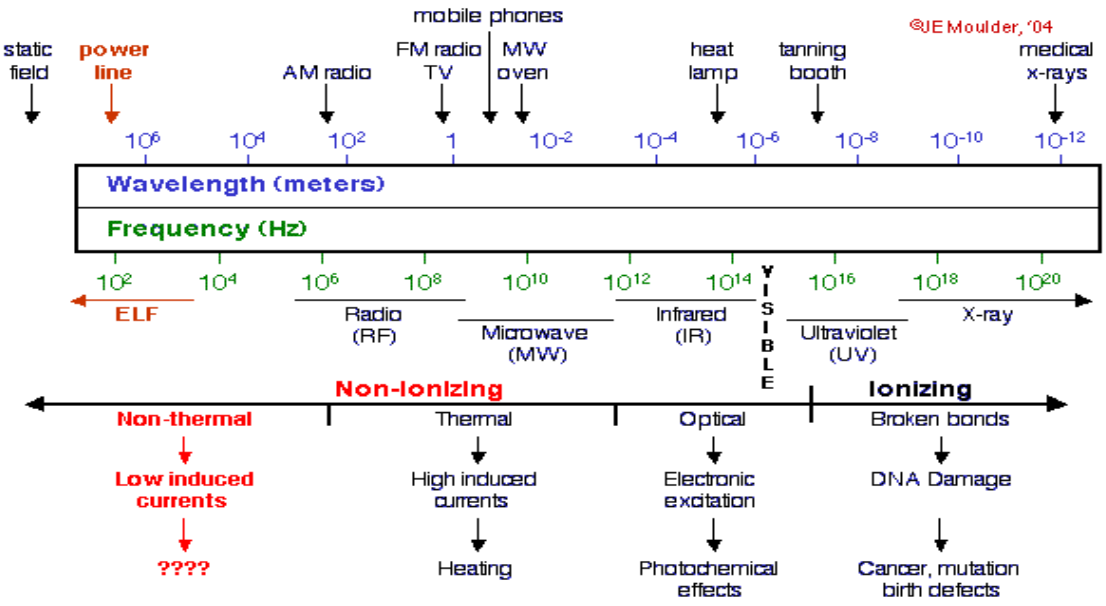
The recurrence of the debate in the media on electromagnetic fields and human health almost has a frequency of its own. Relatively recent reports (Sky News, October 2004) stated that a

study showed an increased risk of childhood leukaemia from powerlines, and a subsequent BBC website report was headlined “Pylons double child cancer risk”. However, the quality of the reporting has been questioned and this section attempts to review the current understanding on the effects of EMFs on human and animal health, and sets out the Eskom policy in this regard.

Electric fields are generated by the voltage applied to a conductor and is measured in volts/metre (V/m). Electric fields are easily shielded by conducting objects, trees, buildings, etc. Electric fields reduce with increased distance from the source. Natural background electric fields near the earth may be around 200V/m on a calm day, but may be as much as 50,000V/m (50kV/m) during a thunderstorm.

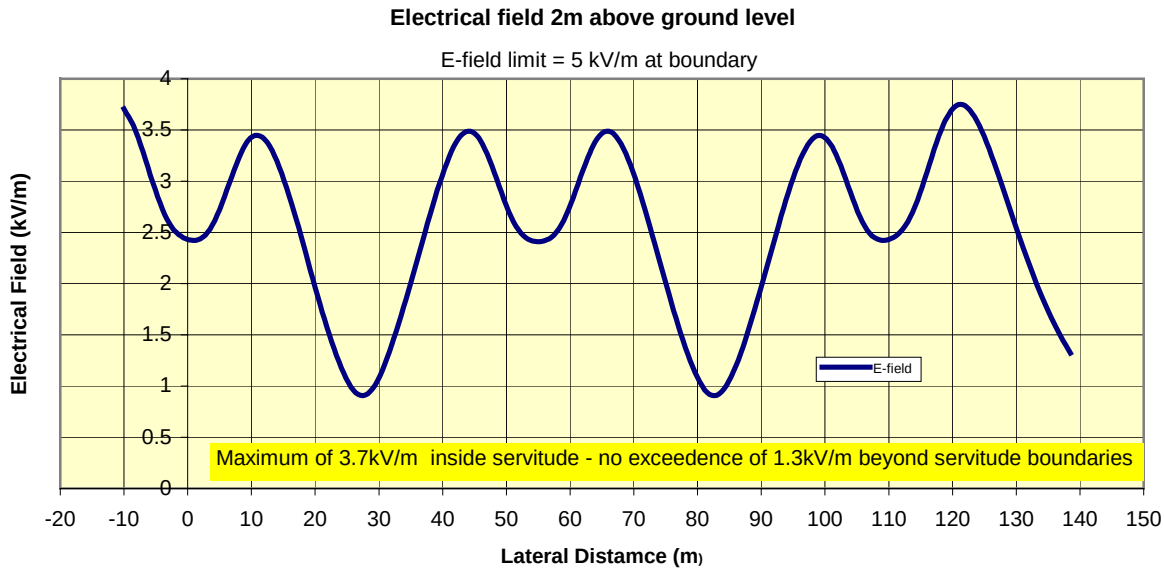
Magnetic fields are generated by the current in the conductor, and internationally is measured in Tesla (T) (in the US it is measured in Gauss, G. 1µT=10mG). Magnetic fields are not easily shielded, but do decrease in strength with increase in distance from source. Natural background levels of the earths magnetic field is around 30µT in Johannesburg, for example, and up to 70µT near the poles.

The electromagnetic spectrum is depicted in the diagram below.

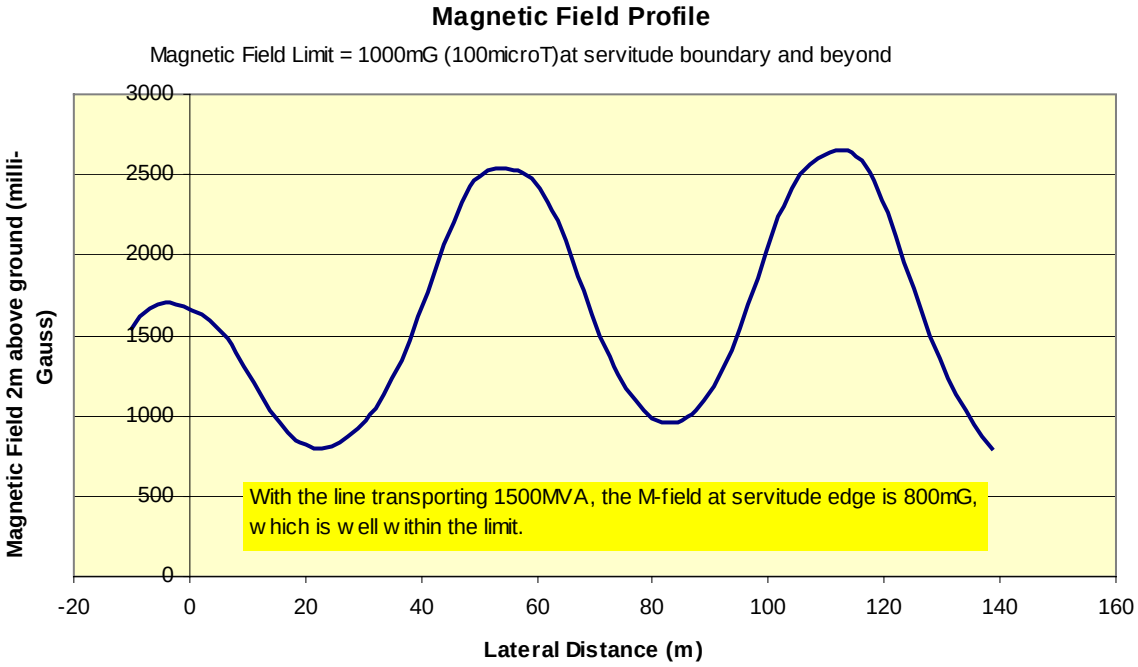


(Source: JE Moulder, October 2004)

Electric fields generated by overhead power lines are dependent on the voltage of the line. Ground level measurements under 400kV lines reach a maximum of 3.7kV/m under the line, while at the edges of the servitude 27.5m from the centre line, the electric field drops to below 1.3kV/m. The latter is deemed an acceptable background level given an international guideline of 5kV/m . The calculated electric field under the 400kV line, assuming the worse case condition of three parallel lines (= Braamhoek-Venus plus two turn-in lines), is shown below.



The calculated magnetic field under the same 400kV line configuration is shown below.



Eskom's stated approach to the minimising any possible risk associated with exposure to EMFs from power lines is to adopt the precautionary approach. The servitude widths are set such that both electric and magnetic fields reduce to more commonly experienced 'everyday' levels. These are shown in each of the graphs above. Examples of such 'everyday' levels are shown in the table below[5].

[5] Source: John E Moulder, October 2004. Electromagnetis fields and human health. Medical College of Wisconsin.

Electric fields from power lines are not elevated in buildings as they are shielded by the building structure. However, magnetic fields are not affected by building structures and will persist in buildings under power lines.

Residences	0.02µT & 2V/m up to 150µT (1500mG) & 200V/m near some appliances (eg microwave ovens)
Some occupations (eg welders)	100µT (1000mG) & 5000V/m
Electric trains (passenger seat level)	60µT (600mG)
Electric blankets	10µT (100mG) & 1000V/m
400kV line servitude boundary	80µT (800mG) & 1300V/m (dependent on current – these values are calculated for the Turn-ins, a worst case condition in this study. See graph above)

Research into EMF and cancer links

Some studies have reported that children living near certain types of power lines (high-current distribution lines and high-voltage transmission lines) have higher than average rates of leukaemia, brain cancers and/or overall cancer. The correlations were not strong, and the studies generally did not show dose-response relationships. When power-frequency fields were measured, the initial correlations generally vanished. Many other studies have shown no correlations between residence near power lines and risks of childhood leukaemia, or overall childhood cancer.[5]

Studies continue, but most still show no significant associations. A Canadian study has, however, reported an association between the incidence of childhood leukaemia and some measures of exposure.

With two exceptions all studies of correlations between adult cancer and residence near power lines have been negative. The one exception reported an excess of total cancer and brain cancer, but no excess of leukaemia; and the other reported the opposite result. The first of these studies was the Wertheimer and Leeper study in 1979 that is widely reported as one of the first studies to raise fears of possible associations between cancer and power line EMFs. However, when tested, this study proved to have flaws, and other possible influences are also seen as potentially significant, for example socio-economic status.[6]

Considerable focus has been given to possible correlations between power lines and increased incidence of childhood leukaemia. This is used as an indicator as radiation raises rates of leukaemia before it produces other forms of cancer. Using this indicator, there have been so many studies done in the last 25 years or so, that many scientists believe that if any significant association existed it would have been found by now. There are a number of reasons why these scientists believe no link will be found[6]:

- The fields produced by power lines is too small. Background levels ‘everyday’ exposures are usually greater than that arising from powerlines.

[6] John Farley, July 2003. Power lines and cancer: Nothing to fear. University of Nevada, US

- No plausible mechanism for adverse health effects has been postulated. Frequencies produced by power lines are too low to have adverse biological effects.
- The initial study was flawed. This is the Wertheimer and Leeper study referred to above.
- The incidences of leukaemia are decreasing. Americans are exposed to increasing sources of magnetic and electric fields as technology and appliances become more widely used, yet it is reported that leukaemia rates are slowly decreasing.
- Furthermore, one would expect power line maintenance personnel to be exposed to unusually high, long-term doses of electric and magnetic fields, and would therefore show higher incidences of cancer. Yet neither international press, nor Eskom (personal communication) report any such trends.

Allegations of vested interests and bias are not uncommon in references on the subject, but yet seemingly there has been no scientific institution that has said anything other than that the data and statistics are inconclusive.

Yet, as far as is known, none have said that EMFs from power lines are safe either. Therefore, the precautionary approach adopted by Eskom would appear to be a sound approach.

7.3. POWER LINE MAINTENANCE: ESKOM AS A 'BAD NEIGHBOUR'

This EIA makes the assumption that the developer (Eskom) will design, construct and operate the Transmission infrastructure in a responsible manner, and that the environment will be considered in all such activities. The 'environment' includes the social and economic environments. However, the accusation has been made by certain stakeholders in the study area that Eskom is a 'bad neighbour' and that poor management of the construction process and subsequent maintenance of power lines in the area have led to stock losses, fire damage and injury. Both Eskom and the environmental consultants have viewed these allegations in a serious light, and it is important that considerations relevant to this EIA are discussed here.

The specifics of the issues raised are not addressed here as they relate to maintenance and operation of existing lines and are not seen to influence the decision making process for the EIA. It is perhaps relevant, however, that the issues refer to both Eskom Transmission and Distribution.

Firstly, it is expected that some potentially avoidable damage will occur during construction and even during the maintenance of the line. Such is the nature of these activities. However, with good management this damage will be repaired and rehabilitated in the short-term. Provision is also made by Eskom for compensation for any damage. To achieve this on long linear developments, clear lines of communication will be needed between the developer and the landowners. From discussion with landowners in the consultation process, it would appear that there has been a problem with communication between landowners and Eskom.

Secondly, irresponsible construction practices and/or poor line and servitude maintenance may result in significant environmental damage. Such damage cannot be supported in an EIA, and it

would be recommended that the development should not be authorised if the current issues were not addressed and there was clear risk that the incidents would recur.

Thirdly, these concerns would apply to any route in the study area. It is not seen that there would be less risk by following one route as opposed to another. Hence, though the implications of 'bad neighbourliness' have been considered in a serious light in this study, they have not influenced the identification of the best environmental route.

Eskom has responded to the allegations at senior management level and has had a first meeting with the landowners concerned. Contact details of key personnel have been given to the landowners, and investigations into the issues are understood to be underway. It is therefore seen that efforts are being made to address the issues and minimise the risk that the incidents would recur. However, it is recommended that progress in this regard is monitored by the authorities. This will be achieved in part by the usual condition in the Record of Decision (RoD) that servitude agreements must be signed by all landowners before construction can start. It is also recommended that Eskom appoint a full time Environmental Control Officer (ECO) for the duration of the construction programme. The ECO will be the primary contact for landowners during construction (refer to the Impact Tables in Appendix 2).

Reporting faults, property damage, etc.

It is recommended that landowners and members of the public who wish to report faults or damage to their property as a result of failure of Eskom infrastructure or maintenance activities must send their reports in writing, by registered post, to the relevant regional line manager (ie either Transmission or Distribution Regional Manager). Contact details are:

Eskom Distribution, Ladysmith Regional Office
PO Box 99, Ladysmith, 3370
Contact: Mr Ernest Pieterse, Tel:036-6310372 (Regional Line Manager)
Mr Pool Mahadeo, Tel:031-7105129 (Regional Manager Sales & Customer Services)

Eskom Transmission, Kwa-Zulu Natal Regional Office
PO Box 1180, New Germany, 3620
Contact: Mr Jorge Correia, Tel: 031-7105111 (Regional Line Manager)
Mr Pranesh Sewerpershad, Tel: 031-7105666 (Transmission Technical Support)

During the Scoping Study the Ladysmith & District Farmers Association withdrew from participating further in the public consultation process, citing unresolved issues from previous incidents of fire management and property damage. Eskom representatives from Transmission and Distribution met with the Association and it is understood that investigations of the matters are in progress. However, during the Comments period for the Draft Scoping Report, the Ladysmith & District Farmers Association stated they were still waiting for Eskom to resolve the matters before participating in the EIA. It is understood that at least one of the matters is now going to court and is therefore unlikely to be resolved within the timeframes of this EIA. The Association was encouraged to participate by the EIA consultant, but they have elected to maintain their stance. The EIA consultant met with their secretary to explain the EIA process, including the appeal process, as well as the servitude negotiation process, construction activities and DEAT's responsibility in monitoring the construction process.

7.4. POWER LINE MAINTENANCE: FIRES & FIRE MANAGEMENT

A number of stakeholders have raised concerns about the management of servitudes, fire management and fire fighting (lightning issues also raised are discussed in the next section). Additionally, there appears to be different understanding between Eskom and landowners regarding maintenance responsibilities and a lack of awareness that fighting fires under power lines is dangerous. This section looks into the different aspects in more detail and the potential environmental impacts are reviewed.

7.4.1. Maintenance

Eskom undertakes ongoing research into vegetation management. International best practice is regularly reviewed and adapted where appropriate for the South African environment. Eskom Transmission has a "Transmission Vegetation Management Guideline" (ref TRMAGAAZ7, last update May 2003) that is distributed and accepted by all the Regional Line and Servitude Managers.

The definition of a servitude is given as "the right to use someone else's land for a specified purpose". In the case of an overhead power line this right includes the erection, operation and maintenance of the power line, and the right of access to carry out these activities. The servitude also allows Eskom the right to prevent or limit activities that may affect the operation of the line (eg no buildings or tall trees within the servitude). It is also relevant that the Ownership of the land in the servitude is not transferred to Eskom, but remains with the original landowner. **This implies that the landowner retains overall responsibility for the land.** This is significant in terms of the National Veld and Forest Fire Act of 1998, where it is stated that a landowner is presumed negligent if a fire starts or spreads from his/her land.

The primary objective for the establishment of the servitude is the protection of the electricity supply. However, the "Transmission Vegetation Management Guideline" clearly sets out to integrate the maintenance and operational functions of the line and servitude with the local environment, including the landowners activities. Initiatives include:

- Preparation and operation of an Environmental Management Plan (EMP) for the servitude,
- Identification of the appropriate degree of vegetation management depending on botanical content and landuse (Note: it is not automatic that all trees are cleared),
- Vegetation management for fire control. While, the maintenance emphasis is on protecting power supply, the guideline promotes integration with landowner fire management practices where possible. This would include using the servitude as a firebreak where mutually agreed. The guideline states "the landowner should at all times be consulted and be made part of the process".

The guideline promotes minimal removal of vegetation from the servitude unless it is either alien or presents a fire hazard to the line. Vegetation removal includes chemical, manual, mechanical and fire methods, though the latter is recommended only at appropriate locations and under strictly controlled conditions. It is understood that vegetation management by fire is now seldom undertaken.

Disposal of cut material is also noted to be a potential problem (including added fire risk to the line) and various disposal methods are put forward for consideration. However again, this should be done in conjunction with the landowner.

Lack of landowner liaison appears to be the main cause of the dissatisfaction raised on this project. Communication with the landowners would seem to have been very limited in the past, resulting in differing expectations including a) Eskom owns the land and therefore b) Eskom is responsible for undertaking fire break and fire fighting responsibilities as a result.

Eskom does not have veld fire fighting capabilities. The guideline makes reference to working with local Fire Fighting Associations in this respect. It would appear that Eskom should initiate such a relationship with the Ladysmith and Besters Farmers Associations who, it is understood, both operate co-ordinated fire management plans. (*This approach should apply to all other aspects of servitude maintenance.*)

7.4.2. Responsibility for fires generated within the servitude

Potential causes for fires generated by electrical infrastructure in the servitude include (lightning issues are discussed below):

- Flashovers between the conductor and vegetation (or mechanical harvestors) that grow too close.
- Falling trees
- Poor line maintenance and the pylon falls over (such a case has been reported in this study, and involved a gum-pole distribution line).

Other sources of fire originating from the servitude may include cooking fires made by the maintenance contractors or cigarette butts. However, these are normally prohibited on site.

Flashovers with the ground due to excessive heat from veld fires may also occur and apart from being a threat to the power supply, they are also particularly dangerous to fire fighters.

It is understood that in circumstances where any of the above may have occurred, Eskom will assume responsibility for damages arising. Landowners will have the right to claim for damages. However, Eskom will investigate such claims to ascertain proof of negligence. It is understood the landowner should be given a copy of the investigation report.

Concerns have also been raised by landowners regarding the dumping of cut material in the servitude as this may also constitute a fire hazard. Eskom does not have the right to remove cut material from within the servitude as this belongs to the landowner. However, Eskom should liaise with the landowner and agree on what to do with the material. It is understood that cut material should not be left in the servitude without the landowner's agreement.

Eskom will not accept responsibility for veld fires passing underneath a line. Eskom's vegetation management in the servitude does not consider this unless there is specific agreement with the landowner. Therefore it is seen to be the landowner's responsibility to manage veld fire on his/her farm where there are overhead electricity lines.

Eskom will not accept responsibility for 'Acts of God' – for example pylon collapse in a hurricane.

7.4.3. Eskom's early warning system

Veld, forest and bush fires have a severe effect on the operation of power lines and the quality of supply. In recent years Eskom has acquired the use of two satellites to identify and track fires near their lines. An early warning system alerts managers to fires within 5km of power lines. The facility also has a fire weather forecasting system. It is understood this information is available to municipalities and Fire Protection Agencies/Fire Fighting Associations, and interested parties are given access to the website.

It is suggested that, as much of the study area is seen to be a high fire risk area, the early warning system information be made available to the local fire fighting units operated by the Besters and Ladysmith Farmers Association. Indeed, it is Eskom Transmission's policy, according to their 'Fire Protection Association Guideline' (TRMAGABD9, dated March 2004), that Eskom Transmission seeks to participate in the activities of local Fire Protection Associations (FPAs) where possible.

7.4.4. Fire impacts arising from poor servitude management

It can be simply stated that poor servitude vegetation management could result in high environmental impacts arising from veld fires. These environmental impacts include damage to property, crops, livestock and even injury to people. However, it is apparent that there are dual responsibilities in the maintenance of the servitude; Eskom's and the landowners.

Incidents of fire damage apparently related to power lines, and reported during this study are now the subject of separate discussions between the landowners and the relevant sections of Eskom (local offices). However, it is clear from the public consultation process that there is a difference in understanding of responsibilities relating to land management in and around servitudes, and that this can lead to a lack of appropriate maintenance and therefore possible fire related damages. It is recommended therefore that Eskom undertakes to liaise with landowners directly to inform them of the respective responsibilities, and to refine the EMPs accordingly.

It is believed that the level of environmental impact significance associated with this issue can be reduces to an acceptable level (low) given that fires are a natural part of the environment and landuse in this area. To achieve this, however, Eskom's relationship with landowners in the study area needs to improve, and the efforts reported by Eskom Transmission and Distribution at the time of writing are encouraging and should be continued.

The addition of a parallel 400kV line next to the Majuba-Venus #2 line should therefore have a low impact on the fire management environment, and should even improve the current situation.

7.5. LIGHTNING

It is a common concern that the presence of power lines and pylons increase the risk of lightening strikes where they occur. This section seeks to report on the risks associated with Transmission lines (i.e. above 132kV).

There are three main conductors plus an earth wire to each power line. Transmission line configurations usually place the earth wire above the main conductors, essentially to protect the main conductors from lightning strikes. These earth wires therefore effectively act as lightning shields for animals and people below them.

The condition around the pylons is the same provided the pylon is properly earthed. Any lightning strike on the pylon tower is transmitted to the earth unless there is high electrical resistance in the foundations of the tower. Soil samples are taken at each tower location during construction and the resistivity of the soil is tested. The tower is then earthed according to the soil conditions.

If the pylon is not properly earthed, or the earth wire on the tower structure has become faulty, it is possible that animals or people in close vicinity to a tower during a lightning strike may be injured. In these instances the landowner has a right to claim damages from Eskom. As with reported incidences of fire, Eskom will investigate the claim and should provide a written report on the findings.

It is important to note that Eskom is able to monitor all lightning strikes on the Transmission network. Therefore, as part of any such investigation, checks will be done on the location of recorded strikes in conjunction with the location of the claim.

This impact assessment must assume that the towers will be properly earthed. Based on work done by the CSIR in 1994, the study area lies on the edge of one of the highest ground-flash densities in the country; the eastern area of Lesotho and the Drakensberg Mountain Range where an average of 12 to 14 ground-flashes/km^2/annum have been recorded. In the study area the range is seen to be between 8 and 10 ground-flashes/km^2/annum, and though the western areas are likely to have the higher risk of ground-flashes, the risk is seen to be similar across the study area as a whole. Therefore, the likelihood of injury to people and animals is seen to be the same everywhere in the study area and, assuming properly earthed towers, the level of environmental significance should be low. Nevertheless, during the comment period on the Draft Scoping Report a case of loss of livestock next to a pylon was reported, and it is clear that extra care should be exercised in earthing pylons in areas of high lightning incidence.

7.6. SUMMARY OF IMPACTS

The summary below is derived from the Impact Tables in Appendix 2.

ISSUE	DETAILS	PHASE OF CONCERN	POTENTIAL SIGNIFICANCE OF IMPACT	
			Before Mitigation	After Mitigation
1. ECONOMIC				
1.1 National and Provincial Impact	National and provincial importance of project in terms of promoting economic growth in the region and South Africa	Operation	High (positive)	High (positive)
1.2 Local Benefits	Economic benefits that the Transmission line will bring to local communities	Construction & operation	Low to Moderate (positive)	Moderate (positive)
1.3 Job Creation	Employment of local labour (South African citizens and people local to the area) and preference given to a local contractor	Construction & operation	Low to Moderate (positive)	Moderate (positive)
1.4 Tourism	The line will detract from the aesthetic appeal of the natural environment, and will therefore negatively impact on tourism activities	Operation	Low to moderate	Low
2. WELL BEING:				
2.1 Electro-magnetic fields	Impact of electromagnetic fields (EMFs) on animals, people and vegetation	Operation	Low	Low
2.2 Dust & Noise (within plant area)	Dust & noise control during construction	Construction	Low	Low
2.3 Corona noise	The effect of the corona (low "buzzing" noise) may be noticeable in properties immediately adjacent to the servitude.	Operation	Low	Low
2.4 Use of creosote poles	Creosote poles may be used during the project and may have a negative health implications and an ecological impact	Construction	Low	Low
2.5 Fire hazard	The construction and operation of the line may alter the occurrence and management of fires in the area. The change in the nature of fire hazards and events can have safety, economic and ecological implications.	Operation & Construction	Potentially High	Moderate to Low
2.6 Lightning	Risk of damage to property and injury to animals and people in close proximity to the lines.	Operation	Potentially High	Moderate to Low
3. AESTHETICS:				
3.1 Visual impact	Visual impacts will be significant in the local area	Operation	Moderate	Moderate
3.2 Sense of Place	Negative impact on the spiritual, aesthetic and therapeutic qualities associated with the area in the vicinity of the line	Operation	Moderate	Moderate
4. SOCIAL:				
4.1 Relocation of people	Will there be a need to relocate people, and their property/houses? What are the likely impacts? Will they be compensated?	Construction	Moderate to Low (negative)	Low (positive)

ISSUE	DETAILS	PHASE OF CONCERN	POTENTIAL SIGNIFICANCE OF IMPACT	
			Before Mitigation	After Mitigation
4.2 Disruption of social networks and daily movement patterns	The social routine and social networks may be disrupted during the construction process.	Construction	Moderate	Moderate to low
4.3 Location of construction camps	The siting of construction camps	Construction	Potentially High	Potentially low (positive)
4.4 Gravesites	Protection of gravesites, disinternment of graves	Construction	Low	Low
4.5 Traffic Safety	Road traffic safety, particularly relating to construction traffic.	Construction	Moderate to high	Low to moderate
5. LAND ISSUES				
5.1 Property value reduction	Negative impact on property values	Operation	Moderate (perceived)	Low (positive)
6.FARMING RELATED ISSUES				
6.1 Access to properties	The creation of new or improved access to properties, for access to the line, brings potential associated issues that need to be considered.	Construction & Operation	Moderate to High	Low
6.2 Access roads	The physical creation and use of new roads, or increased use of existing roads will also have associated impacts	Construction & Operation	Potentially High	Moderate to Low
6.3 Loss of agricultural potential	Restrictions on landuse and activities will impact on the agricultural potential of the land.	Construction & Operation	Low to Moderate	Low
6.4 Season for construction activities	Certain activities (construction and operation) may have greater impacts on the environment and agricultural activities at certain times of the year.	Construction	Moderate to High	Moderate to Low
7. NATURAL ENVIRONMENT:				
7.1 Erosion	Erosion on access roads may become a problem.	Construction & Operation	Moderate to low	Low
7.2 Impact on fauna	Impacts on the natural fauna in the area	Construction & Operation	Moderate to high	Low
7.3 Impacts on Avifauna (birds)	Impacts on birds.	Operation	Potentially high	Low
7.4 Impact on flora	General impacts on flora.	Construction & Operation	Moderate	Low
7.5 Impact on wetlands	Potential damage to wetlands in during construction and maintenance	Construction & Operation	Potentially high	Low
7.6 Importation of alien vegetation	Importation of alien vegetation through building materials	Construction	Moderate to High	Low
7.7 Impact of herbicides	Herbicides will be used during the construction and operation phases of the project to clear and potentially manage the line.	Operation	Moderate	Low

ISSUE	DETAILS	PHASE OF CONCERN	POTENTIAL SIGNIFICANCE OF IMPACT	
			Before Mitigation	After Mitigation
7.8 Impact of construction camps	The construction camps may have an impact on the natural environment	Construction	Potentially High	Moderate to low
8. CULTURAL AND ARCHAEOLOGICAL SITES				
8.1 Palae-ontological Sites	Impact on fossils.	Construction	negligible	Negligible
8.2 Archaeology	Impact on late stone age and possible iron age sites.	Construction	Moderate to Low	Low
8.3 Cultural, Historical and National Heritage Sites	Impact on Battlefield sites.	Construction	Potentially high	Low
9. CONSTRUCTION CAMP ISSUES				
9.1 Inmigration of construction workers	Inmigration of construction workers may lead to social disruption, increased crime, sexually transmitted diseases.	Construction	Potentially moderate to high	Moderate to low

8. RECOMMENDATIONS

A number of recommendations are set out in this report, particularly in the Impact Tables in Appendix 2, and these are considered relevant to the future implementation of the project. However, a number of general recommendations are made here.

- Issues raised by landowners along the preferred route that are related to problems and concerns on the existing power lines in the area need to be followed through by Eskom. Senior management attention has already been given to the issues, but it is understood there are still some outstanding matters. These issues relate to the Ladysmith Farmers Association in particular.
- In this regard, it is recommended that Eskom clarify, with landowners, issues relating to servitude access, maintenance and fire management in the servitude and associated responsibilities. It is suggested these responsibilities are clearly set out in the servitude agreements. A greater level of integration with local fire fighting associations is also recommended.
- Extra attention should be given to earthing the pylons in the whole study area.
- It is recommended that the Braamhoek-Venus 400kV line and the Turn-in from the Majuba-Venus #2 line be run in parallel, and that the construction of the two should be done simultaneously.
- Once authorisation is obtained for the route of the line, wayleaves or servitudes will be required from certain authorities where the line crosses their land. These include the N3TC for the planned De Beers Pass highway and Petronet for their pipelines (there is a crude oil line and a refined products line that pass through the area.
- Construction camps for the two projects should also be combined, and as far as possible this should be integrated with the construction camps for the Braamhoek P.S.S. and Braamhoek Substation.

- Liaise with local municipalities regarding availability of local goods and services relevant to the construction of the Transmission infrastructure, and the location of construction camps. Emnambithi Municipality in particular has offered assistance in this regard.
- Relocation of dwellings and homesteads are expected to be few, but a formal relocation programme should be drafted and implemented. Clear documentation of agreements with owners and relocation activities should be available.
- The construction programme should set out anticipated rehabilitation activities and timing. Emergency rehabilitation measures should also be identified (eg for spillage containment, erosion, plant damage, etc.).
- It is important that Eskom appoints a full time Environmental Control Officer (ECO) for the construction planning and construction phase. This ECO will be able to initiate specialist surveys in the design phase (archaeology and ecology) and will ba responsible for drafting a detailed Environmental Management Plan.
- In support of this, it is recommended that the Department of Agriculture and Environmental Affairs – Kwa-Zulu Natal monitor the construction planning and the construction programme.

9. CONCLUDING REMARKS

Comments received on the Draft Scoping Report are set out in Appendix A – Public Participation Process. Though no new issues were raised, some of those raised during the Scoping Study were reinforced. In particular, servitude maintenance and operation of existing lines were a concern of those along the Western Route. It remains the view of the EIA consultant that these do not have bearing on the identification of the best environmental route, and that the issues raised fall outside the scope of this study. However, in support of principles of responsible development and sound environmental management, it will be important for these matters to be addressed before construction of the new line.

The Western Route therefore remains the preferred route for the new Braamhoek – Venus 400kV Transmission line. This option, in combination with the Braamhoek Turn from the Majuba-Venus #2 line, is seen to offer the least impact on the environment.

However, though the levels of impact significance are generally seen to be reduced to a moderate or low level, the route goes through an area of high visual quality, and every effort should be made to minimise any disturbances and that rehabilitation should be implemented as soon as possible in the construction programme.

Furthermore, it is again stressed that current servitude management responsibilities must be clarified with landowners.

APPENDIX 1: MAPS AND LOCATION DATA

BRAAMHOEK P.S.S. - Transmission Integration

General Data Sheet

	Lat.	Long.	
Braamhoek P.S.S.	28° 19'S	29° 35'E.	Farms Braamhoek 1220, Bedford 1845
Braamhoek Sub.1	28° 16.69'S	29° 35.35'E.	Farm Zaaifontein 1070
Braamhoek Sub.2	28° 16.85'S	29° 34.52'E.	Farm Braamhoek 1220
Braamhoek Sub.3	28° 16.60'S	29° 34.18'E.	Farm Braamhoek 1220
Venus Substation	28° 56.28'S	29° 50.74'E.	

The direct distance between Braamhoek and Venus is 79km.

Month	Monthly rain (mm)		Daily Mean Temp (deg C)		Relative Humidity (%)	
	Nr Braamhoek	Nr Venus	Nr Braamhoek	Nr Venus	Nr Braamhoek	Nr Venus
Jan	158	121	20	22	64	68
Feb	141	101	20	22	66	68
Mar	109	95	18	20	66	68
Apr	47	41	16	18	62	66
May	22	20	12	14	58	62
Jun	12	11	10	12	56	60
Jul	12	11	10	12	54	58
Aug	21	21	12	14	54	58
Sep	45	43	14	16	58	62
Oct	84	68	16	18	60	64
Nov	118	102	18	20	64	66
Dec	131	116	20	22	64	68
MAP	900	750				

Frost:	Duration of frost risk period	120 days	mid May-mid August
	Days below zero degrees Centigrade	30 - 40	(average)
Hail risk:	(Average)	5 - 7 days/an	
	High risk area = Spionkop / Winterton	+ 7 days/an	

Snow: The northern sections of the study area regularly (annually) experience snow, and snow loading on the lines will need to be considered in the design. Snow does occur in other areas (particularly western parts of the study area), but the snow is seldom as heavy and is less frequent (estimated once every three to five years on average).

Fire risk: The grassland areas are high-risk fire areas, particularly in the northern and western parts of the study area. Fire management of the veld is a common practice, and co-ordinated burning programmes are in operation within the different Farmers Associations.

Lightning: Lightning ground-flash density is among the highest in the country in this area. Average ground-flash densities of 8 - 9 flashes/km^2/annum are reported for much of the area, though in the western areas these go up to an estimated 10 - 12 flashes/km^2/annum.

Soils:	Western & northern areas	moderate to deep clays (moderate erodability)
	Eastern & southern areas	moderate to deep clay loams (moderate to high erodability)

Slopes: In general, the terrain is described as undulating, though with particularly steep areas in the middle of the study area, along the main river valleys (Tugela, Klip & Bloukrans) and in the northern sections.

Erosion: Erosion is more evident in the eastern areas, but areas of erosion occur in places in much of the study area

APPENDIX 2: IMPACT TABLES

APPENDIX 3: ESKOM NEED AND DESIRABILITY STATEMENT

APPENDIX 4: SOCIO-ECONOMIC ASSESSMENT REPORT

APPENDIX 5: VISUAL IMPACT ASSESSMENT REPORT

APPENDIX 6: ECOLOGICAL IMPACT ASSESSMENT REPORT

APPENDIX 7: AVIFAUNA IMPACT ASSESSMENT REPORT

APPENDIX 8: ARCHAEOLOGY, CULTURAL AND HERITAGE ASSESSMENT REPORT