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6 March 2013

Attention: Lerato Mokoena
Department of Environmental Affairs
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Dear Madam,

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE STEELPOORT TO WOLWEKRAAL 400 KV POWERLINE

DEA REFERENCE: 12/12/20/1341

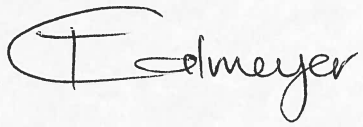
Eskom applied and was issued with a positive Environmental Authorisation (EA) in April 2011 for the construction of the Steelpoort to Wolwekraal 400 kV Powerline. Subsequent to the authorisation, Eskom renamed the project to Tubatse to Marblehall (Silimela) 400 kV Powerline. One of the conditions of the EA was that Eskom must appoint specialists to conduct walkthroughs along the line and update the Construction Environmental Management Programme (CEMP), which would be submitted for approval by the Department of Environmental Affairs (DEA).

Eskom submitted the CEMP titled "*Construction Environmental Management Programme for the Tubatse-Marblehall 400 kV Powerline*" on 4 February 2013. The DEA requested that Eskom revises the CEMP and revert back to the name in the EA.

Please find enclosed the revised final Construction Environmental Management Programme (CEMP) for the Steelpoort-Wolwekraal 400kV Powerline.

Please do not hesitate to contact the undersigned if there are any further queries.

Yours Sincerely



Terry Calmeyer
For ILISO Consulting (Pty) Ltd

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMME (CEMP) FOR THE STEELPOORT TO WOLWEKRAAL 400kV POWERLINE

REVISION 1

DEA REFERENCE: 12/12/20/1341

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CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE STEELPOORT TO WOLWEKRAAL 400kV POWERLINE

DEA Ref. no. 12/12/20/1341

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ILISO Consulting (Pty) Ltd

Approved for ILISO (Pty) Ltd by:

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Terry Calmeyer

Environmental Assessment Practitioner

Date: 2013-03-06

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF APPENDICES

LIST OF ABBREVIATIONS

BA	Basic Assessment
C	Contractor
CECO	Contractor Environmental Control Officer
CEMP	Construction Environmental Management Programme
CM	Contract Manager
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental management Programme
FAO	Food and Agriculture Organisation
I&APs	Interested and Affected Parties
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NWA	National Water Act, 1998 (Act 36 of 1998)
OHSA	Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)
PM	Project Manager
PPE	Personal Protective Equipment
UN	United Nations
USDA	United States Department of Agriculture
WRB	World Reference Base for Soil Resources
WWTW	Wastewater Treatment Works

1. INTRODUCTION

The following is a Construction Environmental Management Programme (CEMP) to mitigate against the potential environmental impacts related to the proposed Steelpoort to Wolwekraal 400kV powerline and its associated secondary infrastructure.

Subsequent to the Environmental Impact Assessment (EIA) report compiled by Nemai in 2010 an Environmental Authorisation (EA) was issued by the Department of Environmental Affairs. The EA (**Appendix A**) specified a number of specific conditions that need to be adhered to in the construction and operation of the Steelpoort to Wolwekraal 400kV powerline. This CEMP document is based on the findings of the Draft Construction and Operation Environmental Management Plan submitted as part of the Final EIA report (Nemai, 2010), and has been amended by ILISO Consulting (Pty) Ltd based on the findings of walkthroughs that were conducted by heritage, fauna, flora and wetlands as well as agriculture specialists in November and December 2012.

The construction and refurbishment of transmission power lines can have a significant impact on the environment. It is thus imperative that better precautions be taken to ensure that environmental damage is prevented, minimised or mitigated. This will take a concerted effort from the Contractor and proper planning is of the utmost importance.

1.1 SCOPE

The scope of this document is to give environmental management specifications, to the Contractor constructing the Steelpoort to Wolwekraal 400kV powerline, in fulfilment of ISO 14001 requirements, and the conditions set out in the Environmental Authorisation (EA) issued by the Department of Environmental Affairs (DEA) on 19 April 2011. This document is part of the contract and supplementary to Eskom's Specification for Transmission Line Towers and Line Construction. **The recommendations and constraints, as set out in this document are enforceable under the general conditions of contract**.

The environmental management programme has a long-term objective to ensure that:

1) Environmental management conditions and requirements are implemented from the start of the project;
2) Precautions against damage and claims arising from damage are taken timeously; and
3) The completion date of the contract is not delayed due to problems with Landowners arising during the course of construction.

Eskom requires a commitment from the Eskom Project Manager and the Contractor on the following issues:

1) Take into consideration the Landowner special conditions as the line traverses private property.
2) To underwrite Eskom Transmission's Environmental Policy at all times.
3) Ensure environmental conditions stipulated in the Environmental Authorisation are implemented.
4) Resolve problems and claims arising from damage immediately to ensure a smooth flow of operations.
5) To implement this EMP for the benefit of all involved.
6) To preserve the natural environment by limiting destructive actions on site.

1.2 REPORTING STRUCTURE

ECO: - Environmental Control Officer
C: - Contractor
CM: - Contract Manager (Eskom)
CECO: - Contractor Environmental Control Officer (Dedicated person)
PM: - Project Manager (Eskom)
DEA: - Department of Environmental Affairs

1.3 RESPONSIBILITY MATRIX

Function	Name / Cell No	Responsibility
Project Manager (PM) (Eskom)	TBA	Overall management of project and CEMP implementation.
Site Supervisor/ Contract Manager (CM) (Eskom)	TBA	Oversees site works, liaison with Contractor, PM and ECO.

Function	Name / Cell No	Responsibility
Environmental Control Officer (ECO) – appointed by Eskom	TBA	Implementation of CEMP and liaison between Eskom, Contractor and Landowners,
Contractor (C)	TBA	Implementation and compliance with recommendations and conditions of the CEMP, Appointment of a dedicated person (Community Liaison Officer) to work with ECO.
Contractor Environmental Control Officer (CECO)	TBA	Implementation of CEMP, landowner interaction, environmental control of site actions, re-mediation and rehabilitation work.
Transmission Services Environmental Advisor (Eskom)	TBA	Environmental advice and auditing.

(Table to be completed upon Contract award)

The ECO shall convey the contents of this document, the conditions of the Environmental Authorisation (EA) from DEA as well as the Landowner conditions to the Contractor's site staff and discuss the contents in detail with Eskom's Project Manager and Contractor at a pre-construction meeting. This formal induction training is a requirement of ISO 14001 and shall be done with all main and sub-Contractors. A record of the training date, people who attended the training and discussion points shall be kept by the ECO. Included in the formal induction training is ensuring that the Contractor, Site Agent, Construction Supervisor and Safety Officer are conversant with the mitigation measures and to verify that the Contractor's employees have undergone induction on these measures.

The ECO shall monitor the execution of the mitigation measures and ensure the safeguarding of the environment.

The ECO shall make contact with the local Extension Officer of the Department of Agriculture and the Chairpersons of the Farmers Associations where the route

traverses, as these contacts have valuable information about the area and the local farming community.

Landowners shall therefore be informed timeously of the construction programme, duration and all interference with their daily activities.
The contact numbers of the ECO and CECO shall be made available to Landowners.

The ECO shall report progress made on a monthly basis to the Project Manager (PM). These reports shall be available at all times, on site or in the project file and be made available on request by auditors, DEA and other Interested and Affected Parties (I&APs).

The ECO shall record all non-conformances and action plans to ensure that measures are put in place to remedy possible effects.

The ECO shall facilitate communication between I&APs, Eskom and the Contractor.

All environmentally sensitive areas are indicated on the profiles and the Project Manager and Contractor shall take note of these. **The Contractor shall take all the necessary precautions to prevent damage.**

During the construction period at Environmental Audits shall be conducted every 6 months to determine compliance with the recommendations of the EIA, EMP and conditions of the Environmental Authorisation. These can be internal audits or external by DEA or the ISO14001 auditors or combined audits.

2. DESCRIPTION OF THE PROJECT

The transmission line shall run for approximately 65 km from the Steelpoort switching station to the proposed Wolwekraal switching station. The purpose of the line is to supply the Steelpoort Pumped Storage Scheme PSS with the energy it requires. The powerline will traverse the Greater Marble Hall Local Municipality, and the Elias Motsoaledi Local Municipality. It will also traverse the Makhuduthamaga Local Municipality.

The powerline originates in the Wolwekraal area and extends north-eastward through agricultural areas of the Farm *Blauwwildebeestfontein 16 JS* before crossing the Olifants River. It continues north-eastwards and runs in between the settlement areas of Rite and Ngwalemong, turns eastwards and passes the settlement areas of Luckau, Mareleng and Ga-Matloponya, after which it turns to run south-eastwards. At Mmotwaneng the line turns southwards through the area of Hlogotlou. It then turns eastwards to cross over the Thaba Ya Sekhukhune Mountains, after which it turns southwards and terminates at the Steelpoort Substation located on the western side of the Steelpoort River between Steynsdrift 145 JS and Luiperdshoek 149 JS. A total of 33 landowners are affected by the powerline (Nemai, 2010). **Figure 2-1** and **Appendix B** show the location of the powerline.

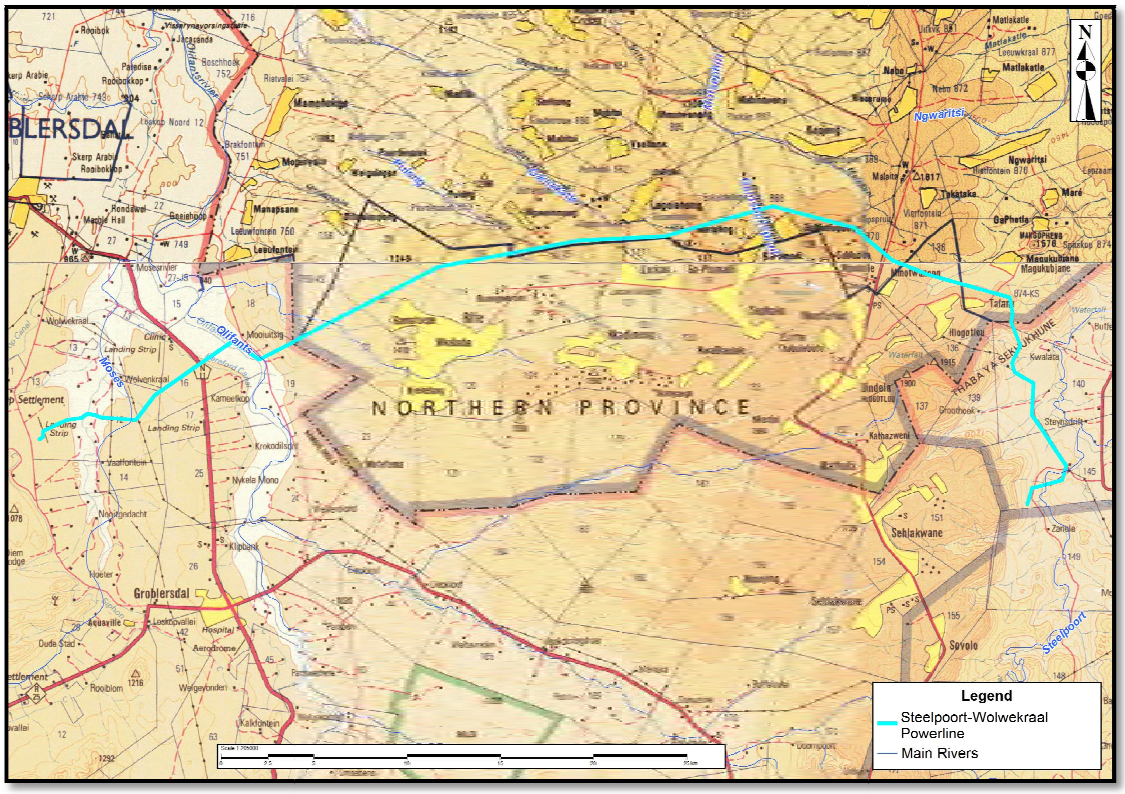

Figure 2-1: Steelpoort to Wolwekraal 400 kV Powerline Locality Map

3. CONDITIONS OF THE ENVIRONMENTAL AUTHORISATION

In terms of the Environmental Authorisation that was issued by the DEA, the following conditions will apply.

3.1 SCOPE OF AUTHORISATION

- The preferred route corridor Alternative 2 (northern route) is approved.
- The holder of the authorisation shall be responsible for ensuring compliance with the conditions contained in the environmental authorisation. This will include any person acting on the holder's behalf, including but not limited to, an agent, servant, contractor, sub-contractor, employee, consultant or person rendering a service to the holder of the authorisation.
- The activities authorised may only be carried out at the property described in the authorisation.
- Any changes to, or deviations from, the project description set out in the authorisation must be approved, in writing, by the Department before such change or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deem necessary to evaluate the significance and impact of such changes or deviations and it may be necessary for the holder of the authorisation to apply for further authorisation in terms of the regulations.
- The activity must commence within five (5) years from the date of issue. If commencement of the activity does not occur within that period, the authorisation lapses and a new application for environmental authorisation must be made in order for the activity to be undertaken.
- Commencement with on activity listed in terms of the authorisation constitutes commencement of all authorised activities.
- This authorisation does not negate the holder of the authorisation‘s responsibility to comply with any other statutory requirements that ay be applicable to the undertaking of the activity.
- Relevant legislation that must be complied with by the holder of the authorisation includes inter alia:
    - Archaeological remains, artificial features and structure older than 60 years are protected by the National Heritage Resources Act, 1999 (Act No 25 of 1999). Should any archaeological artefacts be exposed during excavation for the purpose of construction, construction in the vicinity of the finding must be stopped immediately. A registered Heritage Specialist must be called to the

site for inspection. Under no circumstances shall any heritage material be destroyed or removed from the site and the relevant heritage resource agency must be informed about the finding. Heritage remains uncovered or disturbed during earthworks must not be disturbed further until the necessary approval has been obtained from the South African Heritage Resources Agency and/or any of their delegated provincial agencies.

- All provisions of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).
- All provisions of the National Water Act, 1998 (Act No. 36 of 1998).
- All provisions of the National Forests Act, 1998 (Act No. 84 of 1998).
- All provisions of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
- All provisions of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) and its Regulations
- Should fill material be required for any purpose, the use of borrow pit must comply with the provisions of the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) administered by the Department of Minerals and Energy.

- The holder of the authorisation has the responsibility to notify the competent authority of any alienation, transfer and change of ownership right in the property on which the activity is to take place.
- The EMP submitted as part of the application for EA must be amended and submitted to the Department for written approval prior to commencement of the the activity. The recommendations and mitigation measures recorded in the EIR dates September 2010 must be incorporated as part of the EMP. Once approved, the EMP must be implemented and adhered to.

3.2 MONITORING

- The applicant must appoint a suitably experienced independent ECO for the construction phase of the development that will have the responsibility to ensure that the mitigation/rehabilitation measures and recommendations referred to in tho authorisation are implemented and to ensure compliance with the provisions of the EMP.
- The ECO shall be appointed before commencement of any authorised activity/ies.

- Once appointed, the name and contact detail of the ECO must be submitted to the Director: Compliance Monitoring of the Department.
- The ECO shall keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.
- The ECO shall remain employed until all rehabilitation measures, as required for implementations due to construction damage, are completed and the site is ready for operation.
- Records relating to monitoring and auditing must be kept on site and made available for inspection to any relevant and competent authority in respect of this development.

3.3 RECORDING AND REPORTING TO THE DEPARTMENT

- All documentation eg audit/monitoring/compliance reports and notifications, required to be submitted to the Departments in terms of the authorisation, must be submitted to the Director: Compliance Monitoring of the Department.
- The holder of the authorisation must submit an environmental audit report upon completion of the construction and rehabilitation activities.
- The environmental audit report must indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions as well as the requirements of the EMP.
- All compliance monitoring and audit report must be submitted to the Director: Compliance Monitoring of the Department.

3.4 COMMENCEMENT OF THE ACTIVITY

- The authorised activities shall commence within 30 days of the date of signature of the authorisation.
- An appeal under Section 43 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (as amended), does not suspend an environmental authorisation or exemption, or any provisions or conditions attached thereto, or any directive, unless the Minister, EC or delegated organ of state directs otherwise.

3.5 NOTIFICATION TO AUTHORITIES

- Fourteen (14) days written notice must be given to the Department that the activity will commence. Commencement for the purposed of thi condition included site preparation. The notice must include a date on which it is anticipated that the

activity will commence. This notification period may coincide with the period contemplated above.

3.6 OPERATION OF THE ACTIVITY

- Fourteen (14) days written notice must be given to the Department that the activity operational phase will commence.
- The applicant must compile an operational EMP for the operational phase of the activity or alternatively, if the applicant has an existing operational environmental management system, it must be amended to include the operation of the authorised activity.

3.7 SITE CLOSURE AND DECOMMISSIONING

- Should the activity ever cease or become redundant, the applicant shall undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

3.8 SPECIFIC CONDITIONS

- Anti-collision devices such as bird flappers must be installed where the power lines crosses avifaunal corridors. The input of an avifaunal specialist must be obtained for the fitting of the anti-collision devices onto specific sections of the line once the exact positions of the towers have been surveyed and pegged.
- A floral and faunal specialist should be present during the planning and pegging of the final route alignment to ensure that the positions of pylons result in minimum impacts on sensitive vegetation, protected trees and habitats.
- An agricultural specialist must form part of the walk through in the final route determination in order to identify critical centre pivot irrigation systems which need to be avoided by the power line.
- The wetlands, including rivers, riparian zones and river banks must be designated as sensitive areas and must be demarcated as such. No construction activities (including placing of pylons, temporary ablution, fuel storage, storing of equipment, waste disposal, construction camps, vegetation clearing, excavations, access roads, soil stockpiling and material storage) must take place in such sensitive area.
- A wetland specialist should be present during the pegging of the final route alignment to ensure that no pylons are placed within wetlands and river banks.

- No activities will be allowed to encroach into a water resource without a water use authorisation being in place from the Department of Water Affairs.
- No exotic plants may be used for rehabilitation purposes. Only indigenous plants of the area may be utilised.
- Indigenous vegetation which does not interfere with the safe operation of the power line must left undisturbed.
- Protected trees must not be cut or removed prior to a licence being obtained in line with the National Forests Act, 1998 (Act No 84 of 1998) administered by the Department of Agriculture, Forestry, and Fisheries.
- The EMP must include the final route indicating all sensitive features or aspects which were avoided and those that could not be avoided. (Game farms, centre pivots, wetlands, rivers, ridges, heritage resources, visual intrusion, vegetation including protected trees and residential communities).
- Liaison with communities and land owners is to be done prior to construction in order to provide sufficient time for them to plan livelihood activities.
- An integrated waste management approach must be implemented that is based on waste minimisation and must incorporated reduction, recycling, re-use and disposal where appropriate. Any solid waste shall be disposed of at a landfill in terms of section 20 (b) of the National Environment Management Waste Act, 2008 (Act No 59 of 2008).

3.9 GENERAL

- A copy of this authorisation must be kept at the property where the activities will be undertaken. The authorisation must be produced to any authorised official of the Department who requests to see it and must be made available of inspection by any employee or agent of the holder of the authorisation who works or undertakes work at the property.
- Where any of the applicant's contact details change, including the name of the responsible person, the physical or postal address and/or telephonic details, the applicant must notify the Department as soon as the new details become known to the applicant.
- The holder of the authorisation must notify the Department, in writing and within 48 (forty eight) hours, if any condition of this authorisation cannot be or is not adhered to. Any notification in terms of this condition must be accompanied by reasons for the non-compliance. Non-compliance with a condition of this

authorisation may result in criminal prosecution or other actions provided for in the National Environmental Management Act, 1998 and the regulations.

- National government, provincial government, local authorities or committees appointed in terms of the conditions of this authorisation or any other public authority shall not be held responsible for any damages or losses suffered by the applicant or his successor in title in any instance where construction or operation subsequent to construction be temporarily or permanently stopped for reasons of non0compliance by the applicant with the conditions of authorisation as set out in this document or any other subsequent document emanating from these conditions of authorisation.

4. LEGISLATION, DEVELOPMENT STRATEGIES AND GUIDELINES

On compiling this CEMP, the following legislation and guidelines/policies were taken into consideration:

- The National Environmental Management Act, 1998 (Act No 107 of 1998);
- The National Heritage Resources Act, 1999 (Act No 25 of 1999);
- The National Water Act, 1998 (Act No 36 of 1998);
- The Occupational Health and Safety Act, 1993 (Act No. 85 of 1993);
- The National Forests Act, 1998 (Act No. 84 of 1998).
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
- The National Fencing Act, 1963 (Act No 31 of 1963 (as amended by Act 108 of 1991);
- The National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) and its Regulations;
- The Explosives Act , 2003 (Act No. 15 of 2003);
- The National Veld and Forest Fire Act (Act 101 of 1998), National Forests Act (Act 30 of 1998);
- The Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965) (APPA);
- The Conservation of Agricultural Resources Act, (Act 43 of 1983);
- South African National Standard (SANS) 10228:2005;
- Procedure for Access to Farms (TRMPVACV2 REV 1);
- Eskom Standard for bush clearance and maintenance within overhead power line servitudes (ESKASABG3);
- Eskom Vegetation Management Guideline;
- Eskom Procedure for Access to Farms (TRMPVACV2 REV 1); and
- Eskom Construction Procedures for Transmission Line Towers and Line Construction (TRMSCAAC1 REV 3).

5. TECHNICAL SPECIFICATIONS OF THE LINE

The construction and refurbishment of Transmission power lines can have a major impact on the environment. It is thus imperative that better precautions be taken to ensure that environmental damage is minimised. This shall take a concerted effort from the Contractor and proper planning is of the utmost importance.

5.1 LENGTH

The transmission line shall run for approximately 65 km from the Steelpoort switching station to Wolwekraal substation.

5.2 TOWER PARAMETERS

- Tower spacing : 400m (Average)
- Tower height : 36m
- Conductor attachment height : 33m
- Conductor type : Bear
- Minimum ground clearance : 10m above the ground
- Separation between parallel power lines : 32m minimum

The Contractor shall ensure that the correct equipment for construction purposes is available at all times to ensure construction proceeds without damage to the environment. Shall alternative methods be used, it requires approval from the PM and the ECO shall be informed to ensure environmental issues are addressed as per the Environmental Authorisation and in terms of the principles of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

5.3 TOWER DESIGN

The following types of towers are used on this project:

- Cross rope suspension tower lines.
- Guyed-V suspension tower structures.
- Strain tower lines.

5.4 CONSTRUCTION AREA

The proposed powerline requires a servitude width of 55m (27.5m on either side of the centre of the powerline). Generally, the pylons to be used for the powerline can be spaced at 350m to about 550m apart, depending on the type of pylon used,

location of the bend points, topography and sensitive areas. The type of Pylons used is dependent on bend points, conductor configuration, voltage level and topography.

5.5 MAJOR ACTVITIES OF THE PROJECT

The project involves 21 major activities of which five (5) are completed. These are:

1. Environmental Impact Study – Copy of EA is appended to this document.
2. Negotiations for the servitude.
3. Land survey to determine the exact routing of the lines and tower placement.
4. Profiling work to produce the profiles for construction.
5. Pegging of bend tower by a Transmission surveyor.

The following activities are still to be performed for the powerlines:

6. Erection of camp sites for the Contractors' workforce.
7. Negotiations with landowners for access roads to the servitude.
8. Servitude gate installation to facilitate access to the servitude.
9. Vegetation clearing to facilitate access, construction and the safe operation of the line.
10. Establishing of access roads on the servitude where required.
11. Pegging of tower positions for construction by the contractor.
12. Transportation of equipment, materials and personnel to site and stores.
13. Installation of foundations for the towers.
14. Tower assembly and erection.
15. Conductor stringing and regulation.
16. Taking over the line from the contractor for commissioning.
17. Final inspection of the line, commissioning and hand over to the Grid Line and Servitude Manager for operation.
18. Rehabilitation of disturbed areas.
19. Signing off of all Landowners upon completion of the construction and rehabilitation.
20. Handing over and taking over of the servitude by the Grid Environmental Manager.
21. Operation and maintenance of the line by the Grid.

6. SPECIALIST WALKTHROUGHS

A wetland, flora and fauna, a heritage resources specialist and an agriculture potential specialist were appointed to conduct the walkthroughs along the lines and at the Steelpoort switching station. **Sections 6.1** to **6.3** provide summaries of the findings of the walkthroughs and the full specialist reports are attached as **Appendix C** of this report.

6.1 AGRICULTURE POTENTIAL

The walkthrough to assess the agriculture potential of the study area was conducted by Mr Petrus Stephanus Rossouw and Dr Johan van der Waals of Terra Soil Sciences.

Dr. Johan van der Waals completed his undergraduate studies in Soil Science and Botany at the Potchefstroom University for CHE (cum laude) in 1995. He completed his honours degree in Soil Science and Plant Nutrition (University of Pretoria) in 1999 (part-time), Masters in Soil Science and Plant Nutrition (University of Pretoria) in 2001 and PhD in Soil Science (University of Pretoria) in 2006. Both his Masters and PhD degrees focussed on heavy metal mobility in soils as a result of the use of metal containing waste products. He was a staff member in the department of Plant Production and Soil Science of the University of Pretoria from 1999 to 2007 and presented 13 courses of which many were self developed. His favourite and strongest course was Soil Classification in which the students were intensively exposed to the South African Taxonomic System as well as to the World Reference Base for Soil Resources (WRB) of the Food and Agriculture Organisation (FAO) of the United Nations (UN) and the United States Department of Agriculture's (USDA) Soil Taxonomy. During his tenure at the University of Pretoria he was actively involved in research on:

- heavy metal mobility in soils and the correlation of this mobility with easily classifiable soil properties,
- soil borne plant pathogens and the soil properties governing the incidence of the diseases (in collaboration with a number of other departments and institutes), and
- the influence of soil properties on the distribution of plants and animals (especially the Juliana's Golden Mole) in collaboration with a number of other departments and institutes.

Mr Petrus Stephanus Rossouw is the Director of Rossouw and Associates - Soil and Water Science (Pty) Ltd. He has 6 years experience and a MSc degree in Agriculture: Soil Science. He has experience in Forensic soil chemistry, contaminated land remediation, acid/neutral mine drainage and industrial effluent treatment using passive treatment systems, constructed wetland design, pedochemical and pedohydrological modelling. Mr Rossouw also has specialised experience in Water flow (saturated and unsaturated) and solute transport modelling in the vadose zone with the Hydrus 1D and Hydrus 2D/3D programs, chemical modelling with the PHREEQC code, laboratory and field based experimental design, critical evaluation of laboratory analytical procedures, report writing, project management, field data collection

6.1.1 Introduction

The Marble Hall/Groblersdal area is one of the best known and most productive agricultural regions in South Africa. The area is irrigated (Loskopdam irrigation scheme) and high yields of maize, potato, grapes, sunflower, tobacco, millet and manna (amongst other crops) are harvested here. Subsistence farming is practiced towards the Steelpoort switching station. The transmission line may therefore have a negative impact on food security in South Africa.

The aim of the walkthrough was to:

- Assess the agricultural potential and land capability of the study area;
- Determine the impact of the proposed transmission line on the agricultural potential of the area; and
- Propose mitigation measures to negate the negative impact of the proposed transmission line on the long term agricultural use of the area.

6.1.2 Criteria used to assess the Agricultural Potential of Soil

The assessment of agriculture potential was based on the physical features of the soil.

6.1.3 Description of the Study Area

The area is mountainous towards the Steelpoort switching station but forms flat areas in the higher lying parts that are mainly used for subsistence farming. Large portions of the area towards the Wolwekraal substation are under irrigation. The lower lying, higher agricultural potential area, lies approximately between 25° 02’ 40.32” S and

29° 25' 19.85" E (approximately 932 m above sea level) and 25° 05' 13.33" S and 29° 17' 50.85" E (approximately 928 m above sea level).

Figure 6-1: Location of the Steelpoort-Wolwekraal 400kV powerline

6.1.4 Findings

There are a number of towers that are situated next to centre pivots and may impact the edged of the centre pivots and therefore the agriculture potential of the area. These towers shall be moved. Please refer to the accompanying tower profiles for

the specific towers that shall be moved. **Table 6-1** provides a summary of the findings.

Table 6-1: Summary of findings from the agricultural potential specialist walkthrough

Tower	Description	Discussion	Mitigation and Recommendations
Tower 3 to 45	The towers generally span a high agricultural potential area with a number of centre pivots that can clearly be seen. The area is also relatively flat, making the cultivation of the land and irrigation easy. The area lies predominantly in the Bc and Bd land types with a small section comprising the Ib land type. The Bc and Bd land types are described as a plinthic catena: upland duplex and margalitic soils rare. The Ib land type refers to Miscellaneous land classes. This is land types with a soil pattern difficult to accommodate elsewhere. The Ib land type is dominated by exposed rock and shallow soils.	The soils in the vicinity of Towers 2, 4, 13 are deeper than 900mm, but surrounded by shallow soils.	These pockets of deeper soils cannot be cultivated in an economically viable manner and the towers shall not influence the agricultural potential of the soils.
		Tower 32 is situated on a soil of the Clovelly soil form (orthic A-horizon/yellow brown apedal B-horizon) that exhibits a depth of more than 1500 mm.	The soil is sandy in nature, of poor fertility status and currently not under cultivation.
		Towers 27, 28, 30, 34, 35, 38 and 39 are situated next to centre pivots and may impact the edges of the centre pivots. These pylons shall not have the same impact on food production as the pylons positioned in the centre pivots, but could hamper cultivation and especially irrigation.	The siting of towers was agreed with the landowner during negotiation process. The impact of the towers on agricultural activities of affected landowner's was assessed during the EIA and the landowners will be compensated accordingly.
		Towers 38 and 44 are positioned in areas that are currently under cultivation. The area where tower 44 is positioned is no longer used as a centre pivot irrigation system, but has been converted to a citrus farming area. Towers 38 and 44 shall adversely affect food production in the area.	The siting of T38 and T44 was agreed with the landowner during the negotiation process. The impacts of towers on agricultural activities of the affected landowners were assessed and the landowners will be compensated accordingly.
Tower 59 to 156	These Towers are positioned in areas where subsistence farming is practiced. Cultivation is less easy than in the section west of this area and water for irrigation is not readily available. Deep soils are	Towers 93, 94, 105, 106, 107, 134 and 135 shall impact on the agricultural potential of the soils. However:	It is unlikely that the positions of the pylons shall adversely affect the food security of the area.

Tower	Description	Discussion	Mitigation and Recommendations
	interspersed with granite outcrops so that the land that can be cultivated occurs in smaller patches than is the case in the Loskop irrigation scheme. Fast stretches of land has nonetheless been cultivated in the past, but is currently not under cultivation or has not been ploughed for the next growing season. This is typical of subsistence farming. Towers 150 and 153 are positioned on wetland soils.	i. These areas of medium to high agricultural potential are interspersed by low agricultural potential soils. In fact, the greater portion of the area is of low to medium agricultural potential. It is doubtful that these areas of higher agricultural potential are large enough to be able to accommodate an economically viable dryland production scheme. ii. Small patches of land are currently being cultivated. Most of the medium to high agricultural potential soils are left fallow. The pylons shall not have a major impact on the subsistence farmers. iii. The farmers are not afraid to plough around structures that would impede the functionality of irrigation schemes	
Towers 47 to 58 and 156 to 168	The majority of the towers are positioned on medium to low agricultural potential soils. Towers 47 to 58 and 156 to 168 are located in mountainous regions.		

6.2 HERITAGE RESOURCES

The walkthrough for the heritage resources was conducted by Dr. Johnny van Schalkwyk Head of Research: National Cultural History Museum.

Dr. Johnny van Schalkwyk has 32 years of experience in both anthropology and archaeology. As an Assistant Researcher, he was responsible for excavations at various sites in the provinces of Limpopo and Mpumalanga. He undertook extensive field work in anthropology and archaeology between 1978 and 1991 as a Curator for the Anthropological Department of the National Cultural History Museum. His work extends to the provinces of Gauteng and North West as well as Botswana, Lesotho and Swaziland. He curated various exhibitions at different museums ranging from ceramics, beadwork and woodcraft to Iron Age Archaeology. He has conducted more than 800 Heritage Impact Assessment studies (archaeology, anthropology and social) for various government departments and private companies. The projects he worked on include powerlines, roads, pipelines, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments. He is currently the Head of the Department: Research where he supervises about seven researchers. He has published more than 50 papers on topics relating to anthropology, archaeology, and history and impact assessment in various scientific journals.

6.2.1 Introduction

The aim of the heritage specialist walkthrough was to analyse and recommend heritage management mitigation measures and monitoring programmes for sites, features and objects within the corridor of the proposed power line. Areas with important heritage resources were mapped and described, and mitigation measure to be employed at each site were identified.

6.2.2 Findings

A number of archaeological sites and graves and cemeteries were identified. These are summarised in **Table 6-2.**

Table 6-2: Summary of heritage resources along the powerlines and substation

Tower	Site Type	Description	Latitude	Longitude	Significance	Mitigation and Recommendations
Between Tower 189 and 190	Archaeological Site	Ephemeral stone walling with no distinctive layout. Due to the difficulty in determining the stone walling, its size could not be determined.	S 25.11071	E 29.83828	High on a regional level – Grade III	As this site is located some distance from the power line, it is unlikely that it would be impacted on by the development of the power line. A permit should be obtained from SAHRA for the possible impact on the site before construction commences.
Tower 188	Archaeological Site	Stone walling which probably formed part of a homestead with a cattle kraal. It is estimate to be approximately 80 x 50 metres in size.	S 25.10819	E 29.84185	High on a regional level – Grade III	This site is close to Tower 188 and also below the power line. If the tower cannot be moved, an archaeologist shall be present when construction takes place. It is also recommended that prior to construction taking place that the area surrounding the site is cleared by hand in order to determine the full extent of the site. A permit should be obtained from SAHRA for the possible impact on the site before construction commences.
Tower 186. The site is also located below the line	Archaeological sites	Strategically located stone walled site on a ridge overlooking Steelpoort River. The site consists of a large cattle kraal and smaller stone circles on the periphery. It is estimate to be 150 by 80 metres in size.	S 25.10253	E 29.84378	High on a regional level – Grade III	If the towers cannot be moved, an archaeologist shall be present when construction takes place. It is also recommended that prior to construction taking place that the area surrounding the site is cleared by hand in order to determine the full extent of the site. A permit shall be obtained from SAHRA for the possible impact on the site prior to the development taking place. A permit should be obtained from SAHRA for the possible impact on the site before construction commences.
Between Tower 169 and 170	Graves and Cemeteries	A single marked grave fenced off with a metal fence.	S 25.05435	E 29.81929	High on a local level – Grade III	This site is probably located within the power line reserve. It shall be protected, leaving a buffer of at least 10 metres around it.
Tower 167	Graves and Cemeteries	A single marked grave next to a homestead.	S 25.04711	E 29.81732	High on a local level – Grade III	This site is probably located within the power line reserve. It shall be protected, leaving a buffer of at least 10 metres around it.
Tower 168	Graves and Cemeteries	A number of well-marked graves, fenced off with wire.	S 25.05702	E 29.82026	High on a local level – Grade III	This site is probably located within the power line reserve. It shall be protected, leaving a buffer of at least 10 metres around it.
Tower 156	Graves and Cemeteries	A formal community cemetery with probably more than 100 graves. Most have gravestones, but some are only marked with stone cairns. It is a large and well fenced cemetery that is unlikely to be impacted on by the power line development.	S 25.01692	E 29.81023	High on a local level – Grade III	Although the current alignment by-passes the cemetery, it is recommended that the site is protected for the duration of the construction period.
Tower 111	Graves and Cemeteries	An informal burial place with an unknown number of graves marked only with stone cairns, located under a large tree. The site is located close to the powerline reserve as well as Tower 111.	S 24.98028	E 29.65839	High on a local level – Grade III	Although the current alignment by-passes the cemetery, it is recommended that the site is protected for the duration of the construction period.
Tower 84	Archaeological sites	A stone walled site that was used for the initiation of young boys. The various elements such as the central fire place, accommodation structures, etc. are clearly identifiable and also indicate that the site has been used in the recent past. Tower 84 shall be located on this site and the power line shall cross it as well.	S 24.99308	E 29.56529	High on a regional level – Grade III	It is recommended that the tower is moved to a location off the site. In addition it is recommended that the local community is briefed about the line crossing the site and that their consent is gained for the line to pass over it.

Tower	Site Type	Description	Latitude	Longitude	Significance	Mitigation and Recommendations
Between Tower 65 and 66	Graves and Cemeteries	An informal burial place with three graves, two of which are marked with headstones. The site is located close to the power line reserve.	S 25.00625	E 29.50139	High on a local level – Grade III	Although the current alignment by-passes the cemetery, it is recommended that the site is protected for the duration of the construction period.
Between Tower 65 and 67	Graves and Cemeteries	A single grave with a headstone, but with no inscription. The site is located close to the power line reserve.	S 25.00754	E 29.50175	High on a local level – Grade III	Although the current alignment by-passes the cemetery, it is recommended that the site is protected for the duration of the construction period.
Tower 32	Archaeological sites	The remains of a typical farm labourer homestead built with clay bricks. Due to the dense vegetation it was difficult to determine size and layout. This site is inside the power line reserve and the powerline shall cross over it. Tower 32 shall be located close to this site.	S 25.04876	E 29.38458	High on a regional level – Grade III	The site shall be protected, leaving a buffer of at least 50 metres, from the outermost visible remains of the structure, around it. It is recommended that prior to construction taking place that the area surrounding the site is cleared by hand in order to determine the full extent of the site.
Between Tower 15 ad 16	Graves & Cemeteries	A single grave with a headstone. The site is located inside the power line reserve.	S 25.07637	E 29.34009	High on a local level – Grade III	Although the current alignment by-pass both, it is recommended that the site is protected for the duration of the construction period. It is also recommended that prior to construction taking place that these areas are cleared by hand in order to determine the full extent of the burial sites.
Between Tower 15 ad 16	Graves & Cemeteries	An informal burial place with an unknown number of graves, only a few of which are marked with headstones. The site is located inside the power line reserve.	S 25.07610	E 29.33858	High on a local level – Grade III	Although the current alignment by-pass both, it is recommended that the site is protected for the duration of the construction period. It is also recommended that prior to construction taking place that these areas are cleared by hand in order to determine the full extent of the burial sites.

6.3 FLORA, FAUNA AND WETLAND DELINEATION

Mr Emile van der Westhuizen conducted the walkthrough for fauna, flora and wetland delineation process.

Emile van der Westhuizen is currently employed by Scientific Aquatic Services (SAS) and focuses in the facilitation of EIA, EMPR, Basic Assessment and Biodiversity Action Plan processes. Emile is further a talented field biologist and undertakes terrestrial ecological assessments. Further skills include GIS and Wetland Delineation processes. He started to build his career in 2007 with a firm specialising in EIA's, BA's, Water Use Licensing and the development of Rehabilitation Plans, Landscape plans and Visual Assessments. He has extensive experience in all the above mentioned fields of practice, and decided to diversify his fields of expertise and focus on his passion for botany and ecology by joining Scientific Aquatic Services early in 2008.

6.3.1 Introduction

The purpose of the walk through project was to assess each proposed tower position and identify and document sensitive habitat areas and protected and/or endangered floral species in the vicinity of the tower footprints. In addition, areas with abundant avifaunal populations were identified where additional mitigatory measures are deemed necessary to minimise the impact on faunal ecology. Following the assessment, sensitive habitat areas and protected floral localities were indicated on aerial map printouts of the proposed tower positions of the entire servitude length. In addition points where specific mitigatory measures are required along with areas where 'bird flappers' shall be installed to mitigate the impact of the proposed power line on avifaunal communities were highlighted on the route plans (please refer to the accompanying tower profiles). Finally, the existing Environmental Management Plans (EMP) were reviewed in order to "ground truth" the EMP conditions and ensure that all EMP conditions are valid and propose additional mitigation measures and management recommendations were deemed necessary.

6.3.2 Findings

During the assessment, a number of protected floral species were identified and marked and indicated on the accompanying profile maps. These protected species are:

- *Sclerocarya birrea* subsp. *caffra* (protected tree under the National Forests Act, 1998 (Act No. 84 of 1998))*;*
- *Boscia albitrunca* (protected tree under the National Forests Act, 1998 (Act No. 84 of 1998)).
- *Curtisia dentata* (protected tree under the National Forests Act, 1998 (Act No. 84 of 1998)).
- *Elaeodendron transvaalense* (protected tree under the National Forests Act, 1998 (Act No. 84 of 1998));
- *Urginea epigea* (Orange Listed species in Mpumalanga); and
- *Huernia* sp. (No positive species level identification due to incorrect flowering season, possibly *Huernia stapelioides* which is protected under the Mpumalanga Nature Conservation Act of 1998 and Limpopo Schedule 12).

It was recommended that an ecologist/floral specialist is commissioned to attend the physical surveying of the proposed power line route before construction in order to mark and where possible relocate any protected floral species which may occur within the development servitude, with specific reference to the abovementioned species and sensitive habitat areas such as mountains and wetlands. Large trees which are not possible to relocate must be documented and the necessary permits must be applied for in order to cut or destroy these trees.

Table 6-3 provides a summary of issues associated with the positioning of the Towers.

Table 6-3: Summary of ecological findings along the powerlines

Tower	Description	Mitigation and Recommendations
Switching station	The switching station is located in an area that contains protected trees (*Sclerocarya Birrea*).	Permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 186 to Tower 191	The Towers are located in an area that contains protected trees (*Sclerocarya Birrea*).	Permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 185	Tower 185 is located within a watercourse.	The Tower shall be moved to the north of the current site. If the tower cannot be moved, then a water use licence shall be obtained from the Department of Water Affairs. (**Refer to Sections 8.4 and 8.5**)
Tower 181 to 184	No protected trees were encountered during the walkthrough. However the probability that *Sclerocarya Birrea* may occur is high.	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 179	No protected trees were encountered during the walkthrough. However the probability that *Sclerocarya Birrea* may occur is high.	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 176 to 178	No protected trees were encountered during the walkthrough. However the probability that *Sclerocarya Birrea* may occur is high.	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 175	No protected trees were encountered during the walkthrough. However the probability that *Sclerocarya Birrea and Elaeodendron transvaalense*may occur is high.	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 172 to 174	No protected trees were encountered during the walkthrough. However the probability that *Sclerocarya Birrea and Elaeodendron transvaalense*may occur is high.	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 169	Tower 169 is located in the vicinity of a watercourse	The tower shall be moved away 100m from the watercourse or 1 in 100 year floodline. If the tower cannot be moved, then a water use licence shall be obtained from the Department of Water Affairs (**Refer to Sections 8.4 and 8.5**)
Tower 167	The area where tower 167 is located contains protected trees (*S Birrea*). There is also high probability that the protected tree, *Curtisia Dentata* may occur. The area is generally classified as a sensitive habitat.	Permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).

Tower	Description	Mitigation and Recommendations
Tower 163 to 166	There is high probability that the protected tree, *Curtisia Dentata* may occur. The area is generally classified as a sensitive habitat.	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Tower 162 to 159	The area affected by Towers 159 to 162 is generally classified as a sensitive habitat, with protected tree species (*S Birrea*).	Assess during construction. If protected trees are encountered, they shall be clearly marked and permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Towers 148 to 153	The Towers are located in a cultivated wetland.	If the towers cannot be moved, a water use licence application shall be conducted (**Refer to Section 8.3**).
Tower 140	The tower is located in a wetland.	The tower shall be moved to the east of the current position and shall be at least 500 m from the edge of the wetland or riparian zone (**Refer to Section 8.3**).
Tower 132	Tower 132 is located in a cultivated wetland	The tower shall be moved from the current position and shall be at least 500m from the edge of the wetland or riparian zone. If the tower cannot be moved, a water use licence application shall be conducted (**Refer to Section 8.3**).
Tower 122	Tower 122 is located in a cultivated wetland	The tower shall be moved from the current position and shall be at least 500m from the edge of the wetland or riparian zone. If the tower cannot be moved, a water use licence application shall be conducted (**Refer to Section 8.3**).
Tower 118	Tower 118 is located in the vicinity of a watercourse	The tower shall be moved to the West of the current position. 100m from the watercourse or 1 in 100 year floodline. If the tower cannot be moved, then a water use licence shall be obtained from the Department of Water Affairs
Tower 102	Tower 102 is located in a cultivated wetland	The tower shall be moved to the East of the current position and shall be at least 500m from the edge of the wetland or riparian zone. If the tower cannot be moved, a water use licence application shall be conducted (**Refer to Section 8.3**).
Tower 84	There is *Urginea Epigea* tree species located on the site marked for Tower 84. There is also a wetland, in the vicinity of the tower.	The plants shall be relocated (**Refer to Section 8.**8).
Tower 66 t0 73	Tower 66 to 73 are located in a cultivated wetland	The tower shall be moved from the current position and shall be at least 500m from the edge of the wetland or riparian zone. If the tower cannot be moved, a water use licence application shall be conducted (**Refer to Section 8.3**).
Tower 65	Tower 65 is located in a cultivated wetland /rocky outcrop matrix	A water use licence shall be applied for before commencement of construction

Tower	Description	Mitigation and Recommendations
		(**Refer to Section 8.3**).
Tower 46 to 58	The entire section is considered to be sensitive. There is a probability that protected tree species may occur in the area, however positive identification was not possible. *A Huernia* species was identified between Towers 53 and 54.	Tower 57 is located in a wetland and shall be moved to the north east of the current position). If the tower cannot be moved, then a water use licence shall be obtained from the Department of Water Affairs. (**Refer to Section 8.3**)**.**
Tower 45	Tower 45 is located in a sensitive habitat	Tower 45 shall be moved to the north east of the current position
Tower 43	Tower 43 is located in a sensitive habitat (riparian zone)	The tower shall be moved to the east of the road if possible. If the tower cannot be moved, then a water use licence shall be obtained from the Department of Water Affairs. (**Refer to Section 8.3**)**.**
Towers 37, 41 and 42	Towers are located within the riparian zone	Water use licence application shall be conducted for towers that are falling within the riparian zone (**Refer to Section 8.3**).
Tower 32	Tower 32 is located in an area that contains protected trees (*Sclerocarya Birrea*).	Permits for tree removal shall be obtained from the competent authorities (**refer to Section 8.8**).
Towers 7 and 8	Towers 7 and 8 are located in a wetland.	If possible, the towers shall be moved out of the wetland. If it is not possible to move them, a water use licence shall be applied for (**Refer to Section 8.3**).
Tower 2	Tower 2 is close to *B albitanca* (a protected tree).	Assess during construction. Permits for tree removal shall be obtained from the competent authorities (**Refer to Section 8.8**).

In terms of the assessment of the existing draft EMP, the following observations and recommendations were made:

- The mitigation measures contained in the EMP are deemed sufficient to manage the anticipated environmental impacts of the proposed project. The measures set out the EMP shall be strictly adhered to at all times.
- In terms of protected and/or endangered floral species conservation, it is strongly recommended that an ecologist/floral specialist is commissioned to attend the physical surveying of the proposed power line route before construction in order to mark and where possible relocate any protected floral species which may occur within the development servitude, with specific reference to the abovementioned species and sensitive habitat areas such as mountains and wetlands. Large trees which are not possible to relocate shall be documented and the necessary permits shall be applied for in order to cut or destroy these trees as recommended in the 2010 Steelpoort to Wolwekraal 400kV Power Line EMP by Nemai Consulting (Pty) Ltd.
- The ecologist shall further oversee and monitor the relocation of any protected species. The project ECO shall be closely involved in the relocation process and report any significant findings and developments to the ecologist.
- Permits shall be obtained in terms of the National Forest Act (1998) and the MNCA (1998) where plants protected under these acts are to be disturbed or relocated.

7. CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMME

7.1 CONSTRUCTION CAMP SITE PLANNING AND LAYOUT

The construction camp site selection shall be done in consultation with the landowners and ECO. The Contractor and Project Manager shall negotiate with landowners and adjacent landowners for permission and the right to establish a Construction Camp on their land and written agreements shall be developed between the landowner and the contactor. The Contractor may not commence with any site establishment activities, prior to the signing of the contractual agreement by the landowner. Prior to commencement of construction, the Contractor shall inform the construction manager and ECO of the intended actions and programme for site establishment. **Location of construction camps must be carefully considered and approved by the ECO**. All construction areas shall be cleared in accordance with the Eskom Standard for Bushclearing **ESKASABG3** (**Appendix D**). The Contractor's hard park and storage yard shall be located at the designated area as specified by the construction manager.

The construction site, construction road for access to the site, and materials lay down area shall be demarcated prior to construction by the Contractor. No disturbance outside the demarcated road shall be permitted.

The Contractor shall supply a site plan for the Contractor's camp for the project manager's approval. Structures shall be located in a way that shall reduce visual intrusion and minimal disturbance to the biophysical environment.

The Contractor's camp shall be sited so as to cause the least amount of disturbance to adjacent landowners. The Contractor's camp shall be fenced and the Contractor shall maintain the fence in good order for the duration of construction. The Contractor's camp shall not be placed within 100m of a river or 500 m of a wetland. Documentation (Method Statement) for each proposed camp site shall be prepared by the Contractor prior to the commencement of construction activities, and shall be submitted to Eskom for approval. This documentation shall include, but shall not be limited to the following:

- site layout including access points and material storage areas;
- topsoil management;
- cuts and fills;
- sewage treatment;

- erosion control;
- fencing;
- general waste management;
- provision for vehicle and plant servicing;
- management of hazardous materials,
- water supply;
- management of veld fire risk; and
- Rehabilitation.

Damage to sensitive areas shall incur a fine and all impacts shall be rehabilitated and/or environmental compensation shall be made. Movement of construction vehicles and machinery shall be restricted to areas outside of the sensitive habitats on site. The site planning shall ensure that no stormwater may enter the natural drainage system directly, but rather be diverted and dispersed into the natural vegetation for absorption. The Contractor shall develop a Stormwater Management Plan.

The site plan shall ensure that no artificial channels are constructed for stormwater diversion, but that other engineering measures are utilised to adhere to the stormwater management plan.

7.1.1 Management Objective

- Minimise erosion during construction
- Minimise litigation during construction.
- Rehabilitate all disturbed areas.

7.1.2 Measurable Targets

- Written agreements with landowners where construction camps are situated on private land.
- No claims leading to litigation.
- All damaged areas successfully rehabilitated one year after completion.

7.2 SITE ESTABLISHMENT

The Contractor's hard park and storage yard shall be fenced, to the satisfaction of the construction manager. It is a requirement that the fence is maintained until such

time that the project is completed. The construction site shall be barricaded off to prevent access by unauthorised persons.

A site notice shall be erected at the construction site informing persons of restricted access, the nature and time frames of the construction activities and contact details.

Site structures, shall be fitted with appropriate cladding and colouring to ensure reduced reflection and visual pollution.

Access to the site shall only be permitted via the designated construction road as specified on site by the construction manager. The Contractor shall control the movement of all vehicles and plant (including suppliers), such that they remain on designated routes, comply with relevant traffic laws and ensure they are distributed so as not to cause an undue concentration of traffic.

The vehicles of the Contractor and their suppliers shall not exceed a speed of 20 km/hr. Vehicles and personnel shall not move be permitted to move outside the designated areas.

Access roads shall be maintained by the Contractor. The Contractor shall erect and maintain marker pegs along the boundaries of the working areas, access roads, haul roads or paths, to the satisfaction of the Construction Manager, before commencing any other work. If proved insufficient for control, these shall be replaced by fencing, with the additional cost being borne by the Contractor.

Dust control measures, such as dampening with water shall be implemented where necessary.

Construction debris shall be cleared regularly and removed to a permitted landfill site. Damage to the existing access roads as a result of construction activities (during construction), shall be repaired to the satisfaction of the Project Manager. The cost of the repairs shall be borne by the Contractor.

All existing farm roads (private roads) damaged during the construction phase, shall at the end of construction be repaired to the satisfaction of the landowner, as per the

conditions of the written contractual agreement between the landowner and the Eskom.

The Contractor shall erect Traffic safety measures (e.g. traffic warning signs, flagmen) to the satisfaction of the Project Manager where required.

The Contractor and Construction Manager shall ensure that access to the site, including related infrastructure and machinery is restricted to authorised personnel only and ensure that access roads to the site are of a suitable quality to eliminate soil erosion, and channel storm water into grass buffer area.

The Contractor shall ensure that 'No-Go' areas are clearly demarcated and/or fenced before construction starts. Barriers are to be maintained in good order throughout the course of the construction. The Contractor shall ensure that no machinery, personnel, material, or equipment enters 'No-Go' areas at all times during the course of the project.

7.2.1 Management Objective

- Minimise the number of accidents onsite.

7.2.2 Measurable Targets

- No accidents on-site.
- No vehicles or personnel outside designated areas.
- No access to site by unauthorised persons.
- All damaged areas successfully rehabilitated one year after completion.

7.3 FENCING

Fencing shall be erected on farms or in areas where animals/game occur during the construction phase to protect animals/game from falling into the trenches, and from not entering into the construction camp area. Shall a game fence be damaged as a result of construction activities, the fence shall be repaired or rebuilt.

Fences shall be constructed in order to restrict game from escaping. Most wild animals shall only resort to crossing fences when they are under stress or duress. Construction and blasting activities could put the animals under stress and the necessary measures shall be implemented.

All fences constructed for construction purposes (e.g. fences around camp sites, fencing around trenches, etc.) shall be inspected on a daily basis to detect whether any damage has occurred and shall be repaired immediately, to prevent animals from escaping, to prevent easy access for poaching and intrusion by predators.

Where necessary electrified fences shall be erected. Mechanisms shall be put in place to allow for faults on electrified fences to be traced as quickly as possible. Electrified fences shall be safe for contact by Humans. Safety precautions shall be implemented for electrified fences. Where necessary game screens shall be erected to minimize the impact on game, especially on narrow farm portions. The contractor is referred to the National Fencing Act, 1963 (Act No 31 of 1963) (as amended by Act 108 of 1991). Gate installation shall be according to **TRMSCAAC1 REV 3 (Appendix E)**. Game gates shall be installed where necessary. **All gates installed in electrified fencing shall be re-electrified.**

7.3.1 Management Objective

- Minimise the number of accidents onsite.
- Avoid access to site by animals.

7.3.2 Measurable Targets

- No accidents on-site.
- No animals on site.

7.4 MATERIALS HANDLING, USE AND STORAGE

The Contractor shall ensure that delivery drivers are informed of all procedures and restrictions required to ensure compliance with this document. Such drivers shall be supervised during off-loading by a person knowledgeable of the requirements. Materials shall be appropriately secured to ensure safe passage between destinations. Loose loads (e.g. sand, stone chip, refuse, paper and cement) shall be covered. The Contractor shall be responsible for any clean-up resulting from the failure by his employees or suppliers to properly secure transported materials.

Imported fill / soil / sand materials shall be free of weeds, litter and contaminants. All material lay-down areas and stockpiles shall be subject to the Project Manager's approval.

Storage areas shall be roofed with an impervious material, with a suitable overhang or side-cladding. Rainwater runoff shall be channelled away from the storage area as required.

Management Objective

- Minimise the number of accidents during off loading.

Measurable Targets

- No off loading accidents on-site.

7.5 HAZARDOUS SUBSTANCES

Cement mixing shall occur in a designated area on an impervious layer (e.g. plastic or cement mixing pit). The runoff water shall be contained for re-use in cement mixing or disposed of to the waste water system. Contaminated water shall not be dispersed to the environment.

No paint products may be disposed of on the site. All paint containers shall be removed from the site. Oil based paints and chemical additives and cleaners (e.g. thinners and turpentine) shall be strictly controlled. A painting control work instruction shall be established for the site, including disposal of material and the washing of brushes / rollers. No contaminated water or solvents may be disposed of to the veld.

The Contractor may not store in above ground containers a combined volume of fuel equal to or greater than 80 cubic meters on the site without the appropriate Environmental Authorisation. All fuel storage areas shall be bunded to contain at least 110 % of the volume stored and shall be provided with a hard impervious surface. The Contractor shall ensure that there is a supply of absorbent material (e.g. sawdust, supazorb) readily available to absorb, breakdown and where possible encapsulate minor hydrocarbon spillage. The amount and type of absorbent material shall be appropriate to the volumes of hydrocarbons kept on site. Each construction site shall have a spill kit available during all times. Used material shall be disposed of by an approved service provider to a licenced site.

Potential pollutants shall be kept, stored, and used in such a manner that any escaped pollutants can be contained and the water table not endangered (e.g. bunded hydrocarbon storage area). Bund walls shall be of a sufficient height to contain at least 110% of the volume of any materials stored within the bunded area.

This material is to be removed post-construction and disposed of in a responsible manner. Soils contaminated by minor hydrocarbon spills shall be removed immediately to a designated hazardous waste storage bin to be removed off site and disposed of at a licensed hazardous waste disposal facility. The waste and water manager is to be informed of the procedure.

Hazardous materials shall be removed and disposed of at licenced sites or handed to registered hazardous waste disposal facilities for disposal / recycling.

The Contractor shall notify the Project Manager and the ECO immediately of any pollution incidents and shall prevent any hazardous substance from draining into wetlands or directly into any drainage lines.

The Contractor shall compile and provide a method statement for storage areas of hazardous substances to the ECO for approval before the activity commences.

7.5.1 Management Objective

- To keep the servitude neat and clean.
- Disposal of hazardous waste in an appropriate and legislated manner.
- Minimise litigation.
- Minimise Landowner complaints.
- Avoid contamination of water resources and soil.

7.5.2 Measurable Targets

- No paint containers on site.
- No paint stored on site.
- No concrete spillage on the servitude.
- No fuel equal to or greater than 80 cubic meters stored on the site without the appropriate Environmental Authorisation (Ref to NEMA Regulations).
- No hazardous materials disposed of on site.

7.6 WORKSHOP, EQUIPMENT MAINTENANCE AND STORAGE

No maintenance or repair of construction vehicles or machinery shall occur on site during the construction phase. Maintenance of equipment and vehicles shall be performed off-site at a suitably designed workshop. Movement of construction vehicles and machinery shall be restricted to areas outside of sensitive areas on site.

The Contractor shall ensure that if emergency maintenance occurs on site, that there is no contamination of the soil or vegetation (e.g. use of drip trays). Drip trays shall be provided for the stationary vehicles and machinery.

All vehicles and equipment shall be kept in good working order and serviced regularly. Leaking equipment shall be repaired immediately or removed from the site. No washing of vehicles and machinery shall be allowed on the site.

The relevant Contractor shall ensure that facilities for the collection of hydraulic and other vehicle oils are provided within the hard park area.

The following shall apply to hazardous substance spills:

- All contaminated soil / yard stone shall be removed and be placed in containers. Contaminated material can be taken to one central point where bio-remediation can be done.
- Smaller spills can be treated on site.
- A specialist Contractor shall be used for the bio-remediation of contaminated soil where the required remediation material and expertise is not available on site.
- All spills of hazardous substances shall be reported to the ECO and Transmission Services Environmental Advisor **(Transmission Key Performance Indicator requirement)**.

7.6.1 Management Objective

- To keep the servitude neat and clean.
- Disposal of hazardous waste in an appropriate and legislated manner.
- Minimise Landowner complaints.
- Avoid contamination of water resources and soil.

7.6.2 Measurable Targets

- No leaking vehicles.
- No contamination of soils and vegetation.
- No vehicles serviced on site.

8. LABOUR AND SOCIAL ISSUES AND THEIR CONROL

The Contractor shall ensure proper supervision of employees at all times. Preference shall be given to the local community for unskilled labour. The Contractor shall ensure workers refrain from trespassing on surrounding private property and that immediate and decisive action is taken shall this occur. Machine / vehicle operators shall receive clear instructions to remain within demarcated access routes and construction areas. Designated smoking areas shall be provided, with special bins for discarding cigarette butts.

8.1.1 Management Objective

- To keep the servitude neat and clean.

8.1.2 Measurable Targets

- No vehicles and machinery outside designated areas.
- No trespassing into private property by workers.

8.2 TOILET / ABLUTION FACILITIES

The Contractor shall provide sufficient ablution facilities, in the form of mobile / portable / VIP toilets at the Construction Camps and along construction sites, and shall conform to all relevant health and safety standards and codes. No pit latrines, French drain systems or soak away systems shall be allowed and toilets may not be situated within 100 meters of any water body or the 1:100 year flood line. A sufficient number of toilets shall be provided to accommodate the number of personnel working in any given area. Toilet facilities supplied by the Contractor for the workers shall occur at a maximum ratio of 1 toilet per 30 workers. Separate toilets shall be provided for the different genders. All temporary / portable / mobile toilets shall be secured to the ground to prevent them from toppling due to wind or any other cause. Toilets shall not be further than 100 m from any working area.

Prior to establishment of the ablution facilities, the Site Manager shall approve an appropriate location. The Contractor shall ensure the provision and proper utilisation, maintenance and management of toilet, wash and waste facilities. These facilities shall be maintained in a hygienic state and serviced regularly. Toilet paper shall be provided. The Contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that a licensed service provider removes the contents from site. Such waste shall only be disposed of to an approved Wastewater Treatment

Works (WWTW). The necessary permission from the Local Municipality shall be obtained in writing.

8.2.1 Management Objective

- To keep the servitude neat clean, and hygienic.
- To avoid contamination of water resources by effluent from the toilets.

8.2.2 Measurable Targets

- No toilets within 100 m of a water resource or the 1:100 year flood line.
- Sufficient toilets provided to workers (maximum ratio of 1 toilet per 30 workers).
- No toilets shall further than 100 m from any working area.
- Toilet paper available in all toilets at all times.

8.3 CONSTRUCTION CAMP AND EATING AREAS

Open uncontrolled fires shall be forbidden at the site camp. 'Contained' cooking mechanisms shall be used – e.g. gas stoves or an enclosed braai facility. The cooking area shall be positioned such that no vegetation is in close proximity thereto, including overhanging trees. An area around the cooking area shall be cleared such that any escaping embers shall not start an uncontrolled fire.

Eating areas shall be designated and demarcated. The feeding, or leaving of food for animals, is strictly prohibited. The Contractor shall ensure that sufficient vermin / weatherproof bins are present in this area for all waste material. No fires for the purpose of cooking or warming purposes shall be permitted other than within designated areas, for instance, at the site camp.

Dish washing facilities shall be provided. These may be very basic, but a process shall be put in place to ensure that wastewater is disposed of appropriately. No wastewater shall be disposed of directly into a watercourse.

8.3.1 Management Objective

- To keep the servitude neat and clean.
- To avoid fires on site.

8.3.2 Measurable Targets

- No uncontrolled fires at the site camp.

- No cooking areas positioned in close proximity to vegetation, including overhanging trees.
- Sufficient dish washing areas supplied to workers.

8.4 AESTHETICS

The Contractor shall ensure that lighting is sufficient to ensure security but shall not constitute 'light pollution' to the surrounding areas. The site shall be shielded from the adjacent landowners to minimise the visual impact where this is feasibly possible. Site structures, albeit temporary, shall be fitted with appropriate cladding and colouring to ensure reduced reflection and visual pollution. The rehabilitation of the disturbed areas shall prevent the exposure of soil, which may cause a reduction in the visual quality of the construction area.

8.5 WASTE MANAGEMENT

Vermin / weatherproof bins shall be provided in sufficient number and capacity to store all solid waste produced on a daily basis. These bins shall be kept closed to reduce odour build-up and emptied regularly (minimum weekly) such that they do not overfill.

Waste shall be separated at source (e.g. containers for glass, paper, metals, plastics, organic waste and hazardous wastes). The Contractor shall ensure the provision of waste skips on site. These skips shall be sufficient in number, the skip storage area shall be kept clean. Skips shall be emptied and replaced before overflowing or spillage occurs.

The PM shall ensure that no burying, dumping or burning of waste materials, vegetation, litter or refuse occurs. All solid waste shall be removed and disposed of to suitable licensed disposal sites. Wherever possible, materials shall be recycled via a "Greens waste site". Where a registered waste site is not available close to the construction site, **the Contractor shall provide a method statement with regard to waste management**. The disposal of waste shall be in accordance with all relevant legislation.

Containers of brake and clutch fluid, oil etc. although initially containing potentially hazardous wastes when disposed of contain minimal amounts thereof and may be disposed of as standard domestic waste. Waste shall be removed during off-peak

periods to minimise impacts on local traffic patterns. The Contractor shall prevent any waste effluent from draining into wetlands or directly into any drainage lines and visual inspections and proper storage facilities for waste shall be monitored in consultation with the CLO.

8.5.1 Management Objective

- To maintain good relations with surrounding landowners.
- To keep the servitude neat and clean.
- To avoid contamination of water resources by waste from site.

8.5.2 Measurable Targets

- Sufficient number and capacity of vermin / weatherproof bins provided to store all solid waste produced on a daily basis (no overspilling bins on site).
- Separate bins for different types of waste.
- Sufficient number and capacity of waste skips provided on site.
- No contamination of water resources by waste.

8.6 WATER MANAGEMENT

Water supply during the construction phase for construction activities shall be obtained from an existing water source and all connections and decommissioning shall be the Contractor's responsibility on approval of the construction manager. The Contractor shall ensure that the correct and sufficient amount of hosepipes, taps and connections are supplied. The Contractor shall ensure that no leakage occurs from pipes or dripping taps. The Contractor shall comply with the stormwater management plan and shall be responsible for preventing erosion on temporary construction roads. If water is required, the Contractor shall negotiate with the relevant Landowner and a written agreement shall be drawn up (**TRMSCAAC1 REV 3**).

8.6.1 Management Objective

- To ensure that water supply is properly managed.
- To minimise erosion on temporary construction roads.
- To minimise wasting water.

8.6.2 Measurable Targets

- No erosion on temporary construction roads.
- Sufficient water, hosepipes, taps and connections supplied to site.

- No leakage of water from pipes or dripping taps.

8.7 POLLUTION GENERATION POTENTIAL

8.7.1 Light Pollution

Prior to construction, the position and type of lighting shall be planned to ensure unnecessary light pollution shall be eliminated. During construction only directional / down lighting shall be used for security purposes. All lighting installed on site shall not interfere with road traffic or lead to unacceptable light pollution to the surrounding community and natural environment.

8.7.2 Management Objective

- To maintain good relations with surrounding landowners.
- To minimise light pollution.

8.7.3 Measurable Targets

- No light pollution to the surrounding community and natural environment.

8.7.4 Noise

The provisions of SABS 1200A shall apply to all areas within audible distance of residents. No amplified music shall be allowed on the site. The use of radios, tape recorders, compact disc players, television sets etc. shall not be permitted unless at a level that does not serve as an intrusion to adjacent land-owners. Construction activities generating output levels of 85 dB or more shall be confined to the hours 08h00 to 17h00 Mondays to Fridays. The Contractor shall take preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to minimise complaints regarding noise and vibration nuisances from sources such as power tools. The Contractor shall ensure that all machinery to be maintained to reduce noise levels and provide labourers with hearing protection. The Contractor shall ensure that all blasting shall be carried out in accordance with the Explosives Act (Act 15 of 2003).

8.7.5 Management Objective

- To maintain good relations with surrounding landowners.
- To minimise noise pollution.

8.7.6 Measurable Targets

- No construction activities generating output levels of 85 dB after 1700 during the week.
- No amplified music on site
- All machinery in good working order.

8.7.7 Dust Generation

Contractors shall be solely responsible for the control of dust arising from their operations and for any costs against the Employer for damages resulting from the dust. Appropriate dust suppression measures or temporary stabilising mechanisms shall be used when dust generation is unavoidable (e.g. dampening with water, chemical soil binders, straw, brush packs, chipping), particularly during prolonged periods of dry weather. Removal of vegetation shall be avoided or kept to a minimum until such time as soil stripping is required. Excavation, handling and transport of erodable materials shall be avoided under high wind conditions or when a visible dust plume is present. If dust-damping measures are deemed inadequate, work shall cease until wind speeds drop to an acceptable level. Soil stockpiles shall be located in sheltered areas to limit the erosive effects of the wind. Vehicle speeds shall not exceed 20 km/h along dust roads or when traversing unconsolidated / non-vegetated areas. The Contractor shall take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of affected parties).

8.7.8 Management Objective

- To maintain good relations with surrounding landowners.
- To minimise soil erosion on site.
- To minimise dust pollution.

8.7.9 Measurable Targets

- No construction activities generating output levels of 85 dB after 1700 during the week.
- No excavation conducted under high win conditions.
- Stockpiles located in sheltered areas to avoid erosion.
- Minimise removal of vegetation.

8.7.10 Erosion and Sediment Control

During construction, the Contractor shall protect areas susceptible to erosion by installing necessary temporary and / or permanent drainage works as soon as possible and by taking suitable measures to prevent surface water concentration into nearby roadways. Silt trap mechanisms shall be installed on all temporary stormwater channels. The Project Manager shall ensure that these silt traps shall be regularly checked and serviced as required. All excavated and filled slopes and stockpiles shall be of a stable angle and capable of accommodating normal expected water flows. Any runnels or erosion channels shall be backfilled and compacted, and the area/s restored to a proper condition. Stabilisation of cleared areas to prevent and control erosion shall be actively managed. The method chosen (e.g. watering, planting, retaining structures, commercial anti-erosion compounds) shall be selected according to the site specifics and ensure acceptable rehabilitation. Traffic and movement over stabilised areas shall be restricted. Any damage to stabilised areas shall be repaired and maintained to the satisfaction of the Site Manager. Where erosion and/or sedimentation occur, rectification shall be carried out in accordance with details specified by the Site Manager. An effort shall be made to limit ponding on the surface and ensure stormwater runoff is channelled from the site. The method used shall be appropriate to the expected stormwater flows and the topography and geology of the site. The Contractor shall be liable for any damage to downstream property caused by the diversion of overland stormwater flows.

Management Objective

- Minimise erosion during construction.
- Provide permanent erosion and sediment control measures.
- Minimise disturbance and loss of topsoil.
- Rehabilitate all disturbed areas along the servitude.

Measurable Targets

- No evidence of erosion in construction areas.
- No claims regarding damage leading to litigation.
- All damaged areas successfully rehabilitated one year after completion.

8.7.11 Cement and Concrete Batching

The siting of batching plants shall be done in conjunction with the Landowner, ecologist/botanist, and archaeologist who participated in the compilation of the CEMP

where required, as well as the ECO. Refer to **TRMSCAAC1 REV 3** for specifications regarding batching plants. The batching plant area shall be operated in such a way as to prevent contaminated water to run off the site and polluting nearby streams or water bodies.

Concrete shall not be mixed directly on the ground or any other permeable surface. The batching / mixing area shall be kept neat and clean at all times. No batching / mixing activities shall occur on a permeable surface. All runoff from such areas shall be strictly controlled, with contaminated water collected, stored / contained and disposed of at an approved waste disposal site. Unused cement bags shall be stored so as not to be affected by rain / runoff. Used cement bags shall be stored so as to prevent wind blown dust and potential water contamination. Used bags shall be disposed of regularly via the solid waste management system. The Project Manager shall ensure that concrete transportation shall not result in spillage. To prevent spillage onto roads, ready mix trucks shall rinse off the delivery shoot into a suitable sump prior to leaving the site. Suitable screening and containment shall be in place to prevent windblown contamination from cement storage, mixing, loading and batching operations. All visible remains of excess concrete shall be physically removed on completion of the plastering or concrete pouring and disposed off in an acceptable manner.

Eskom shall ensure that all agreements reached with the Landowner are fulfilled, and that such areas be rehabilitated once construction is completed. Shall any claim be instituted against Eskom due to the actions of the Contractor at a batching plant site, Eskom shall hold the Contractor fully responsible for the claim until such time that the Contractor can prove otherwise with the necessary documentation.

8.7.12 Management Objective

- To ensure all agreements with Landowners are adhered to.
- Prevention of complaints from Landowners.
- Successful rehabilitation of disturbed areas.
- Prevention of pollution of water resources.

8.7.13 Measurable Targets

- No complaints from Landowners.

- All disturbed areas successfully rehabilitated three months after completion of the contract.

The Contractor is to supply a method statement for the siting of batching plants to the ECO for approval before the activity commences.

8.8 PREVENTION OF DISEASE

Applicable where the Transmission power line traverses land where livestock (cattle, sheep, goats and pigs) and game farming are practised. The Contractor shall take all the necessary precautions against the spreading of disease, especially from livestock. Refer to **TRMSCAAC1 REV 3** regarding prevention measures. A record shall be kept of drugs administered and the dates when this was done. This can then be used as evidence in court shall any claims be instituted against Eskom or the Contractor.

8.8.1 Management Objective

- Prevent litigation due to infestation of livestock.

8.8.2 Measurable Targets

- No complaints and claims from Landowners.
- No litigation.

8.9 INTERACTION WITH LANDOWNERS

The successful completion of the project depends a lot on the good relations with the Landowner. It is therefore required that the Contractor shall supply one person to be the liaison officer (CLO) for the entire contract, and that this person shall be available to investigate all problems arising on the work sites concerning the Landowners (**TRMSCAAC1 REV 3**).

All negotiations for any reason shall be between Eskom, the Landowner and the Contractor. **NO** verbal agreements shall be made. All agreements shall be recorded properly and all parties shall co-sign the documentation. A photographic record of access roads be kept. This shall then be available shall any claims be instituted by any Landowners. Any claims instituted by the Landowners shall be investigated and treated promptly. Unnecessary delays shall be avoided at all costs.

The Landowners shall always be kept informed about any changes to the construction programme shall they be involved. If the ECO is not on site the Contractor's ECO shall keep the Landowners informed. The contact numbers of the Contractor's ECO officer and the Eskom ECO shall be made available to the Landowners. This shall ensure open channels of communication and prompt response to queries and claims.

All contact with the Landowners shall be courteous at all times. The rights of the Landowners shall be respected at all times and all staff shall be sensitised to the effect of construction work being carried out on private property.

8.9.1 Management Objective

- Maintain good relations with Landowners.

8.9.2 Measurable Targets

- No delays in the project due to Landowner interference.
- Landowner signs final release form.

8.10 LITTERING CONTROL

Littering by the employees of the Contractor's staff shall not be allowed (**TRMSCAAC1 REV 3**). The ECO shall monitor the neatness of the work sites as well as the campsite The Contractor shall collect all litter and dispose thereof in a legislated manner.

8.10.1 Management Objective

- Neat workplace and site.
- No littering.

8.10.2 Measurable Targets

- No complaints from Landowners
- All litter is removed and disposed of (with proof) at a licenced landfill site

8.11 ACCESS CONTROL TO PROPERTIES

Due to the current security situation Landowners are not comfortable when strangers come on to their properties. They shall look for reasons to interfere with the construction process and may therefore cause delays in the process that can be very costly to Eskom and the Contractor.

The Landowners shall be kept abreast of all developments and shall be kept informed about the progress and phases of the contract. (Refer **TRMPVACV2 REV 1** – Procedure for Access to Farms (**Appendix F**))

No camping shall be allowed on any private property. If the Contractor wants to leave guards on site, it shall only be done with the written consent of the Landowners involved.

Damage to fencing, gates and other infrastructure may occur at any time. This shall create problems with the Landowners and shall be avoided as far as possible. All damage to be repaired immediately and to the satisfaction of the landowner

8.12 EMERGENCY PROCEDURES

No open fires shall be allowed on site under any circumstance (the National Veld and Forest Fire Act (Act 101 of 1998), National Forests Act (Act 30 of 1998), **TRMSCAAC1 REV 3**). The Contractor shall have fire-fighting equipment available on all vehicles working on site, at all time. All fire fighting equipment shall be in accordance with SANS 10228:2005. Staff in charge of fire fighting equipment shall be fully trained and certified as a fire fighter.

A Fire Management Plan and Fire Protection Plan shall be put in place by the Contractor and Eskom. Landowners shall be consulted prior to the compilation of these plans in order to incorporate their site specific fire fighting measures. The plan shall identify sources of fire hazard, and appropriate management measures to reduce the identified risk. The relevant authority shall be notified of such potential fire hazards. The Fire Protection Plan and Fire Management Plan shall be reviewed and approved by the National Department of Agriculture and the Local Municipality. Preferentially no fires shall be lit on the site, if however required, fires shall be limited to use for cooking and heating use only within a designated area. This area shall be at a suitable distance from fuel sources. In terms of the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965) (APPA), burning is not permitted for waste disposal. The Fire Protection Plan shall contain a detailed section on undertaking welding and grinding activities. Welding and grinding shall not be permitted under high wind conditions. The Project Manager shall be notified when welding shall take place, to ensure that precautionary measures are put in place. Welded joints shall be inspected after welding to ensure that the joint has cooled off properly, and that no

smouldering material is lying around. All fire control mechanisms (fire fighting equipment) shall be routinely inspected by a qualified investigator for efficacy and be approved by local fire services. Such mechanisms shall be present and accessible at all times. All staff on site shall be made aware of general fire prevention and control methods and the name of the responsible person to alert to the presence of a fire. The Contractor shall advise the relevant authority of a fire outside of a demarcated area as soon as it starts and shall not wait until he can no longer control it. The Contractor shall be responsible to compensate the landowner for damages caused by a fire as a result of the Contractor's working activities.

8.12.1 Accidental Leaks and Spillages

The Contractor shall ensure that his employees are aware of procedures to be followed for dealing with spills and leaks, which shall include notifying the relevant authorities. The Contractor shall ensure that the necessary materials and equipment for dealing with spills and leaks are available on site at all times. Treatment and remediation of the spill areas shall be undertaken to the reasonable satisfaction of the Site Manager in consultation with the ECO. In the event of a hydrocarbon spill, the source of the spillage shall be isolated and contained. The area shall be cordoned off and secured. The Contractor shall ensure that there is always a supply of an appropriate absorbent material readily available to absorb, breakdown and where possible, encapsulate a minor hydrocarbon spillage.

8.13 SAFETY AND HEALTH

Contractor to provide an Occupational Health and Safety Management Plan to the ECO for approval prior to the commencement of works in terms of the Construction regulations. The Contractor shall ensure that there is an inspection schedule and log for use by security or contracts staff. Fencing and barriers shall be in place in accordance with the Occupational Health and Safety Act (Act No. 85 of 1993). Applicable notice boards and hazard warning notices shall be put in place and secured. Night hazards shall be indicated suitably (e.g. reflectors, lighting, traffic signage). Emergency and Management contact details shall be prominently displayed. Security personnel shall be briefed and have facilities to contact relevant management and emergency personnel. Security personnel shall be stationed at all construction heads, construction camps, construction vehicle yards, etc. during times when the construction crew is not present i.e. nighttimes, weekends, etc. The Contractor to ensure he has sufficient first aid boxes and certified first aid attendants

available at each construction head. The necessary procedures shall be in place for if an employee is bitten by a snake. Prior arrangements shall also be made with the local medical facilities regarding these procedures. Two-Way Radio Systems shall be available in such working areas. No unauthorised firearms or weapons of any kind shall be permitted on the site. Shall scaffolding be required, it shall be secured during both use and storage. Structures vulnerable to high winds shall be secured. All landowners adjacent to areas where construction activities are imminent shall be alerted timeously. Potential risks and hazards shall be communicated effectively. All construction personal shall be issued with the same type and colour clothing to enable better identification of them. All employees shall also be issued with employee cards for landowners to identify them on. Fire hazards shall be identified in the Fire Protection Plan and Fire Management Plan. All workers shall be supplied with the required Personal Protective Equipment (PPE) as per the Occupational Health and Safety Act (Act No. 85 of 1993) (OHSA).

9. PHYSICAL ISSUES AND THEIR CONTROL

9.1 GEOLOGY AND SOILS

The site and surrounding area shall be shaped to permit the ready drainage of surface water and to prevent ponding. The Contractor shall determine the correct position of the topsoil stockpile/s within the construction servitude. Dumping or storage of topsoil shall not be done on established vegetation, but shall remain within the servitude footprint. The position of construction related materials shall be approved by the Project Manager and shall ensure minimal impact to the area outside of the construction servitude. Measures for the safety of workers in areas where potentially unstable geologic conditions are encountered shall be put in place, and engineering solutions shall be put in place to address potential risks. Areas where unstable geological conditions occur could be stabilized by using rock anchors or temporary retaining structures to stabilize slopes. In areas of severe instability, the power line route shall be re-aligned to avoid these sensitive geological areas. Excavations and drilling shall be restricted to the “legs” of the towers.

9.2 RIVERS AND STREAMS

No roads shall be cut through river and stream banks as this may lead to erosion causing siltation of streams and downstream dams. The Contractor shall minimise the extent of any damage to flood plains that is necessary to complete the works, and shall not pollute any river as a result of construction activities. The introduction of any construction related effluent water into any natural stream shall be approved by the ECO. No construction materials shall be stockpiled on the 1:100 year flood plain. The Contractor shall not modify the banks or bed of a watercourse without a Water Use Licence. In order to avoid erosion at stormwater discharge points proper erosion and sedimentation prevention techniques shall be implemented. Under no circumstances may rocks from any watercourse be used for erosion and sedimentation control. Existing drifts and bridges may be used if the Landowner gives written consent. (Refer to **TRMSCAAC1 REV 3** regarding access across running water). Furthermore, permission will be sorted from the Department of Water Affairs (DWA) before any new drifts and bridges are constructed.

9.3 WET AREAS

Permanently wet wetlands areas are shown on the profiles. No vehicular traffic shall be allowed in such wetlands. Only existing roads through such wetlands may be used with the approval of Eskom, the Department of Water Affairs (DWA), and the

Landowner. No equipment shall be used which may cause irreparable damage to wetlands. The Contractor shall use alternative methods of construction in such wetlands. All stockpiles shall be positioned away from drainage lines and rivers. Refer to **TRMSCAAC1 REV 3** regarding access through seasonally wet wetlands**.**

9.3.1 Management Objective

- Avoid all types of wetlands to prevent damage.

9.3.2 Measurable Targets

- No damage to wetlands (including digging and pegging).
- No complaints from authorities or landowners and litigation.

9.4 RIVER CROSSINGS

No roads shall be cut through river and stream banks as this may lead to erosion causing siltation of streams and downstream dams. Existing drifts and bridges may be used if the Landowner gives written consent. Such structures shall then be thoroughly examined for strength and durability before they are used. New drifts and bridges shall only be constructed with the approval of Eskom and the Landowner and at the discretion of the ECO. All structures constructed for access purposes shall be properly designed and drawings of such structures shall be available for record purposes. (Refer to **TRMSCAAC1 REV 3** regarding access across running water). Furthermore, permission shall be sorted from the Department of Water Affairs (DWA) before any new drifts and brides are constructed.

9.4.1 Management Objective

- Prevent damage to river and stream embankments.
- Minimise erosion of embankments and subsequent siltation of rivers, streams and dams.
- Follow DWA and NEMA Regulations for construction of new bridges.

9.4.2 Measurable Targets

- No access roads through river and stream banks.
- No visible erosion scars on embankments once construction is completed.
- No siltation of rivers, streams, dams or wetlands.
- Embankment vegetation successfully rehabilitated three months after construction.

The Contractor is to supply a method statement for river crossings to the ECO for approval before the activity commences.

9.5 EROSION AND DONGA CROSSINGS

Crossing of dongas and eroded areas shall be thoroughly planned in accordance with **TRMSCAAC1 REV 3** and will require a water use licence in terms of the National Water Act, 1998 (Act 36 of 1998). Water diversion berms shall be installed at donga crossings to ensure runoff water on the servitude does not run into dongas and cause an erosion hazard. Suitable erosion containment structures shall be constructed at donga crossings where required and viable. All structures shall be properly designed and drawings shall be available for reference purposes. No unplanned / improperly planned cutting of donga embankments is allowed as this leads to erosion and degradation of the environment.

9.5.1 Management Objective

- Minimise erosion damage on donga crossings.
- Minimise impeding the natural flow of water.
- Minimise initiation of erosion through donga embankments.

9.5.2 Measurable Targets

- No disturbance to donga embankments.
- No erosion visible on donga embankments due to construction activities.
- No interference with the natural flow of water, unless permitted.

The Contractor is to supply a method statement for erosion and donga to the ECO for approval before the activity commences.

9.6 ACCESS ROADS

Planning of access routes shall be done in conjunction between the Contractor, Eskom, the ECO and the Landowner. All agreements reached shall be documented in writing and no verbal agreements shall be made. The condition of existing access / private roads to be used shall be documented with photographs.

The Contractor shall properly mark all access roads. Markers shall show the direction of travel as well as tower numbers to which the road leads. Roads not to be used

shall be marked with a "**NO ENTRY**" sign (refer also **TRMSCAAC1 REV 3**). Where required, speed limits shall be indicated on the roads. All speed limits shall be strictly adhered to at all time.

Where new access roads are constructed, this shall be done in accordance with **TRMSCAAC1 REV 3**. Water diversion berms shall be installed from the start of the contract in accordance with **TRMSCAAC1 REV 3**. These berms shall be maintained at all times and be repaired at the end of the contract. Where berms are installed on severe slopes the outflow shall be suitably stone pitched to prevent erosion from starting at the base of the berm.

No roads shall be constructed on slopes of more than 20% unless such roads follow contours. In such areas the Contractor shall only use existing roads or alternative methods of construction.

The installation of concrete pipes and drifts, to facilitate access, shall be at the discretion of the ECO on site. All structures shall be properly designed and drawings shall be available for reference purposes. Any dangerous crossings shall be marked as such and where necessary, speed limits shall be enforced.

Where necessary a suitable mixture of indigenous grass seed shall be used to re-seed damaged areas. Badly damaged areas shall be fenced in to enhance rehabilitation.

9.6.1 Management Objective

- Prevent damage to existing access roads.
- Prevent damage to environment due to construction of new access roads.
- Prevent loss of topsoil and enhancement of erosion.

9.6.2 Measurable Targets

- No claims from Landowners due to damage on existing access roads.
- No visible erosion on access roads six months after completion of construction.
- No loss of topsoil due to runoff water on access roads.

The Contractor is to supply a method statement for access roads to the ECO for approval before the activity commences.

9.7 RUBBLE AND REFUSE DISPOSAL

The Contractor shall dispose of all excess material on site in an appropriate manner and at a designated place. All packaging material shall be removed from site and disposed of and not burned or buried on site. No landfill may be used without the consent from the Landowner. Shall a landfill be used for biodegradable materials only, the rubble shall be compacted and at least 1m of soil shall cover the waste material. No hazardous material, e.g. oil or diesel fuel shall be disposed of in any unlicenced waste site.

No material shall be left on site that may harm man, animals or vegetation. Any broken insulators shall be removed and all shards picked up. Broken, damaged and unused nuts, bolts and washers shall be picked up and removed from site as it is considered a hazardous material. Surplus concrete may not be dumped indiscriminately on site, but shall be disposed of in a licenced waste disposal site, certified for a specific waste. Concrete trucks shall not be washed on site after depositing concrete into foundations. Any spilled concrete shall be cleaned up immediately.

9.7.1 Management Objective

- To keep the servitude neat and clean.
- Disposal of rubble and refuse in an appropriate and legislated manner.
- Minimise litigation.
- Minimise Landowner complaints.

9.7.2 Measurable Targets

- No rubble or refuse lying around on site.
- No incidents of litigation.
- No complaints from Landowners.
- No concrete spillage on the servitude.

The Contractor is to supply a method statement for rubble and refuse disposal to the ECO for approval before the activity commences.

9.8 VEGETATION CLEARING

The objective of vegetation clearing is to trim, cut or clear the minimum number of trees and vegetation necessary for the safe mechanical construction and electrical

operation of the transmission line. Vegetation clearing shall be done in accordance with **ESKASABG3 REV 0** (Standard for bush clearance and maintenance within overhead power line servitudes and the Vegetation Management Guideline (**Appendix G**). **Only an 8m strip may be cleared flush with the ground to allow vehicular passage during construction.**

No scalping shall be allowed on any part of the servitude road unless absolutely necessary and authorised by the ECO. The removal of all economically valuable trees or vegetation shall be negotiated with the Landowner before such vegetation is removed. All trees and vegetation cleared from the site shall be cut into manageable lengths and neatly stacked at regular intervals along the line. No vegetation shall be pushed into heaps or left lying all over the servitude.

Vegetation clearing on tower sites shall be kept to a minimum. Big trees with large root systems shall be cut manually and removed, as the use of a bulldozer shall cause major damage to the soil when the root systems are removed. Stumps shall be treated with an Eskom approved herbicide. Smaller vegetation can be flattened with a machine, but the blade shall be kept above ground level to prevent scalping. Any vegetation cleared on a tower site shall be removed or flattened and not be pushed to form an embankment around the tower.

No vegetation clearing in the form of de-stumping, scalping or uprooting shall be allowed on river and stream banks. Vegetation shall only be cut to allow for the passage of the pilot-cables and headboard. **No vegetation clearing shall be allowed across ravines and gullies,** as this vegetation shall very rarely interfere with the clearance to the strung conductor. Trees and vegetation not interfering with the statutory clearance to the conductors can be left under the line. Dense vegetation under the line which could cause a fire hazard, particularly in the middle third of the span in the vicinity of the lowest point of the conductors, shall be considered as a separate case. With permission of the landowner, the total servitude under the line and up to 5m outside the outer phases can be cleared.

Protected or endangered species of plants shall not be removed unless they are interfering with a structure. Where such species have to be removed due to interference with a structure, the necessary permission and permits shall be

obtained from Provincial Nature Conservation. All protected species not to be removed shall be clearly marked and such areas fenced off if required by the ECO.

The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. Eskom's approval for the use of herbicides is mandatory. Application shall be under the direct supervision of a qualified technician registered in terms of the Fertilizers, Farm Feeds, Agricultural Remedies and Stock remedies Act, Act 36 of 1947. All surplus herbicide shall be disposed of in accordance with the supplier's specifications.

Upon completion of the stringing operations and before handover, the servitude shall be inspected and all vegetation interfering with the safe operation of the line shall be removed / cut down. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides

It is recommended that an ecologist be appointed, who shall assist during vegetation clearing with the following:

- Identify protected species.
- Identify declared weeds and alien species that can be totally eradicated.

9.8.1 Management Objective

- Minimise damage to indigenous vegetation.
- Keep servitude as natural looking as possible.
- Minimise interference by indigenous vegetation to flow of electricity.
- Minimise possibility of erosion due to removal of vegetation.
- Minimise removal of plant material on river and stream embankments.
- Eradication of alien invader and densifier species that cause a fire hazard.
- Prevent spreading of alien invader species by collecting and destroying their seeds.

9.8.2 Measurable Targets

- Only 8m vegetation cleared along the centre of the servitude for access purposes.
- No vegetation interfering with structures and statutory safety requirements upon completion of the contract.

- No de-stumping of vegetation on river and stream embankments.
- All alien invaders and densifiers removed to limit the fire hazard.
- No visible herbicide damage to the vegetation along the servitude one year after completion of the contract due to incorrect herbicide use.
- No litigation due to unauthorised removal of vegetation.
- No spreading of alien invaders six months after completion of vegetation clearing.

The Contractor is to supply a method statement for vegetation clearing to the ECO for approval before the activity commences. Construction across agricultural land shall take place outside of the growing and harvesting period.

9.9 GATE INSTALLATION AND GATE CONTROL

The Contractor is referred to the Fencing Act, 1963 (Act No 31 of 1963 (as amended by Act 108 of 1991). Gate installation shall be according to **TRMSCAAC1 REV 3**. Game gates shall be installed where necessary. **All gates installed in electrified fencing shall be re-electrified.** The ECO shall approve gate positions. All gate positions shall be three (3) metres off centre to allow for continued access when stringing takes place.

All gates shall be fitted with locks and be kept locked at all times during the construction phase. Gates shall only be left open on request of the Landowner if he accepts partial responsibility for such gates in writing, once the Contractor has left site and the gates are fitted with Eskom locks. Such gates shall be clearly marked by painting the posts green. All claims arising from gates left open shall be investigated and settled in full by the Contractor. If any fencing interferes with the construction process, such fencing shall be deviated / protected until construction is completed.

9.9.1 Management Objective

- Properly installed gates to allow access to the servitude.
- Minimise damage to fences.
- Limit access to Eskom and Contractor personnel with gate keys.

9.9.2 Measurable Targets

- No transgressions of the Fencing Act and therefore no litigation.
- No damage to fences and subsequent complaints from Landowners.

- All gates equipped with locks and kept locked at all times to limit access to key holders.
- All fences properly tied off to the gate posts.
- All gates properly and neatly installed according to specifications.
- No complaints or claims due to open gates.
- All electrified fences in working order.

The Contractor is to supply a method statement for gate installation and gate control to the ECO for approval before the activity commences.

9.10 CLAIMS FOR DAMAGE

All anticipated crop damage shall be noted while access negotiations are underway. All damage to commercial crops shall be recorded immediately. The ECO shall also keep a photographic record of such damage. The date, time of damage, type of damage and reason for the damage shall be recorded in full to ensure the responsible party is held liable. All claims for compensation emanating from crop damage shall be directed to the ECO for appraisal. The Contractor shall be held liable for all unnecessary damage to the environment and crops and livestock. **A register shall be kept of all complaints from Landowners. All claims shall be handled immediately to ensure timeous rectification / payment.**

9.10.1 Management Objective

- Minimise complaints from Landowners.
- Prevent litigation due to outstanding claims.
- Successful completion of the contract and all Landowners signing release forms.

9.10.2 Measurable Targets

- All claims investigated within 24 hours and settled within one month.
- No litigation due to unsettled claims.
- All Landowners signing release forms within six months after completion of the contract.

9.11 TOWER POSITIONS

Refer to **TRMSCAAC1 REV 3 section 4.4.5** for specifications concerning tower sites on slopes. Disturbance of topsoil on tower sites with severe slopes shall be minimised at all costs. At any tower sites where conventional foundations are

installed, the Contractor shall remove the topsoil separately and store it for later use during rehabilitation of such tower sites.

Re-seeding shall be done on disturbed areas as directed by the ECO. In accordance with the Conservation of Agricultural Resources Act, (Act 43 of 1983), slopes in excess of 2% shall be contoured and slopes in excess of 12% shall be terraced. Other methods of rehabilitation of tower sites may also be used at the discretion of the ECO, e.g. stone pitching, logging, etc. Contour banks shall be spaced according to the slope on tower sites. The type of soil shall also be taken into consideration.

A mixture of seed indigenous to the area can be used provided the mixture is carefully selected to ensure the following:

a) Annual and perennial plants are chosen.
b) Pioneer species are included.
c) All the plants shall not be edible.
d) Species chosen shall grow in the area without many problems.
e) Root systems shall have a binding effect on the soil.
f) The final product shall not cause an ecological imbalance in the area.

To get the best results in a specific area a vegetation specialist or the local extension officer of the Department of Agriculture shall be consulted. Seed distributors can also give valuable advice as to the mixtures and amount of seed necessary to seed a certain area. Re-seeding, as well as fencing in of badly damaged areas shall always be at the discretion of the ECO, in co-operation with the Landowner.

9.11.1 Management Objective

- Prevent damage to topsoil and environment at tower positions.
- Successful rehabilitation of all damaged areas.
- Prevention of erosion.

9.11.2 Measurable Targets

- No loss of topsoil due to construction activities.
- All disturbed areas successfully rehabilitated within three months of completion of the contract.
- No visible erosion scars three months after completion of the contract.

9.12 WINCH AND TENSIONER STATIONS

The siting of winch and tensioner stations shall be done in conjunction with the Landowner and ecologist/botanist and archaeologist that participated in the compilation of the CEMP where necessary.

Specifications require the protection of Eskom supplied material on site, especially conductor drums. This normally means that a firebreak is bladed around a drum station in the veld. Once the stringing of conductor has been completed in a certain area, the winch- and tensioner stations shall be rehabilitated where necessary. If the area was badly damaged, re-seeding shall be done and fencing in of the area shall be considered and carried out.

9.12.1 Management Objective

- Prevent damage to vegetation.
- Minimise damage to topsoil.
- Successful rehabilitation of barren areas.

9.12.2 Measurable Targets

- No damage to vegetation outside the servitude.
- No loss of topsoil.
- No visible erosion three months after completion of the contract.
- All disturbed areas successfully rehabilitated one year after completion of the contract.

9.13 STRINGING OPERATIONS

The necessary scaffolding / protection measures shall be installed to prevent damage to structures supporting certain high yield agricultural crops, such as vineyards, orchards, nurseries, etc., as well as the crops itself (Refer **TRMSCAAC1 REV 3**). All structures supplying services such as telephone and smaller power lines, as well as main and farm roads shall be safeguarded by measures to prevent disruption of services. All fences shall be protected against damage during stringing operations. Use of “rugby” posts to protect roads and telephone lines are sufficient.

9.13.1 Management Objective

- Prevent damage to structures and crops.
- Prevent disruption of services.

9.13.2 Measurable Targets

- No claims emanating from damage to supporting structures and crops.
- No complaints or claims arising from disruption of services.

10. BIOLOGICAL ISSUES AND THEIR CONTROL

10.1 FAUNA AND AVIFAUNA

The Project Manager and Contractor shall ensure that perch deterrents are made use of and that bird flappers are placed within areas identified as important migratory routes as shown on the accompanying Tower Profiles.

Construction workers shall be prohibited from interfering with stock and game animals. Construction activities shall be planned carefully so as not to interfere with the calving and lambing season for most animal species. The Contractor's workforce shall have to be very careful not to disturb the animals as this may lead to fatalities which shall give rise to claims from the Landowners.

The Contractor shall under no circumstances interfere with livestock without the Landowner being present. This includes the moving of livestock where they interfere with construction activities. Shall the Contractor's workforce obtain any livestock for eating purposes; they shall be in possession of a written note from the Landowner.

An ecologist was appointed to identify the sections of the line that require demarcation for anti-collision devices once the route has been finalised. The following areas were marked on the tower profiles:

- **All sections of line crossing a wetland or within 500 metres of a wetland.**
- **All river crossings.**
- **All sections of line crossing a centre pivot or within 500 metres of it.**
- **All protected plant species affected by the proposed towers.**

Self-supporting strain towers shall be protected with bird guards. Areas where bird flappers shall be installed are shown on the accompanying profiles.

Educate staff before they commence work in the area that poaching is against the law and transgressors shall be criminally charged.

The Contractor shall notify the ECO (in cooperation with the provincial nature conservation official) to move any wildlife (mammals, fish, reptiles, amphibians, invertebrates and insects) encountered out of the way to a safe environment during the construction period.

10.1.1 Management Objective

- Minimise disruption of farming activities.
- Minimise disturbance of animals.
- Minimise interruption of breeding patterns of birds.

10.1.2 Measurable Targets

- No stock losses where construction is underway.
- No complaints from Landowners or Nature Conservation.
- No litigation concerning stock losses and animal deaths.

10.2 FLORA

Protected or endangered species may occur along the power line route. Special care shall be taken not to damage or remove any such species unless absolutely necessary. Permits for removal shall be obtained from **Provincial Nature Conservation Department** shall such species be affected. All plants not interfering with the operation of the Transmission Power Line shall be left undisturbed. **Collection of firewood is strictly prohibited**.

10.2.1 Management Objective

- Minimal disturbance to vegetation where such vegetation does not interfere with construction and operation of the line.
- Prevention of litigation concerning removal of vegetation.

10.2.2 Measurable Targets

- No litigation due to removal of vegetation without the necessary permits.

10.3 HERBICIDE USE

Herbicide use shall only be allowed with the approval of Eskom. The application shall be according to set specifications and under supervision of a qualified technician. The possibility of leaching into the surrounding environment shall be properly investigated and only environmentally friendly herbicides shall be used.

10.3.1 Management Objective

- Control over the use of herbicides.

10.3.2 Measurable Targets

- No signs of vegetation dying due to leaching of herbicides one year after completion of the vegetation clearing.
- No Landowner complaints and litigation.

11. CULTURAL ISSUES AND THEIR CONTROL

11.1 ARCHAEOLOGY

The positions of known sites are described in **Table 6-3**. Such areas shall be marked as no go areas. Artefacts shall not be removed under any circumstances. Any destruction of a site can only be allowed once a permit is obtained and the site has been mapped and noted. Permits shall be obtained from the South African Heritage Resources Association (SAHRA) shall the proposed line affect any World Heritage Sites or if any sites are to be destroyed or altered. No dolomite, breccia or stomatolites may be removed or disturbed without the required permits from SAHRA.

Shall any archaeological sites be uncovered during construction, their existence shall be reported to Eskom immediately. An archaeologist shall then take the necessary action so that construction can continue.

11.1.1 Management Objective

- Protection of archaeological sites and land considered to be of cultural value.
- Protection of known sites against vandalism, destruction and theft.
- The preservation and appropriate management of new archaeological finds shall these be discovered during construction.

11.1.2 Measurable Targets

- No destruction of or damage to known archaeological sites.
- Management of existing sites and new discoveries in accordance with the recommendations of the Archaeologist.

11.2 GRAVE SITES

Any graves shall be clearly marked and treated as no go areas. No destruction of any site shall be allowed. Shall it be necessary to remove any graves, the necessary procedures shall be followed and permits obtained. Shall any bones be dug up, all work in the area shall cease immediately and the ECO (who shall in turn contact the archaeologist) shall be contacted.

11.2.1 Management Objective

- Protection of sites and land considered to be of cultural value.
- Protection of known sites against vandalism, destruction and theft.
- The preservation and appropriate management of new finds shall these be discovered during construction.

11.2.2 Measurable Targets

- No destruction of or damage to known sites.
- Management of existing sites and new discoveries in accordance with legislation.
- No litigation due to destruction of sites.

11.3 FARMHOUSES/BUILDINGS

Where the line crosses an inhabited area, the necessary precautions shall be taken by the Contractor to safeguard the lives and property of the inhabitants. The Contractor shall under no circumstances interfere with the property of Landowners.

11.3.1 Management Objective

- Control over actions and activities in close proximity to inhabited areas.

11.3.2 Measurable Targets

- No complaints from Landowners.
- No damage to private property.

11.4 INFRASTRUCTURE

If damaged infrastructure is not repaired to the expectations of the Landowners, they may refuse to sign the release forms and even engage in litigation. Outstanding claims may also result in release forms not being signed by the Landowners.

No telephone lines or fences shall be dropped during the stringing operations. Where pipe lines are found along the route, the depth of the pipes under the surface shall be determined to ensure that proper protection is afforded to such structures. All pipelines shall be clearly marked and protected. Any damage to pipe lines shall be repaired immediately. The use of private roads for construction purposes always leads to damage due to heavy equipment and frequent use. It is foreseen that the Contractor shall receive many complaints in this regard, especially during the rainy season.

All existing private access roads used for construction purposes, shall be maintained at all times to ensure that the local people have free access to and from their properties. Speed limits shall be enforced in such areas and all drivers shall be

sensitised to this effect. Upon completion of the project all roads shall be repaired to their original state.

Many Landowners use electrically driven farming practices such as irrigation or dairies. Power cuts to facilitate construction and especially stringing shall be carefully planned. If possible disruptions shall be kept to a minimum and shall be well advertised and communicated to the Landowners. Care shall be taken not to damage irrigation equipment, lines, channels and crops, as this could lead to major claims being instituted against Eskom and the Contractor. The position of all pipelines and irrigation lines shall be obtained from the Landowners and be shown on the physical access plan.

11.4.1 Management Objective

- The control of temporary or permanent damage to plant and installations.
- Control of interference with the normal operation of plant and installations.
- Securing of the safe use of infrastructure, plant and installations.

11.4.2 Measurable Targets

- No unplanned disruptions of services.
- No damage to any plant or installations.
- No complaints from authorities or Landowners regarding disruption of services.
- No litigation due to losses of plant, installations and crops.

12. REQUIREMENTS DURING CONSTRUCTION PERIOD

1. Proper and continuous liaison between Eskom, the Contractor and Landowners to ensure everyone is informed at all times.
2. A physical access plan along the servitude shall be compiled and the Contractor shall adhere to this plan at all times. Proper planning when the physical access plan is drawn up by the ECO in conjunction with the Contractor shall be necessary to ensure access to all tower sites.
3. The Landowners shall be informed of the starting date of construction as well as the phases in which the construction shall take place.
4. The Contractor shall adhere to all conditions of contract including the CEMP and Landowner special conditions.
5. Proper planning of the construction process to allow for disruptions due to rain and very wet conditions.
6. All servitude gates on a section of the line route shall be completely installed before any construction activities are undertaken.
7. Where existing private roads are in a bad state of repair, such roads' condition shall be documented (including photographs) before they are used for construction purposes. If necessary some repairs shall be done to prevent damage to equipment and plant.
8. All manmade structures shall be protected against damage at all times and any damage shall be rectified immediately.
9. Rehabilitation of the servitude roads shall be done properly to ensure all Landowners sign the release forms. The Contractor shall ensure that all damaged areas are rehabilitated to the satisfaction of Eskom and each and every property owner and that outstanding claims are settled.
10. Proper site management and regular monitoring of site works.
11. Proper documentation and record keeping of all complaints and actions taken.
12. Regular site inspections and good control over the construction process throughout the construction period.
13. Appointment of a CECO on behalf of the Contractor to implement this CEMP as well as deal with all Landowner related matters.
14. Independent Environmental Audits to be carried out during and upon completion of construction (at least two for the project).

The Contractor shall not be released from site until all Landowners have signed off the release documentation to the satisfaction of the Eskom ECO.

12.1 LANDOWNER SPECIAL CONDITIONS

Landowner special conditions are listed in **Appendix H**.

13. PHYSICAL ACCESS PLAN

The CECO, in conjunction with the ECO and Landowners, shall draft a physical access plan. No decisions shall be made without the consent of the Landowner. All agreements shall be in writing and well documented and photographed.

A physical access plan shall be developed and shall allow for the installation of concrete pipes and drifts where such structures may be needed to facilitate access. The ECO in conjunction with the Contract Manager shall use discretion as to what special measures shall be required to ensure access. The necessary agreements reached shall be implemented to the satisfaction of the Landowner.

14. SITE DOCUMENTATION/MONITORING/REPORTING

The standard Eskom site documentation shall be used to keep records on site. All documents shall be kept on site and be available for monitoring and auditing purposes. Site inspections by an Environmental Audit Team may require access to this documentation for auditing purposes. The documentation shall be signed by all parties to ensure that such documents are legitimate. Regular monitoring of all site works by the Environmental Control Officer is imperative to ensure that all problems encountered are solved punctually and amicably. When the Environmental Control Officer is not available, the Contract Manager/Site Supervisor shall keep abreast of all works to ensure no problems arise.

Two-weekly reports shall be forwarded to the appointed Transmission Environmental Advisor with all information relating to environmental matters. The following **Key Performance Indicators** shall be reported on a two-weekly basis:

1. Complaints received from Landowners and actions taken.
2. Environmental incidents, such as oil spills, concrete spills, etc. and actions taken (litigation excluded).
3. Incidents possibly leading to litigation and legal contraventions.
4. Environmental damage that needs rehabilitation measures to be taken.

The following documentation shall be kept on site:

- Access negotiations and physical access plan.
- Complaints register.
- Site daily diary.
- Records of all remediation / rehabilitation activities.
- Copies of two-weekly reports to the **Transmission** Environmental Advisor.
- Copy of the Construction Environmental Management Programme (CEMP) file.

APPENDIX A

LOCALITY MAP

STEELPOORT TO WOLWEKRAAL 400KV POWERLINE

LOCALITY MAP

![ILISO consulting logo]

ILISO consulting

Eskom

Date: 22 January 2013

System: Hartebeeshoek94

APPENDIX B

COPY OF THE ENVIRONMENTAL AUTHORISATION

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Fedsure Building · 315 Pretorius Street · PRETORIA
Tel (+ 27 12) 310 3911 · Fax (+ 2712) 322 2682

NEAS Reference: DEAT/EIA/2643/2008
DEA Reference: 12/12/20/1341
Enquiries: Lerato Mokoena
Telephone: 012-310-3137 **Fax:** 012-320-7539 **E-mail:** lmokoena@environment.gov.za

Ms Mmamoloko Seabe
Eskom Holdings Limited
PO Box 1091
JOHANNESBURG
2001

Fax no: (011) 800-3917

PER FACSIMILE / MAIL

Dear Ms Seabe

APPLICATION FOR ENVIRONMENTAL AUTHORISATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998: GN R. 386/387: THE PROPOSED CONSTRUCTION OF THE STEELPOORT TO WOLWEKRAAL 400KV POWER LINE AND ASSOCIATED SECONDARY INFRASTRUCTURE, MPUMALANGA AND LIMPOPO PROVINCES

With reference to the abovementioned application, please be advised that the Department has decided to grant authorisation. The environmental authorisation and reasons for the decision are attached herewith.

In terms of regulation 10(2) of the Environmental Impact Assessment Regulations, 2006, you are instructed to notify all registered interested and affected parties (IAPs), in writing and within ten (10) calendar days of the date of this letter, of the Department's decision in respect of your application as well as the provisions regarding the making of appeals that are provided for in the Environmental Impact Assessment (EIA) Regulations, 2010.

Your attention is drawn to Chapter 7 of the EIA Regulations, 2010, which regulates appeal procedures. Attached please find a simplified copy of the appeals procedure to be followed. Kindly include a copy of this procedure with the letter of notification to IAPs.

A copy of the official appeal form can be obtained from Mr TH Zwane, Senior Legal Administrator (Appeals), Tel: 012 310 3929, TZwane@environment.gov.za at the Department.

Should any party, including the applicant, wish to appeal any aspect of the decision, they or the applicant must, *inter alia*, lodge a notice of intention to appeal with the Minister, within 20 days after the date of the decision, by means of one of the following methods:

By facsimile: 012 320-7561
or
By post: Department of Environmental Affairs
Private Bag X447
Pretoria
0001

or

By hand: Fedsure Forum Building,
2nd Floor North Tower
Corner Van der Walt and Pretorius Streets
Pretoria

If the appellant is a person other than the applicant, the appellant must within ten (10) days of lodging the notice of intention to appeal, provide a copy of the notice to the applicant and a notice indicating where and for what period the appeal submission will be available for inspection by the applicant.

If the applicant is the appellant, the applicant must also provide a copy of the notice of intention to appeal, within ten (10) days of having lodged such notice, to each person and organ of state which was a registered interested and affected party. The applicant must furthermore provide all the above-mentioned registered interested and affected parties with a notice indicating that the appeal submission will be made available on the day of lodging it with the Minister or MEC, and indicate where and for what period the appeal submission will be available for inspection by such person or organ of state.

Please include the Department, attention of the Director: Environmental Impact Evaluation, in the list of IAPs, notified through your notification letter of the decision, for record purposes.

The authorised activity or activities shall not commence within thirty (30) days of the date of signature of the authorisation. An appeal under section 43 of the National Environmental Management Act (NEMA), Act 107 of 1998 (as amended), does not suspend an environmental authorisation or exemption, or any provisions or conditions attached thereto, or any directive, unless the Minister, MEC or delegated organ of state directs otherwise.

Yours sincerely

Mr Dumisani Mthembu
ACTING CHIEF DIRECTOR: ENVIRONMENTAL IMPACT MANAGEMENT
Department of Environmental Affairs
Date: 19/04/2011

CC: Ms Sonja Van Eden — NEMAI Consulting (EAP) — Fax: 011 781-1731
Mr Thami Zwane — Appeals Authority (DEA)

APPEALS PROCEDURE IN TERMS OF CHAPTER 7 OF THE NEMA EIA REGULATIONS, 2010 AS PER GN R. 543 OF 2010 TO BE FOLLOWED BY THE APPLICANT AND INTERESTED AND AFFECTED PARTIES UPON RECEIPT OF NOTIFICATION OF AN ENVIRONMENTAL AUTHORISATION

APPLICANT	INTERESTED AND AFFECTED PARTIES (IAPs)
1. Receive notice of Environmental Authorisation (EA) from the relevant Competent Authority (CA).	1. Receive notice of Environmental Authorisation (EA) from Applicant/Consultant.
2. Within 20 days after the date of the decision, notify the relevant Appeal Authority of the intention to appeal.	2. Within 20 days of date of the decision, notify the relevant Appeal Authority of the intention to appeal.
3. The Applicant must within 10 days of having submitted the notice of intention to appeal, as indicated in 2 above, provide to each persons and organ of state who was a registered IAP- 3.1 a copy of the notice of intention to appeal; and 3.2 a notice indicating that the appeal submission will be made available on the day of lodging it with the Appeal Authority and where and for what period the appeal submission will be available for inspection by such registered IAP.	3. Appellant must within 10 days of having submitted the notice of intention to appeal, as indicated in 2 above, provide the applicant with- 3.1 a copy of the notice of intention to appeal; and 3.2 a notice indicating where and for what period the appeal submission will be available for inspection by the applicant.
4. The appeal must be submitted to the Appeal Authority within 30 days after the lapsing of the 20 days period which is allowed for the submission of the notice of intention to appeal.	4. The appeal must be submitted to the Appeal Authority within 30 days after the lapsing of the 20 days period which is allowed for the submission of the notice of intention to appeal.
5. A person or organ of state that receives notice of an appeal may submit a responding statement to the relevant Appeal Authority or designated organ of state within 30 days from the date that the appeal submission was lodged with the Appeal Authority.	5. An applicant that receives notice of an appeal may submit a responding statement to the relevant Appeal Authority or designated organ of state within 30 days from the date the appeal submission was lodged with the Appeal Authority.

NOTES:

1. **An appeal against a decision must be lodged with-**
   a) the Minister of Water and Environmental Affairs if the decision was issued by the Director-General of the Department of Environmental Affairs (or another official) acting in his/her capacity as the delegated Competent Authority;
   b) the Minister of Justice and Constitutional Development if the applicant is the Department of Water Affairs and the decision was issued by the Director-General of the Department of Environmental Affairs (or another official) acting in his/her capacity as the delegated Competent Authority;
   c) the MEC if the decision was issued by the Head of Department (or another official) acting in his/her capacity as the delegated Competent Authority; or
   d) the delegated organ of state where relevant.

2. **An appeal lodged with-**
   a) the Minister of Water and Environmental Affairs must be submitted to the Department of Environmental Affairs;
   b) the Minister of Justice and Constitutional Development must be submitted to the Department of Environmental Affairs;
   c) the MEC must be submitted to the provincial department responsible for environmental affairs; or
   d) the delegated organ of state, where relevant, must be submitted to the delegated organ of state.

3. **An appeal must be-**
   a) on an official form obtainable or published by the relevant Appeal Authority;
   b) accompanied by:
      - a statement setting out the grounds of appeal;
      - supporting documentation which is referred to in the appeal and is not available to the relevant Appeal Authority;
      - a statement that the appellant has complied with regulation 60 (2) or (3) has been complied with together with copies of the notices referred to in regulation 60; and
      - the prescribed appeal fee, if any.

4. **A copy of the official appeal form can be obtained from:**
   Mr TH Zwane, Senior Legal Administrator (Appeals): Tel: 012 310 3929, TZwane@environment.gov.za

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Environmental Authorisation

Authorisation register number:	*12/12/20/1341*
NEAS reference number:	DEAT/EIA/2643/2008
Last amended:	*First issue*
Holder of authorisation:	*ESKOM HOLDINGS LIMITED*
Location of activity:	*MPUMALANGA AND LIMPOPO PROVINCES: Within Greater Marble Hall Local Municipality, Elias Motsoaledi Local Municipality and Makhuduthamaga Local Municipality*

This authorisation does not negate the holder of the authorisation's responsibility to comply with any other statutory requirements that may be applicable to the undertaking of the activity.

Decision

The Department is satisfied, on the basis of information available to it and subject to compliance with the conditions of this environmental authorisation, that the applicant should be authorised to undertake the activity/ies specified below.

Details regarding the basis on which the Department reached this decision are set out in Annexure 1.

Activities authorised

By virtue of the powers conferred on it by the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the Environmental Impact Assessment Regulations, 2006 the Department hereby authorises –

ESKOM HOLDINGS LIMITED

with the following contact details –

Ms Mmamoloko Seabe
Eskom Holdings Limited
PO Box 1091
JOHANNESBURG
2001

Tel: (011) 800-2345
Fax: (011) 800-3917
Cell: (082) 801-3911
E-mail: SeabeJM@eskom.co.za

to undertake the following activities (hereafter referred to as "the activities"):

DEA 19/04/2011

GN R. 387

Item 1(l): *The construction of facilities or infrastructure, including associated structures or infrastructure, for –The transmission and distribution of above ground electricity with a capacity of 120 kilovolts or more.*

GN R. 386:

Item 1 (m): *The construction of facilities or infrastructure, including associated structures or infrastructure, for any purpose in the one in ten year flood line of a river or stream, or within 32m from the back of a river or stream where the flood line is unknown, excluding purposes associated with existing residential use, but including (i) canals; (ii) channels; (iii) bridges; (iv) dams; and (v) weirs.*

Item 7: *The above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1000 cubic metres at any one location or site.*

Item 12: *The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).*

Item 20: *The transformation of an area zoned for use as a public open space or for a conservation purpose to another use.*

as described in the Environmental Impact Report (EIR) dated September 2010 at:

Bend Coordinates Corridor Alternative 2	
Latitude	**Longitude**
25° 04' 32.92119"S	29° 20' 54.89154"E
25° 02' 14.66282"S	29° 24' 30.78394"E
25° 00' 10.62167"S	29° 30' 37.43513"E
24° 59' 24.32746"S	29° 35' 06.84854"E
24° 59' 16.76670"S	29° 37' 51.11753"E
24° 58' 21.38386"S	29° 41' 18.00734"E
24° 59' 01.59106"S	29° 43' 53.07964"E

DEA
19/04/2011

25° 00' 08.63966"S	29° 45' 22.69764"E
25° 01' 31.67134"S	29° 45' 28.73462"E
25° 02' 17.63352"S	29° 46' 23.27138"E
25° 02' 11.54999"S	29° 46' 43.20823"E
25° 02' 29.02805"S	29° 47' 27.26525"E
25° 02' 42.56580"S	29° 48' 36.09200"E
25° 03' 05.00851"S	29° 48' 50.25926"E
5° 05' 43.78917"S	2 29° 49' 30.92105"E
25° 06' 15.32927"S	29° 49' 27.56381"E
25° 06' 46.91325"S	29° 49' 45.47860"E

The construction of a 400kv power line between the Steelpoort Substation and the proposed Wolwekraal Substation within the Greater Marble Hall Local Municipality, Elias Motsoaledi Local Municipality and Makhuduthamaga Local Municipality, Mpumalanga and Limpopo Provinces, hereafter referred to as "the property".

Conditions

Scope of authorisation

1. The preferred route corridor Alternative 2 (northern corridor) is approved.
2. Authorisation of the activity is subject to the conditions contained in this authorisation, which form part of the environmental authorisation and are binding on the holder of the authorisation.
3. The holder of the authorisation shall be responsible for ensuring compliance with the conditions contained in this environmental authorisation. This includes any person acting on the holder's behalf, including but not limited to, an agent, servant, contractor, sub-contractor, employee, consultant or person rendering a service to the holder of the authorisation.
4. The activities authorised may only be carried out at the property as described above.
5. Any changes to, or deviations from, the project description set out in this authorisation must be approved, in writing, by the Department before such changes or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations and it may be necessary for the holder of the authorisation to apply for further authorisation in terms of the regulations.
6. This activity must commence within a period of five (5) years from the date of issue. If commencement of the activity does not occur within that period, the authorisation lapses and a

DEC
19/04/2011

new application for environmental authorisation must be made in order for the activity to be undertaken.

7. Commencement with one activity listed in terms of this authorisation constitutes commencement of all authorised activities.

8. This authorisation does not negate the holder of the authorisation's responsibility to comply with any other statutory requirements that may be applicable to the undertaking of the activity.

9. Relevant legislation that must be complied with by the holder of this authorisation includes, *inter alia*:

- Archaeological remains, artificial features and structures older than 60 years are protected by National Heritage Resources Act, 1999 (Act No. 25 of 1999). Should any archaeological artefacts be exposed during excavation for the purpose of construction, construction in the vicinity of the finding must be stopped immediately. A registered Heritage Specialist must be called to the site for inspection. Under no circumstances shall any heritage material be destroyed or removed from the site and the relevant heritage resource agency must be informed about the finding. Heritage remains uncovered or disturbed during earthworks must not be disturbed further until the necessary approval has been obtained from the South African Heritage Resources Agency and/or any of their delegated provincial agencies.
- All provisions of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).
- All provisions of the National Water Act, 1998 (Act 36 of 1998).
- All provisions of the National Forests Act, 1998 (Act No. 84 of 1998).
- All provisions of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- All provisions of the National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) and its Regulations.
- Should fill material be required for any purpose, the use of borrow pits must comply with the provisions of the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) administered by the Department of Minerals and Energy.

10. The holder of an environmental authorisation has the responsibility to notify the competent authority of any alienation, transfer and change of ownership rights in the property on which the activity is to take place.

DEA
19/06/2012

Notification of authorisation

11. The holder of the authorisation must notify every registered interested and affected party, in writing and within 10 (ten) calendar days of the date of this environmental authorisation, of the decision to authorise the activity.

12. The notification referred to must –

    9.1 specify the date on which the authorisation was issued;

    9.2 inform the interested and affected party of the appeal procedure provided for in Chapter 7 of the Environmental Impact Assessment (EIA) Regulations, 2010;

    9.3 advise the interested and affected party that a copy of the authorisation will be furnished on request; and

    9.4 give the reasons for the decision.

Management of the activity

13. The Environmental Management Plan (EMP) submitted as part of Application for EA must be amended and submitted to the Department for written approval prior to commencement of the activity. The recommendations and mitigation measures recorded in the EIR dated September 2010 must be incorporated as part of the EMP. Once approved, the EMP must be implemented and adhered to.

Monitoring

14. The applicant must appoint a suitably experienced independent Environmental Control Officer (ECO) for the construction phase of the development that will have the responsibility to ensure that the mitigation/rehabilitation measures and recommendations referred to in this authorisation are implemented and to ensure compliance with the provisions of the EMP.

15. The ECO shall be appointed before commencement of any authorised activity/ies.

16. Once appointed, the name and contact details of the ECO must be submitted to the Director: Compliance Monitoring of the Department.

17. The ECO shall keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.

18. The ECO shall remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site is ready for operation.

DEA
19/04/2011

19. Records relating to monitoring and auditing must be kept on site and made available for inspection to any relevant and competent authority in respect of this development.

Recording and reporting to the Department

20. All documentation e.g. audit/monitoring/compliance reports and notifications, required to be submitted to the Department in terms of this authorisation, must be submitted to the *Director: Compliance Monitoring* at the Department.
21. The holder of the authorisation must submit an environmental audit report upon completion of the construction and rehabilitation activities.
22. The environmental audit report must indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions as well as the requirements of the EMP.
23. All compliance monitoring and audit reports must be submitted to the *Director: Compliance Monitoring*.

Commencement of the activity

24. The authorised activity/ies shall not commence within thirty (30) days of the date of signature of the authorisation.
25. An appeal under section 43 of the National Environmental Management Act (NEMA), Act 107 of 1998 (as amended), does not suspend an environmental authorisation or exemption, or any provisions or conditions attached thereto, or any directive, unless the Minister, MEC or delegated organ of state directs otherwise.

Notification to authorities

26. Fourteen (14) days written notice must be given to the Department that the activity will commence. Commencement for the purposes of this condition includes site preparation. The notice must include a date on which it is anticipated that the activity will commence. This notification period may coincide with the period contemplated in 24 above.

DEA
19/09/2011

Operation of the activity

27. Fourteen (14) days written notice must be given to the Department that the activity operational phase will commence.
28. The applicant must compile an operational EMP for the operational phase of the activity or alternatively, if the applicant has an existing operational environmental management system, it must be amended to include the operation of the authorised activity.

Site closure and decommissioning

29. Should the activity ever cease or become redundant, the applicant shall undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

Specific conditions

30. Anti-collision devices such as bird flappers must be installed where the power lines crosses avifaunal corridors. The input of an avifaunal specialist must be obtained for the fitting of the anti-collision devices onto specific sections of the line once the exact positions of the towers have been surveyed and pegged.
31. A floral and faunal specialist should be present during the planning and pegging of the final route alignment to ensure that the positions of pylons result in minimum impacts on sensitive vegetation, protected trees and habitats.
32. An agricultural specialist must form part of the walk through in the final route determination in order to identify critical centre pivot irrigation systems which need to be avoided by the power line.
33. The wetlands, including, rivers, riparian zones and river banks must be designated as sensitive areas and must be demarcated as such. No construction activities (including placing of pylons, temporary ablution, fuel storage, storing of equipment, waste disposal, construction camps, vegetation clearing, excavations, access roads, soil stockpiling and material storage) must take place in such sensitive area.
34. A wetland specialist should be present during the pegging of the final route alignment to ensure that no pylons are placed within wetlands and river banks..

DEA 19/04/2011

35. No activities will be allowed to encroach into a water resource without a water use authorisation being in place from the Department of Water Affairs.
36. No exotic plants may be used for rehabilitation purposes. Only indigenous plants of the area may be utilised.
37. Indigenous vegetation which does not interfere with the safe operation of the power line must be left undisturbed.
38. Protected trees must not be cut or removed prior to a licence being obtained in line with the National Forests Act, 1998 (Act No. 84 of 1998) administered by the Department of Agriculture, Forestry, and Fisheries.
39. The EMP must include the final route indicating all sensitive features or aspects which were avoided and those that could not be avoided. (Game farms, centre pivots, wetlands, rivers, ridges, heritage resources, visual intrusion, vegetation including protected trees and residential communities).
40. Liaison with communities and land owners is to be done prior to construction in order to provide sufficient time for them to plan livelihood activities.
41. An integrated waste management approach must be implemented that is based on waste minimisation and must incorporate reduction, recycling, re-use and disposal where appropriate. Any solid waste shall be disposed of at a landfill licensed in terms of section 20 (b) of the National Environment Management Waste Act, 2008 (Act No. 59 of 2008).

General

42. A copy of this authorisation must be kept at the property where the activity/ies will be undertaken. The authorisation must be produced to any authorised official of the Department who requests to see it and must be made available for inspection by any employee or agent of the holder of the authorisation who works or undertakes work at the property.
43. Where any of the applicant's contact details change, including the name of the responsible person, the physical or postal address and/or telephonic details, the applicant must notify the Department as soon as the new details become known to the applicant.
44. The holder of the authorisation must notify the Department, in writing and within 48 (forty eight) hours, if any condition of this authorisation cannot be or is not adhered to. Any notification in terms of this condition must be accompanied by reasons for the non-compliance. Non-compliance with a condition of this authorisation may result in criminal prosecution or other actions provided for in the National Environmental Management Act, 1998 and the regulations.

45. National government, provincial government, local authorities or committees appointed in terms of the conditions of this authorisation or any other public authority shall not be held responsible for any damages or losses suffered by the applicant or his successor in title in any instance where construction or operation subsequent to construction be temporarily or permanently stopped for reasons of non-compliance by the applicant with the conditions of authorisation as set out in this document or any other subsequent document emanating from these conditions of authorisation.

Date of environmental authorisation: 19/04/2011

Mr Dumisani Mthembu

ACTING CHIEF DIRECTOR: ENVIRONMENTAL IMPACT MANAGEMENT

Department of Environmental Affairs

Annexure 1: Reasons for Decision

1. Background

The applicant, Eskom Holdings Limited applied for the following activities:

GN R. 386

Item 1(l): *The construction of facilities or infrastructure, including associated structures or infrastructure, for –The transmission and distribution of above ground electricity with a capacity of 120 kilovolts or more.*

GN R. 386:

Item 1 (m): *The construction of facilities or infrastructure, including associated structures or infrastructure, for any purpose in the one in ten year flood line of a river or stream, or within 32 m from the back of a river or stream where the flood line is unknown, excluding purposes associated with existing residential use, but including (i) canals; (ii) channels; (iii) bridges; (iv) dams; and (v) weirs.*

Item 7: *The above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1000 cubic metres at any one location or site.*

Item 12: *The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).*

Item 20: *The transformation of an area zoned for use as a public open space or for a conservation purpose to another use;*

DEA
19/Dec/2014

- for the proposed construction of a 400kv power line between the Steelpoort Substation and the proposed Wolwekraal Substation within the Greater Marble Hall Local Municipality, Elias Motsoaledi Local Municipality and Makhuduthamaga Local Municipality, Mpumalanga and Limpopo Provinces, as described in the Environmental Impact Report dated September 2010.

The applicant appointed NEMAI Consulting to undertake an environmental assessment process in accordance with the EIA Regulations, 2006.

2. Information considered in making the decision

In reaching its decision, the Department took, *inter alia*, the following into consideration -

a) The information contained in the EIR dated September 2010;
b) The comments received from the Directorate: Biodiversity and Conservation, organs of state and interested and affected parties as included in the EIR dated September 2010;
c) Mitigation measures as proposed in the EIR dated September 2010 and the EMP;
d) The information contained in the specialist studies contained within Appendix D of the EIR.
e) The objectives and requirements of relevant legislation, policies and guidelines, including section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

3. Key factors considered in making the decision

All information presented to the Department was taken into account in the Department's consideration of the application. A summary of the issues which, in the Department's view, were of the most significance is set out below.

a) Details provided of the qualifications of the EAP indicate that the EAP is competent to carry out the environmental impact assessment procedures.
b) The findings of all the specialist studies conducted and their recommended mitigation measures.
c) The need and desirability for the proposed 400kv power line between the Steelpoort Substation and the proposed Wolwekraal Substation.
d) The EIR dated September 2010 included a description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.

DEA 19/04/2011

e) The EIR dated September 2010 identified all legislation and guidelines that have been considered in the preparation of the EIR dated September 2010.

f) The methodology used in assessing the potential impacts identified in the EIR dated September 2010 and the specialist studies have been adequately indicated.

g) A sufficient public participation process was undertaken and the applicant has satisfied the minimum requirements as prescribed in the EIA Regulations, 2006 for public involvement.

4. Findings

After consideration of the information and factors listed above, the Department made the following findings -

- Floral assessment found that the southern route alternative 1 was chosen as the preferred alternative mainly due to the fact that it follows an existing power line for 85% of its route. A site walk-through survey of the preferred line alternative will need to be undertaken to ensure that Red Data Listed and protected floral species be surveyed and mapped prior to construction. This is especially important in the areas that have been designated as "High impact areas" as well as those areas that incorporate vegetation types known to support a high degree of endemism (e.g. Sekhukhune Mountain Bushveld and Sekhukhune Mountain Grasslands).
- The faunal assessment found that Alternative 1 (southern route) is regarded as the route alternative that would pose the least threat to the overall conservation of the vegetation type, habitat type features and therefore, faunal community structures and within the region.
- The Avifaunal assessment found that the southern route alternative 1 have the least overall impact on avifaunal conservation within the region. This option also incorporates fewer areas that would potentially require mitigation measures to abate collisions from various avifaunal species.
- The Ecological reassessment found that though the fauna, flora and avifauna (Ecological aspects) had corridor Alternative 1 as the preferred alternative, it was found that, the topography/terrain maybe limiting for Alternative 1. As such a preliminary engineering study was conducted. This study indicated that Alternative 1 would indeed result in serious technical problems during construction and maintenance. The second ecological survey was undertaken to find the possibilities of ecological degradation on corridor Alternative 2. The

DEA 19/04/2011

result was that it was possible to construct the power line at Alternative 2 without incurring extensive environmental degradation.

- The heritage impact assessment found Alternative Two would have the least impact on known sites. It is also the route in which the least unknown sites are expected to occur.
- The visual impact assessment found corridor Alternative 1 as the most preferred alternative. Its location parallel with to existing lines and along agricultural land as well as informal settlements is considered to cause the least impact on the landscape character due to the reduced sensitivity of the landscape along the roads and servitudes.
- The Soil, Land Use and Land Capability Assessment found that the two routes traverse areas with a wide range of land uses with very limited irrigated agriculture land uses. Impacts are expected to be low upon the condition that pylons are placed outside of areas with irrigation infrastructural developments. There was no preferred alternative as both will have similar impacts, if mitigated.
- The Social Impact Assessment found that Impacts on health and social well-being; quality of the living environment; economic material well-being; culture; family and community; institutional, legal, political and equity impacts; and gender relations would be least significant at corridor Alternative 2.
- The Economic assessment using a macro econometric model to determine the impacts of the project on the provincial economies of Mpumalanga and Limpopo and capturing the sectoral inter-relationships between the various components of the provincial economies concluded that Alternative 2 would be preferred.
- Preliminary engineering report recommended the northern route Alternative 2 as the technically best route compared to the southern route. However, this recommendation is not based on the exact coordinates of the bend points which were not available during the time of the study, and it is therefore based on rough sketches of the proposed new 400kV line.
- Public concerns, for example, on issues such as: eco tourism; game farming; division of land/farms; loss property value; pivot centred irrigation systems; visual impact; cumulative impact of power lines; rehabilitation from previous power lines; loss of fauna, flora and wetlands and electric magnetic fields (EMF) were raised.
- The identification and assessment of impacts are detailed in the EIR dated September 2010 and sufficient assessment of the key identified issues and impacts have been completed.
- The procedure followed for impact assessment is adequate for the decision-making process.

DEA 19/04/2011

- The proposed mitigation of impacts identified and assessed adequately curtails the identified impacts.
- All legal and procedural requirements have been met.
- The information contained in the EIR dated September 2010 is accurate and credible.
- EMP measures for the pre-construction, construction and rehabilitation phases of the development were proposed and included in the EIR and will be implemented to manage the identified environmental impacts during the construction process.

In view of the above, the Department is satisfied that, subject to compliance with the conditions contained in the environmental authorisation, the proposed activity will not conflict with the general objectives of integrated environmental management laid down in Chapter 5 of the National Environmental Management Act, 1998 and that any potentially detrimental environmental impacts resulting from the proposed activity can be mitigated to acceptable levels. The application is accordingly granted.

DEA
19/12/12

APPENDIX C

SPECIALIST WALKTHROUGH REPORTS

Scientific Aquatic Services

Applying science to the real world

91 Geldenhuis Road, Malvern East Ext 1, 2007
Tel 011 616 7893
Fax 011 615 6240
www.sasenvironmental.co.za
admin@sasenvironmental.co.za

Name: Stephen van Staden
Date: Friday, 07 December 2012
Ref: SAS/ILISO 06122012

Iliso Consulting (Pty Ltd)
Tel : +27 12 685 0900
Fax: +27 12 665 1886
Cell: +27 82 455 1157
Email: terry@iliso.com

Attention: Ms. T. Baker

RE: RESULTS OF A WALK-THROUGH SITE ASSESSMENT FOR THE PROPOSED STEELPOORT MARBLEHALL (WOLWEKRAAL) 400KV POWER-LINE AND STEELPOORT INTEGRATION PROJECT NEAR GROBLERSDAL, LIMPOPO PROVINCE, SOUTH AFRICA

Scientific Aquatic Services was appointed by ILISO Consulting (Pty) Ltd to undertake a 'walk-through' assessment as part of the development of a site specific Environmental Management Plan (EMP) for the Steelpoort Marblehall (Wolwekraal) 400KV power-line and Steelpoort integration project. The purpose of the walk through project was to assess each proposed tower position and identify and document sensitive habitat areas and protected and/or endangered floral species in the vicinity of the tower footprints. In addition, areas with abundant avifaunal populations were identified where additional mitigatory measures are deemed necessary to minimise the impact on faunal ecology. Following the assessment, sensitive habitat areas and protected floral localities were indicated on aerial map printouts of the proposed tower positions of the entire servitude length. In addition points where specific mitigatory measures are required along with areas where 'bird flappers' must be installed to mitigate the impact of the proposed power line on avifaunal communities were highlighted on the rout plans. Finally, the existing Environmental Management Plans (EMP's) were reviewed in order to "ground truth" the EMP conditions and ensure that all EMP conditions are valid and propose additional mitigation measures and management recommendations were deemed necessary.

The following limitations were encountered during the site walkthrough procedure:

- The investigation was confined to the proposed tower positions and did not include an investigation of the areas between the towers. However, during the walk-through, any floral species of significance (such as protected or other sensitive species) were recorded as observed in the inter tower positions.
- The time of the assessment fell outside of the flowering season of certain, smaller and less easily observable sensitive and/or protected floral species. In order to accurately record all sensitive floral species along the proposed power line, a late summer and possibly early winter assessment must be conducted in order to ensure that variations due to seasonality are addressed.
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa on the subject property may therefore been missed during the assessment.
- A portion of the route (from L48 to L43) could not be accessed due to access complications. Thus, a follow-up visit will be necessary in order to fill in gaps in information.

The following points refer to the aerial maps with handwritten notes and general findings of the assessment:

- During the assessment, a number of protected floral species were identified and marked and also indicated on the aerial maps. These protected species are:
  - *Sclerocarya birrea* subsp. *caffra* (protected tree under the National Forest Act of 1998)*;*
  - *Boscia albitrunca* (protected tree under the National Forest Act of 1998)*;*
  - *Curtisia dentata* (protected tree under the National Forest Act of 1998);
  - *Elaeodendron transvaalense* (protected tree under the National Forest Act of 1998);
  - *Urginea epigea* (Orange Listed species in Mpumalanga); and
  - *Huernia* sp. (No positive species level identification due to incorrect flowering season, possibly *Huernia stapelioides* which is protected under the Mpumalanga Nature Conservation Act of 1998 and Limpopo Schedule 12)

- If the above species are to be damaged or removed, the necessary permits must be applied for.
- The above species were found throughout the extent of the proposed power line route. However, the mountainous areas, bushveld areas, wetlands and rocky grassland areas were deemed the most sensitive in terms of these species. These sensitive habitat areas were indicated on the aerial maps.

Figure 2. A typical rocky ridge area with the highly sensitive natural vegetation observed

- Movement of the proposed towers away from their current positions does not mean that sensitive species will be avoided as protected species, especially *Sclerocarya birrea* subsp. *caffra* are abundant and any new tower position would need to be assessed prior to relocation taking place. Furthermore, it is not deemed viable to move larger trees as the success rate in relocating them is likely to be extremely low.
- In addition, the survey occurred outside of the ideal flowering season (January to March) of other protected, less visible genera such as *Aloe cooperii, Eulophia* sp. and *Gladiolus* sp. which are mostly only readily observable when in flower. Thus such species may be present on the subject property but were not observed due to limitations in timeframes and incorrect season.
- Several proposed tower positions fall within or very close to wetland areas. Recommendations regarding the direction of relocation of the proposed towers have been made on the aerial maps.

Figure 2. A typical drainage line crossing with adjacent rocky ridge habitats

- In addition, the proposed substation falls on a wetland area and also contains several protected *Sclerocarya birrea* subsp. *caffra* trees. This proposed substation must be moved away from the wetland area and permits must be obtained if any protected species will be affected by the footprint of the substation in its new position.
- Areas where bird flappers must be implemented have also been indicated on the aerial maps.
- The impact of the footprint areas of the proposed tower positions, when viewed against the anticipated impact of the construction of the actual power line route and associated vegetation clearing for stringing purposes and for flash control as well as the construction of access roads, is of low significance. It is recommended that an ecological survey of the areas between the proposed power line positions and access roads takes place as the impact on the ecology of the area is likely to be high. This is especially relevant in the areas of increased ecological sensitivity near in and adjacent to the wetlands as well as on the steep slopes and mountainous areas.

Figure 3. A typical area of less sensitive and disturbed habitat with a wetland crossing in the background

The following points refer to the recommendations of the existing EMP and further recommendations deemed necessary in order to minimise the impact of the development on the ecological resources on the subject property to acceptable levels.

- The mitigation measures contained in the EMP's are deemed sufficient to manage the anticipated environmental impacts of the proposed project. The measures set out the EMP's should be strictly adhered to at all times.
- In terms of protected and/or endangered floral species conservation, it is strongly recommended that an ecologist/floral specialist is commissioned to attend the physical surveying of the proposed power line route before construction in order to mark and where possible relocate any protected floral species which may occur within the development servitude, with specific reference to the abovementioned species and sensitive habitat areas such as mountains and wetlands. Large trees which are not possible to relocate must be documented and the necessary permits must be applied for in order to cut or destroy these trees. This has also been recommended in the 2008 Steelpoort Integration Project EMP by Savannah Environmental (Pty) Ltd.
- The ecologist must further oversee and monitor the relocation of any protected species. The project ECO must be closely involved in the relocation process and report any significant findings and developments to the ecologist.
- Permits must be obtained in terms of the National Forest Act (1998) and the MNCA (1998) where plants protected under these acts are to be disturbed or relocated.

- Water Use Licenses must be applied for where wetland crossings will occur or where tower positions will encroach onto wetland areas.
- In addition, a suitably qualified ecologist must be present along with the project ECO at which time the physical pegging/marking of sensitive habitat such as wetlands should take place to guide the process and avoid any unnecessary impacts.
- Throughout the construction process, unnecessary disturbance of natural areas must be avoided through minimisation of footprint areas and edge effects in order to maintain the ecological integrity of the servitude and adjacent areas.

The above information must serve to inform the formulation of the site specific EMP in order to avoid and mitigate impacts associated with the proposed power line construction and guide the proponent, EAP, ECO and relevant authorities as to the viability of the proposed project in terms of the anticipated impact on the receiving environment and the measures required to minimise the impact.

Please do not hesitate to contact us should you require any further assistance.

Yours Sincerely

Stephen van Staden
Managing Member

Scientific Aquatic Services

Applying science to the real world

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Attention: Ms. T. Baker

RE: RESULTS OF A LAST SECTION (T186 – T194) OF THE WALK-THROUGH SITE ASSESSMENT FOR THE PROPOSED STEELPOORT MARBLEHALL (WOLWEKRAAL) 400KV POWER-LINE AND STEELPOORT INTEGRATION PROJECT NEAR GROBLERSDAL, LIMPOPO PROVINCE, SOUTH AFRICA

Scientific Aquatic Services was appointed by ILISO Consulting (Pty) Ltd to undertake the last section of the 'walk-through' assessment and position of the substation as part of the development of a site specific Environmental Management Plan (EMP) for the Steelpoort Marblehall (Wolwekraal) 400KV power-line and Steelpoort integration project.

The purpose of the walkthrough assessment undertaken on the 10th of December was to assess the last section of the proposed servitude and the associated tower positions and identify and document sensitive habitat areas and protected and/or endangered floral species in the vicinity of the tower footprints. The current location of the proposed substation was re-assessed to identify another area that would have less environmental and socio-cultural impacts. Following the assessment, protected floral localities were indicated on aerial maps and additional mitigation measures and management recommendations were proposed where deemed necessary.

The following limitations were encountered during the site walkthrough procedure:

- The investigation was confined to the proposed tower positions and did not include an investigation of the areas between the towers. However, during the walk-through, any floral species of significance (such as protected or other sensitive species) were recorded as observed in the inter tower positions.

- In addition, the survey occurred outside of the ideal flowering season (January to March) of other protected, less visible genera such as *Aloe cooperii, Eulophia* sp. and *Gladiolus* sp. which are mostly only readily observable when in flower. Thus such species may be present on the subject property but were not observed due to limitations in timeframes and incorrect season.
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa on the subject property may therefore been missed during the assessment.

The following points refer to the aerial map and general findings of the assessment:

- During the assessment of the last section of the power line and location of the newly proposed substation, the following protected floral species were identified and marked and also indicated on the aerial map. These protected species are:
  - *Sclerocarya birrea* subsp. *caffra* (protected tree under the National Forest Act of 1998)*;*
  - *Boscia albitrunca* (protected tree under the National Forest Act of 1998)*;*
- If the above species are to be damaged or removed, the necessary permits must be applied for *Sclerocarya birrea* subsp. *caffra* and *Boscia albitrunca*.
- The above species were found throughout the extent of the newly proposed substation position (further north to where it was located) and throughout the last section of the proposed power line route (T186-T194).
- Movement of the proposed towers away from their current positions does not mean that sensitive species will be avoided as protected species, especially *Sclerocarya birrea* subsp. *caffra* are abundant and any new tower position would need to be assessed prior to relocation taking place.
- It is proposed that the substation be moved out of the drainage line area. The area where the substation will be moved to also contains several protected *Sclerocarya birrea* subsp. *caffra* trees. Permits must be obtained for the *Sclerocarya birrea* subsp. *caffra* protected species that will be affected by the footprint of the substation. Please refer to the servitude plan where hand written notes have been made.

Figure 1: The drainage line located east of the newly proposed location of the substation.

- The impact of the footprint areas of the proposed tower positions, when viewed against the anticipated impact of the construction of the actual power line route and associated vegetation clearing for stringing purposes and for flash control as well as the construction of access roads, is of low significance. It is recommended that an ecological survey of the areas between the proposed power line positions and access

roads takes place as the impact on the ecology of the area is likely to be high. This is especially relevant in the areas of increased ecological sensitivity near in and adjacent to the drainage lines as well as on rocky ridge areas.

The following points refer to the recommendations of the existing EMP and further recommendations deemed necessary in order to minimise the impact of the development on the ecological resources on the subject property to acceptable levels.

- The mitigation measures contained in the EMP's are deemed sufficient to manage the anticipated environmental impacts of the proposed project. The measures set out the EMP's should be strictly adhered to at all times.
- In terms of protected and/or endangered floral species conservation, it is strongly recommended that an ecologist/floral specialist is commissioned to attend the physical surveying of the proposed power line route before construction in order to mark and where possible relocate any protected floral species which may occur within the development servitude, with specific reference to the abovementioned species and sensitive habitat areas such as mountains and wetlands. Large trees which are not possible to relocate must be documented and the necessary permits must be applied for in order to cut or destroy these trees. This has also been recommended in the 2008 Steelpoort Integration Project EMP by Savannah Environmental (Pty) Ltd.
- The ecologist must further oversee and monitor the relocation of any protected species. The project ECO must be closely involved in the relocation process and report any significant findings and developments to the ecologist.
- Permits must be obtained in terms of the National Forest Act (1998) and the MNCA (1998) where plants protected under these acts are to be disturbed or relocated.
- Water Use Licenses must be applied for where wetland crossings will occur or where tower positions will encroach onto wetland areas.
- In addition, a suitably qualified ecologist must be present along with the project ECO at which time the physical pegging/marking of sensitive habitat such as wetlands should take place to guide the process and avoid any unnecessary impacts.
- Throughout the construction process, unnecessary disturbance of natural areas must be avoided through minimisation of footprint areas and edge effects in order to maintain the ecological integrity of the servitude and adjacent areas.

The above information must serve to inform the formulation of the site specific EMP in order to avoid and mitigate impacts associated with the proposed power line construction and guide the proponent, EAP, ECO and relevant authorities as to the viability of the proposed project in terms of the anticipated impact on the receiving environment and the measures required to minimise the impact.

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Attention: Ms. T. Baker

RE: RESULTS OF THE AMENDED LAST SECTION (T45-T50; T95-T101 & T186-T191) OF THE WALK-THROUGH SITE ASSESSMENT FOR THE PROPOSED STEELPOORT MARBLEHALL (WOLWEKRAAL) 400KV POWER-LINE AND STEELPOORT INTEGRATION PROJECT NEAR GROBLERSDAL, LIMPOPO PROVINCE, SOUTH AFRICA

Scientific Aquatic Services was appointed by ILISO Consulting (Pty) Ltd to undertake the final section of the 'walk-through' assessment and re-positioning of the substation as part of the development of a site specific Environmental Management Plan (EMP) for the Steelpoort Marblehall (Wolwekraal) 400KV power-line and Steelpoort integration project.

The purpose of the walkthrough assessment undertaken on the 29th of January 2013 was to assess the final amended section of the proposed power line servitude and the associated tower positions and to identify and document sensitive habitat areas and protected and/or endangered floral species in the vicinity of the tower footprints. The current location of the proposed substation was re-assessed to identify an alternative area that would have less environmental and socio-cultural impacts. Following the assessment, protected floral localities were indicated on aerial maps and additional mitigation measures and management recommendations were proposed where deemed necessary.

The following limitations were encountered during the site walkthrough procedure:

- The investigation was confined to the proposed tower positions and did not include an investigation of the areas between the towers. However, during the walk-through, any floral species of significance (such as protected or other sensitive species) were recorded as observed in the inter tower positions.

- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa on the subject property may therefore been missed during the assessment.

The following points refer to the aerial map and general findings of the assessment:

- During the assessment of the final amended section of the power line and the location of the newly proposed substation, the following protected floral species were identified and marked and also indicated on the aerial map. These protected species are:
    - *Sclerocarya birrea* subsp. *caffra* (protected tree under the National Forest Act of 1998)*;*
- If the above species are to be damaged or removed, the necessary permits must be applied for under the National Forest Act of 1998.
- The above species were found throughout the extent of the newly proposed substation position (further north to where it was located). Individual trees were noted throughout the final section of the proposed power line route.
- A drainage feature is located to the north of the newly positioned substation (Figure 1). Care should be taken that the proposed substation does not encroach upon the drainage feature and its associated 32m buffer zone (Figure 2). The area within the substation also contains several protected *Sclerocarya birrea* subsp. *caffra* trees. Permits must be obtained for the *Sclerocarya birrea* subsp. *caffra* protected species that will be affected by the footprint of the substation. Please refer to the servitude plan where hand written notes have been made.

Figure 1: The drainage line located north of the newly proposed location of the substation.

- The impact of the footprint areas of the proposed tower positions, when viewed against the anticipated impact of the construction of the actual power line route and associated vegetation clearing for stringing purposes and for flash control as well as the construction of access roads, is of low significance. It is recommended that an ecological survey of the areas between the proposed power line positions and access roads takes place as the impact on the ecology of the area is likely to be high. This is especially relevant in the areas of increased ecological sensitivity near in and adjacent to the drainage lines.

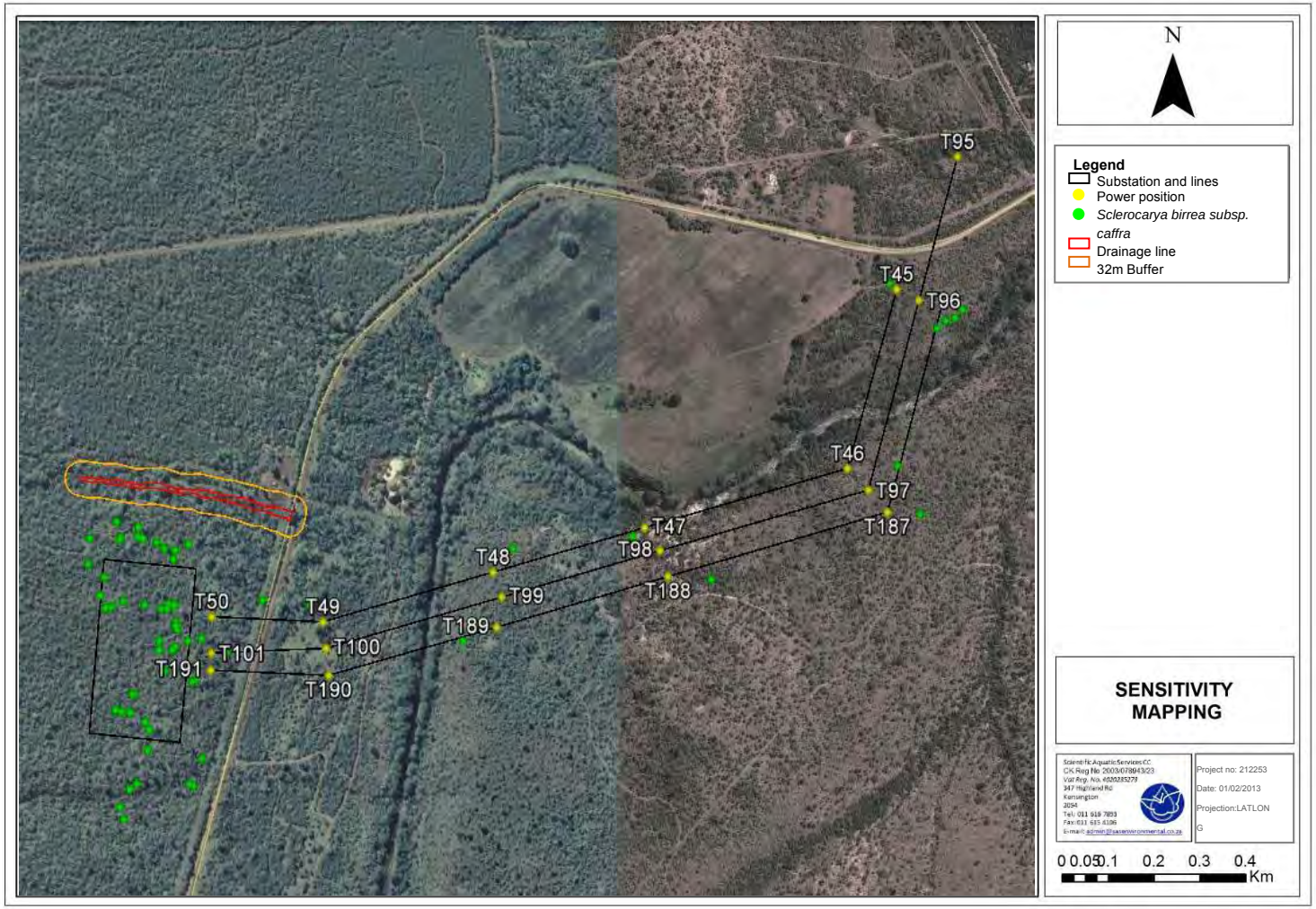

Figure 2: Digital satellite image depicting the location of the protected tree species, *Sclerocarya birrea subsp. caffra* and the drainage line with associated 32m buffer.

The following points refer to the recommendations of the existing EMP and further recommendations deemed necessary in order to minimise the impact of the development on the ecological resources on the subject property to acceptable levels.

- The mitigation measures contained in the EMP's are deemed sufficient to manage the anticipated environmental impacts of the proposed project. The measures set out the EMP's should be strictly adhered to at all times.
- In terms of protected and/or endangered floral species conservation, it is strongly recommended that an ecologist/floral specialist is commissioned to attend the physical surveying of the proposed power line route before construction in order to mark and where possible relocate any protected floral species which may occur within the development servitude, with specific reference to the abovementioned species and sensitive habitat areas such as mountains and wetlands. Large trees which are not possible to relocate must be documented and the necessary permits must be applied for in order to cut or destroy these trees. This has also been recommended in the 2008 Steelpoort Integration Project EMP by Savannah Environmental (Pty) Ltd.
- The ecologist must further oversee and monitor the relocation of any protected species. The project ECO must be closely involved in the relocation process and report any significant findings and developments to the ecologist.
- Permits must be obtained in terms of the National Forest Act (1998) and the MNCA (1998) where plants protected under these acts are to be disturbed or relocated.
- Water Use Licenses must be applied for where wetland crossings / drainage lines will occur (where applicable) or where tower positions will encroach onto wetland areas.
- In addition, a suitably qualified ecologist must be present along with the project ECO at which time the physical pegging/marking of sensitive habitat such as wetlands should take place to guide the process and avoid any unnecessary impacts.
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Please do not hesitate to contact us should you require any further assistance.

Yours Sincerely

Stephen van Staden
Managing Member

MARBLEHALL-STEELPOORT

Land Use Map

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Cartography & Spatial Analysis
TERRAGIS

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Kilometers

1:75 000

Projection - Transverse Mercator
Datum - Hartebeeshoek 1994
Reference Ellipsoid - WGS 1984
Central Meridian - 29

Legend

- Sample Points
- Pylons
- Proposed Powerline
- Bare Rock
- Veld
- Agriculture - Planted Pastures
- Agriculture - Subsistence
- Agriculture - Dryland
- Agriculture - Irrigated
- Wetlands
- Waterbodies
- Infrastructure

MARBLEHALL-STEELPOORT

Land Use Map

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AN ASSESSMENT OF THE IMPACT ON THE SOIL AND AGRICULTURAL POTENTIAL OF THE 65 KM ESKOM TRANSMISSION LINE THAT STRETCHES FROM MARBLE HALL TO STEELPOORT

6 December 2012

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Registration number: 400194/12

TABLE OF CONTENTS

LIST OF FIGURES

AN ASSESSMENT OF THE IMPACT ON THE SOIL AND AGRICULTURAL POTENTIAL OF THE 65 KM ESKOM TRANSMISSION LINE THAT STRETCHES FROM MARBLE HALL TO STEELPOORT

1. TERMS OF REFERENCE

Iliso Consulting (Pty) Ltd, on behalf of Eskom, contracted Terra Soil Science cc to carry out a soil and agricultural potential study for an area earmarked for a 65 km transmission line. The transmission line stretches from the Steelpoort/Tubatse substation to Marble Hall, Limpopo Province. The substation at Marble Hall is currently referred to as the Simimela substation.

2. INTRODUCTION

Iliso Consulting (Pty) Ltd is finalising an Environmental Management Plan for a 65 km transmission line that runs from the Steelpoort/Tubatse substation to Marble Hall, Limpopo Province. The substation at Marble Hall was previously called Wolwekraal in the EIA phase, then changed to Marble Hall and is now referred to as the Simimela substation.

The Marble Hall/Groblersdal area is one of the best known and most productive agricultural regions in South Africa. The area is irrigated (Loskopdam irrigation scheme) and high yields of maize, potato, grapes, sunflower, tobacco, millet and manna (amongst other crops) are harvested here. Subsistence farming is practiced towards the Steelpoort/Tubatse substation. The transmission line may therefore have a negative impact on food security in South Africa.

2.1. Aims and Objectives of the Study

The study aims to:

- Assess the agricultural potential and land capability of the study area;
- Determine the impact of the proposed transmission line on the agricultural potential of the area;
- Propose mitigation measures to negate the negative impact of the proposed transmission line on the long term agricultural use of the area.

2.2. Criteria used to Assess the Agricultural Potential of Soil

The assessment of agricultural potential rests primarily on the identification of soils that are suited to crop production. In order to qualify as high potential soils they must have the following properties:

- Deep profile (more than 600 mm) for adequate root development,
- Deep profile and adequate clay content for the storing of sufficient water so that plants can weather short dry spells,
- Adequate structure (loose enough and not dense) that allows for good root development,
- Sufficient clay or organic matter to ensure retention and supply of plant nutrients,
- Limited quantities of rock in the matrix that would otherwise limit tilling options and water holding capacity,
- Adequate distribution of soils and size of high potential soil area to constitute a viable economic management unit, and
- Good enough internal and external (out of profile) drainage if irrigation practices are considered. Drainage is imperative for the removal (leaching) of salts that accumulate in profiles during irrigation and fertilization.

In addition to pedological characteristics, climatic and soil chemical characteristics need to be assessed to determine the agriculture potential of a site. The latter entails determining the soil fertility levels of the soils, as well as an assessment of any factors that may inhibit plant growth. Saline and other forms of soil pollution, such as heavy metal contamination and acid/neutral/alkaline mine drainage, can adversely affect the production potential of the area It is especially important to determine soil salinity in areas of irrigation as poor irrigation scheduling often leads to a built up of salts in the soil. In these cases the sodium adsorption ratio (SAR) and exchangeable sodium percentage (ESP) are used to measure soil sodicity.

An assessment of the soil chemical characteristics of the area falls outside the scope of this study. The physical features of the soil are regarded as the more important factor for the purposes of this study.

2.3. Survey Area and Physical Features

Figure 1 illustrates the location of the transmission line on a topographical map, while Figure 2 illustrates the position of the line on a satellite photo. The area is mountainous towards the

Steelpoort/Tubatse substation but forms flat areas in the higher lying parts that are mainly used for subsistence farming.

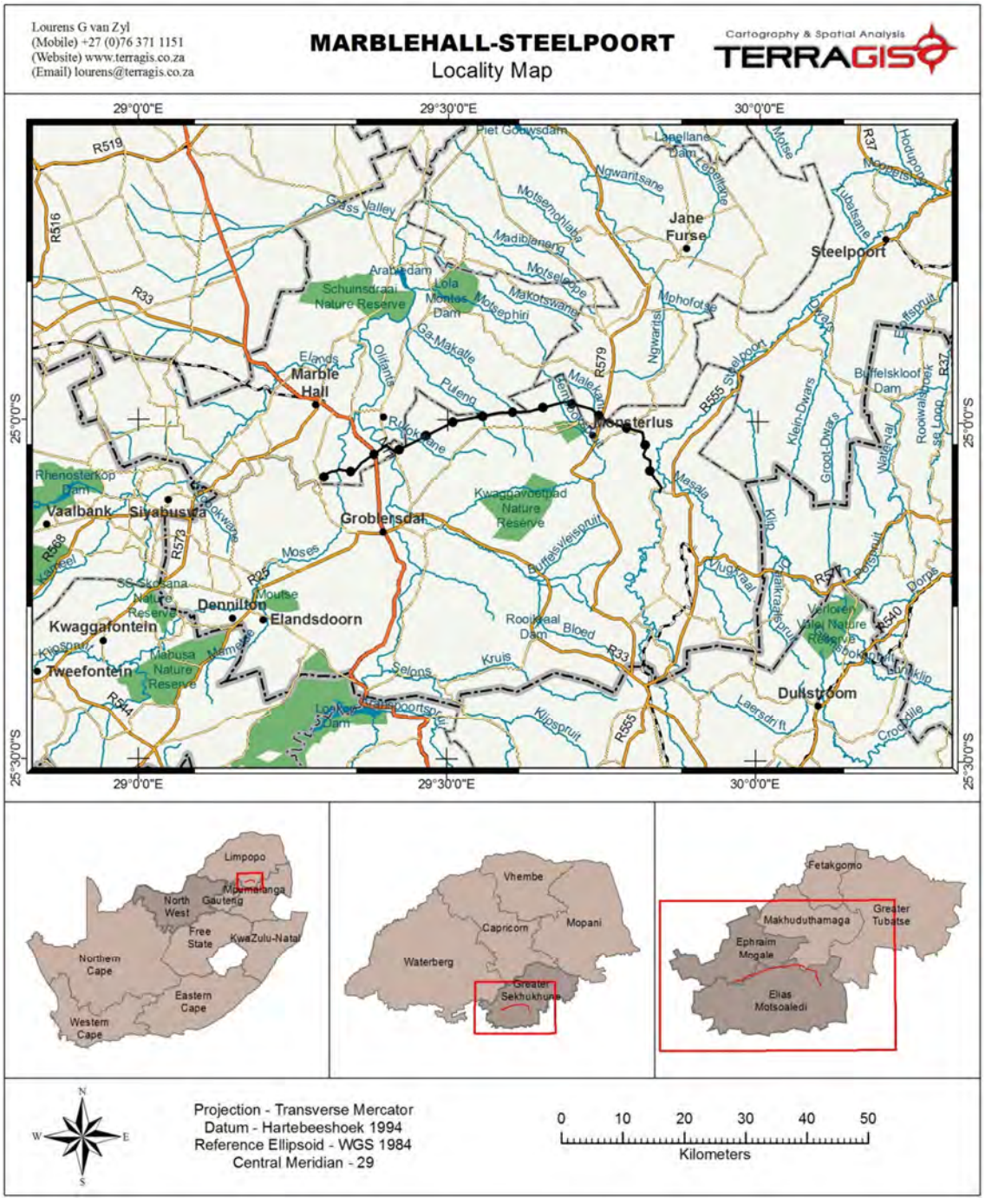

Figure 1 The locality of the 65 km transmission line stretching from Steelpoort/Tubatse to Marble Hall/ Simimela illustrated on a topographical map

The more mountainous, lower agricultural potential, area stretches from approximately 25˚ 01’ 51, 69” S and 29˚ 27’ 03, 97” E (approximately 1120 m above sealevel) to 25˚ 08’ 42.22” S and 29˚ 48’ 45,33” E (approximately 1300 m above sea level).

Figure 2 The locality of the 65 km transmission line stretching from Steelpoort/Tubatse to Marble Hall/Simimela illustrated on a satellite photo

Large portions of the area towards the Marble Hall/Simimela substation are under irrigation. The lower lying, higher agricultural potential area, lies approximately between 25˚ 02' 40.32" S and 29˚ 25' 19.85" E (approximately 932 m above sea level) and 25˚ 05' 13.33" S and 29˚ 17' 50.85" E (approximately 928 m above sea level). Figure 3 is a digital elevation model that illustrates the topography of the study area.

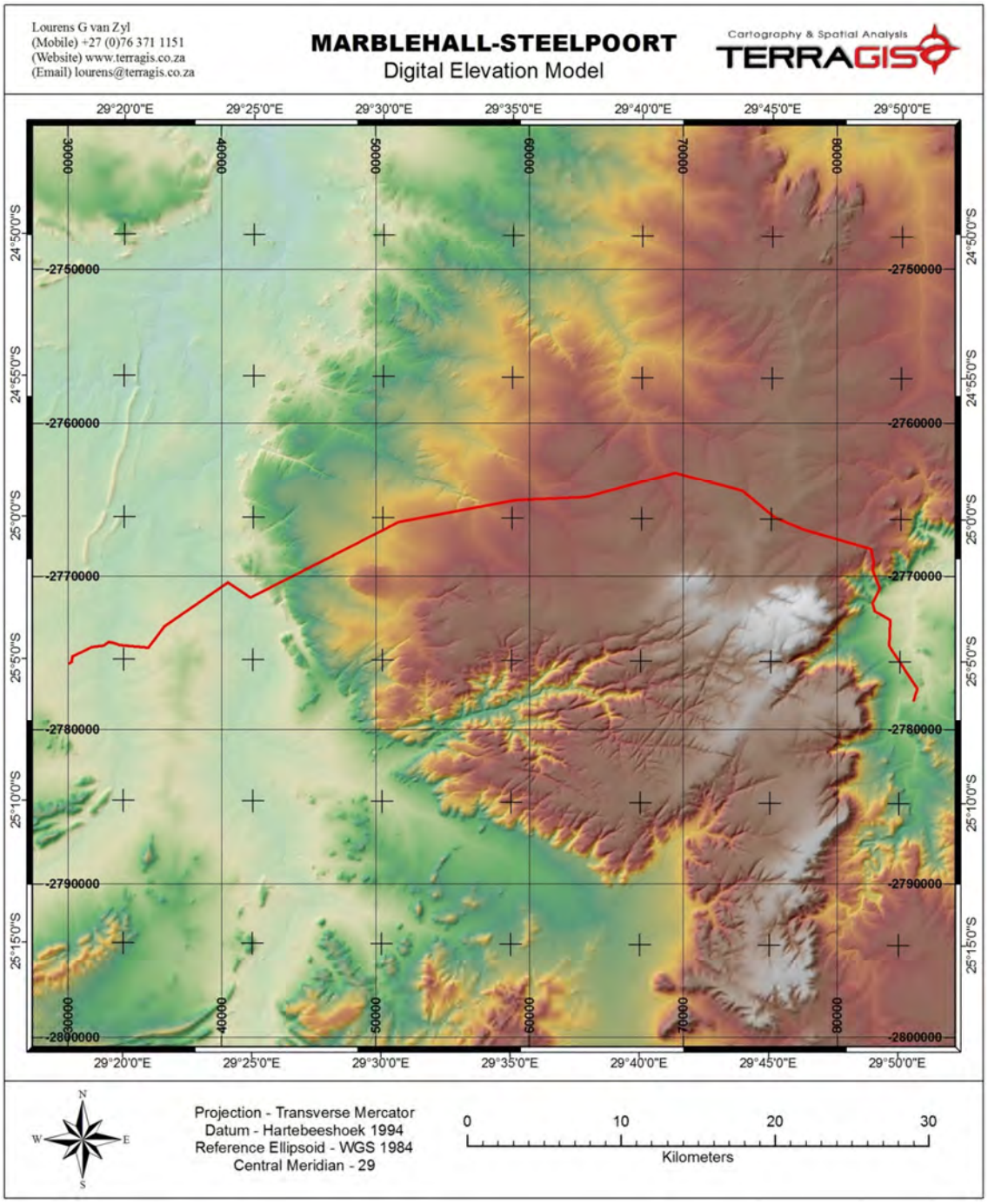

Figure 3 Digital elevation model that illustrates the topography of the study area

3. METHODOLOGY

Three main sources were used to assess the possible impact the proposed transmission line could have on the agricultural productivity of the area:

1. Land type data
2. Site visit and soil survey
3. Personal communication with farmers of the area
4. Rainfall data and the necessity to irrigate in order to obtain economically viable yields

All of the areas could not be inspected during the site visit owing to issues with access to some of the commercial farms.

3.1. Land Type Data

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 – 2006). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991). Figure 4 indicates the land type data for the area.

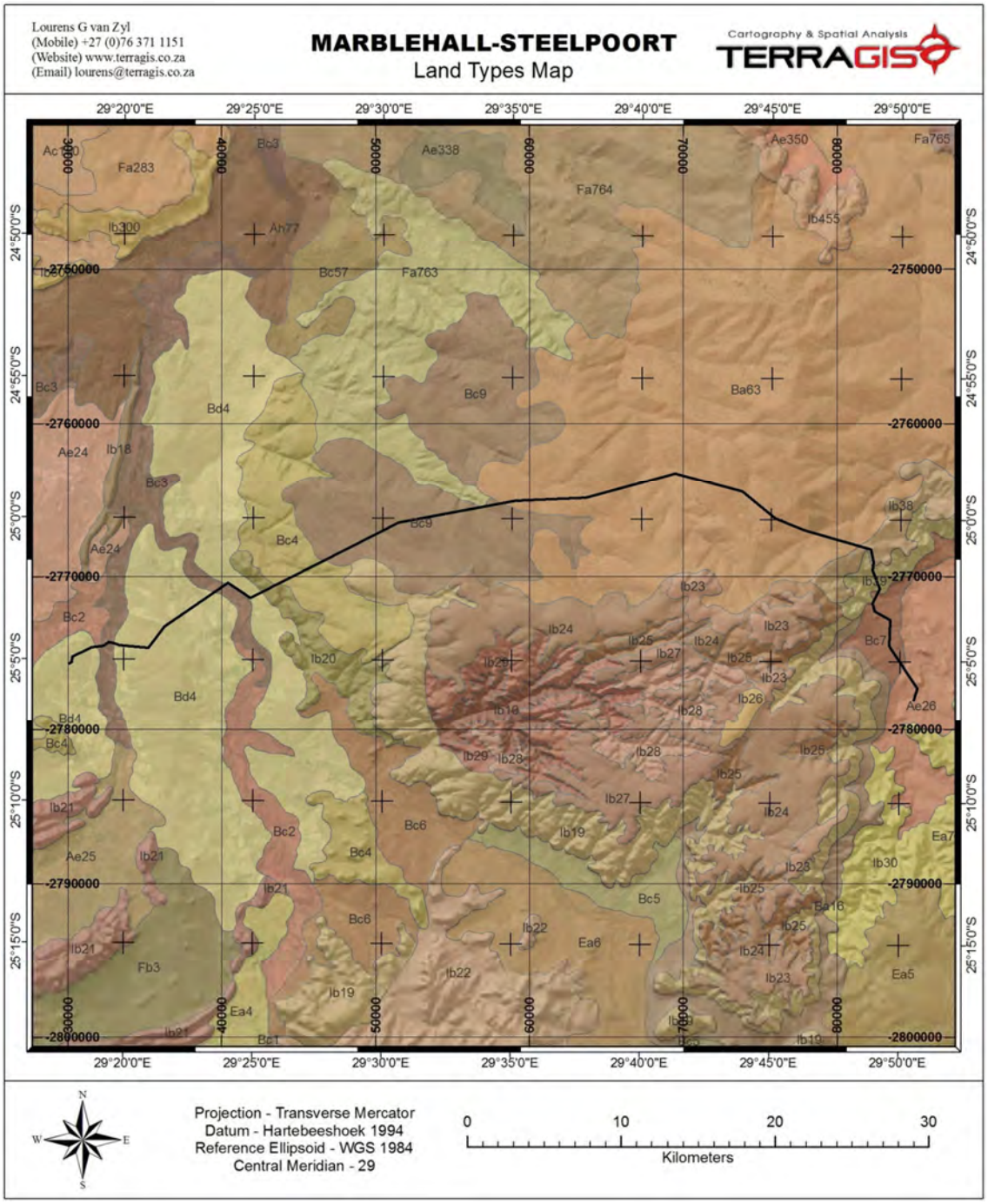

Figure 4 Land type data for the study area

3.2. Soil Survey

The study area was traversed and observations regarding the landscape and occurrence of soils were made continuously. Specific soil characteristics were noted and logged at approximately 110 observation points. Appendix A is an A1 sized map that illustrates the

locations of the observation points, as well as the transmission line pylons. The map also illustrates the main land uses of the area. Augering was done to a maximum of 1500 mm. In some cases the occurrence rocks hampered deep augering. The soils were classified according to the South African Soil Classification System (MacVicar ***et al.,*** 1994). Specific emphasis was placed on the identification of the following aspects as these aid in an assessment of the pedohydrology and agricultural potential of the area:

- Fe(II)/Fe(III) layered double hydroxides (green rusts) that is indicative of moderate conditions of reductions (Eh values of -0.5 to +0.5 V) and usually encountered in wetland soils;
- The accumulation of ferrihydrate, lepridocrosite, goethite and hematite in vesicular nodules (mottling) owing to the reduction of Fe(III) to Fe(II), under conditions of a fluctuating water table, which leads to the mobilisation of Fe;
- The occurrence of grey colours, especially where mottling is not present, as a further indication of Fe mobilisation and semi-permanent or permanent conditions of water saturation;
- The occurrence of bleached soil horizons that indicate lateral drainage of water;
- The occurrence of gleyed soil horizons that can be indicative of a permanent water table;
- The occurrence of uniform red and yellow colouration that is indicative of well drained areas;
- Signs of Mn mobilisation and/or precipitation as an indication of a fluctuating water table;
- The occurrence of smectite clays that lead to swelling and shrinking characteristics in soil and is conducive to saturated flow in the dry state but not in the wet state;
- Textural changes, and other aspects, in the soil profile that will influence saturated and unsaturated flow of water.
- Occurrence of layers that impede water flow.

Soils that display morphological indicators of temporary or seasonal wetness within 500 mm of the soil surface, together with those subject to prolonged and permanent saturation, make up the area that is described as hydromorphic or wetland soils.

3.3. Rainfall Data

Rainfall data for the area was obtained from the Department of Agriculture (AGIS) and is summarised in Figure 5. The area lies predominantly in the 401 to 600 mm per year rainfall

area, while a small section lies in the 601 to 800 mm per year rainfall zone. The rainfall could sustain dryland crop production on soils that exhibit the characteristics akin to soils of high agricultural potential. The crop yields under dryland production will, however, be substantially lower than in the areas that are being irrigated.

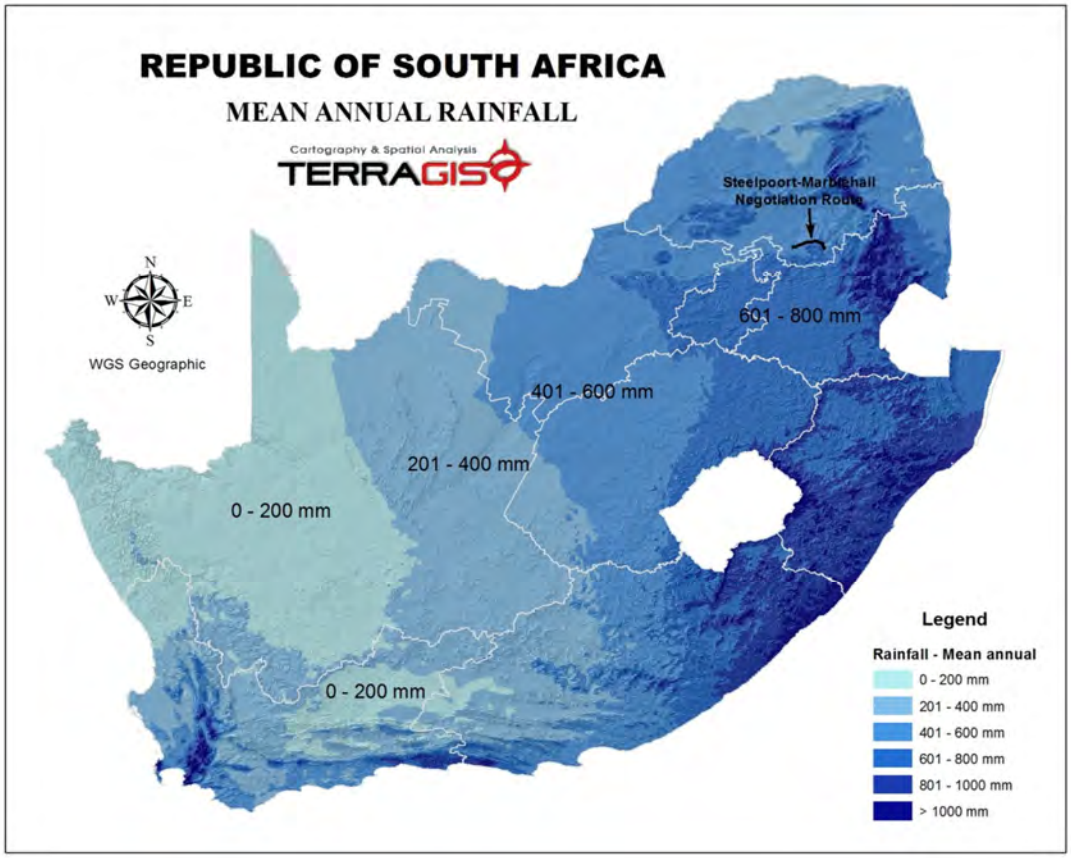

Figure 5 Rainfall data for the area

4. RESULTS AND DISCUSSION

4.1. Areas of High Agricultural Potential

Pylons T3 to T45 span a high agricultural potential area. This area lies approximately between 25˚ 02' 40.32" S and 29˚ 25' 19.85" E and 25˚ 05' 13.33" S and 29˚ 17' 50.85" E. From the satellite image (Figure 2) and the land use map (Appendix A) the number of centre pivots can clearly be seen. The area is also relatively flat (Figure 3), making the cultivation of the land and irrigation easy. Figure 6 illustrates the maize stand under one of the centre pivots found in the area.

Figure 6 The area is intensely cultivated and irrigated

The area lies predominantly in the Bc and Bd land types with a small section comprising the Ib land type. The Bc and Bd land types are described as a plinthic catena: upland duplex and margalitic soils rare. A perfect catena is represented by (from higher to lower lying areas) Hutton, Bainsvlei, Avalon and Longlands soil forms. Gleyed soils, such as Rensburg, Willowbrook, Katspruit and Champagne soil forms, can occur in the valley bottom. Soils with hard plinthite are common in areas where sandstone underlies the area. Where water tables have not extended far beyond the valley bottom, red soils may dominate. In these cases plinthic soils are restricted to valley bottoms and pans.

The Ib land type refers to Miscellaneous land classes. This is land types with a soil pattern difficult to accommodate elsewhere. The Ib land type is dominated by exposed rock and shallow soils. The Ib20 land type is mainly comprised of rock outcrops and the Mispah soil form. The latter comprises an orthic A-horizon that overlies hard rock and is a shallow soil of low agricultural potential.

The Bc2, Bc3 and Bd4 land types are dominated by the following soil forms:

- ***The Hutton soil form*** comprises an orthic A-horizon that overlies a red apedal B-horizon. The latter overlies unspecified material without signs of wetness. The red apedal B-horizon has macroscopically weakly developed structure or is altogether

without structure and reflects weathering under well drained, oxidised conditions. The clay fraction is dominated by non-swelling 1:1 clay minerals and the red colour of the soil is ascribed to iron oxide coatings on individual soil particles that are dominated by hematite. These soils are, in most cases, deeper than 1200 mm, and contain 12 to 35 % clay. These are the soils that are mostly irrigated.

- ***The Oakleaf soil form*** comprises an othic A-horizon that overlies a neocutanic B-horizon and unspecified material without sighns of wetness. The neocutanic B-horizon is not uniform in colour owing to the occurrence of cutans and channel infillings. The horizon shows signs of clay illuviation and is, in many cases, a relatively young soil that occurs in floodplain areas. These soils can be irrigated but carefull management practices must be implemented as the soils are prone to deflocculation and erosion. The soils are deeper than 1200 mm and contain 8 to 20 % clay.
- ***The Longlands soil form*** comprises an othic A-horizon that overlies an E-horizon and a soft plinthic B-horizon. The E-horizon is essentially greyish in colour (bleached), paler than the overlying topsoil (not always) and the horizon which underlies it, relatively coarse textured and without structure. Temporary build-up of water above the underlying material, reduction and lateral removal of iron oxides, organic matter and clay particles give rise to the development of E-horizons. Coarse materials require relatively mild reducing conditions to develop this bleached appearance. The soft plinthic B-horizon is characterised by mottling (high chroma colouration) that is either found within a matrix of low chroma colouration or just above such a matrix. The mottles are vesicular in form and must encompass at least ten percent of the soil matrix. This horizon is indicative of a fluctuating water table. Soil depth ranges from 600 to1200 mm. These soils are found towards drainage channels and forms part of the seasonal zone of wetland systems.
- ***The Glencoe soil form*** comprises an orthic A-horizon that overlies a yellow brown apedal B-horizon and hard plinthic B-horizon. The yellow brown apedal B-horizon exhibits the same characteristics as the red apedal B-horizon except for the colouration. The yellow colour that is encountered in these soils is attributed to Al substituted goethite dominating the iron oxide fraction. The hard-plinthic B-horizon consists of an indurated zone of iron and manganese oxides (ironpan), also known as ferricrete, which is formed by the same processes that give rise to a soft plinthic B-horizon – if this process continues for a long enough period of time. These soils range in depth from 300 to 900 mm. The deeper soils can be irrigated if the irrigation scheduling is done in a responsible way. Waterlogged conditions can readily occur if

the soils are over irrigated. The soils that are deeper 800 mm can be used for dryland crop production.

The Glencoe soil form is mainly encountered outside the centre pivots and the areas under cultivation. Because the area has been cultivated for such a long time and on such an intensive scale, one can assume with confidence that the areas that are not under cultivation are of low agricultural potential. This is substantiated by interviews with the farmers of the area, as well as by soil survey conducted in the area.

Most of the pylons have been positioned to be on shallow (<500 mm) Glencoe soils that are not suited for crop production. Figure 7 illustrates the nature of the yellow brown apedal B-horizon, while Figure 8 illustrates the hard plinthic B-horizon.

Figure 7 The yellow colouration found in the yellow brown apedal B-horizon is attributed to Al substituted goethite dominating the iron oxide fraction

Figure 8 The hard plinthic B-horizon underlies the Clencoe soil form

The soils in the vicinity of Pylon T2, T4, T13 are deeper than 900 mm, but surrounded by shallow soils. These pockets of deeper soils can therefore not be cultivated in an economically viable manner and the pylons will not influence the agricultural potential of the soils. Pylon T32 is situated on a soil of the Clovelly soil form (orthic A-horizon/yellow brown apedal B-horizon) that exhibits a depth of more than 1500 mm. The soil is sandy in nature, of poor fertility status and currently not under cultivation.

The following pylons are situated next to centre pivots and may impact the edges of the centre pivots: T27, T28, T30, T34, T35, T38 and T39. These pylons will not have the same impact on food production as the pylons positioned in the centre pivots (discussed in the next paragraph), but could hamper cultivation and especially irrigation. It has also been found that Cu deficiencies occur close to power lines in crops. The latter is, however, subject to soil specific characteristics and can be amended.

Pylons T38 and T44 are positioned in areas that are currently under cultivation. The area where Pylon T44 is positioned is no longer used as a centre pivot irrigation system, but has been converted to a citrus farming area (Figure 9). Pylons T38 and T44 will adversely affect food production in the area.

Figure 9 Pylon T44 is situated in an area that has been developed as a citrus farm

4.2. Areas where Subsistence Farming are practiced

Pylons T59 to T156 are positioned in areas where subsistence farming is practiced. The area is situated between 25˚ 01' 12.04" S and 29˚ 28' 25.56" E and 25˚ 00' 56.40" S and 29˚ 48' 2.79" E. The area slopes from west (approximately 1517 m above sea level) to east (approximately 1246 m above sea level). Cultivation is less easy than in the section west of this area and water for irrigation is not readily available. Deep soils are interspersed with granite outcrops so that the land that can be cultivated occurs in smaller patches than is the case in the Loskop irrigation scheme. Figure 10 and 11 illustrate the concept.

Figure 10 Deep soils are interspersed with granite outcrops so that the land that can be cultivated occurs in smallish patches

Figure 11 Weathering granite are encountered in between soils of medium to high agricultural potential land

Fast stretches of land has nonetheless been cultivated in the past, but is currently not under cultivation or has not been ploughed for the next growing season. This is typical of subsistence farming. Many of these communities do not have the means to buy fertilisers and other soil ameliorants. Land is therefore seldom cultivated for more than three growing seasons before it is left to “rest”. This ensures a higher crop yield as the land that has not been cultivated for some time is more fertile than the land that has been cultivated during the previous growing season. The fields are therefore left fallow for soil conservation practices. Figure 12 is a photo of a field that is being ploughed, while Figure 13 illustrates a field that has been left to “rest”.

Figure 12 A piece of land is being ploughed amongst fields that have been left fallow

Figure 13 Fields are therefore left fallow for soil conservation purposes

The area lies predominantly in the Ba and Bc land types. These form part of the plinthic catena as elaborated upon in the previous section. The dominant soil forms in the Ba63, Bc4, Bc7 and Bc9 land types are:

- The ***Mispah soil form*** comprises an orthic A-horizon overlying hard rock. These soils are shallow (<200 mm) and comprise approximately 35 to 45 % of the area.
- The ***Glenrosa soil form*** comprises an orthic A-horizon that overlies a lithocutanic B-horizon. The lithocutanic B-horizon is a horizon that has undergone minimal pedogenesis and occurs in a zone of weathering rock. These soils are shallow and comprise approximately 15 % of the area. Figure 10 is an example of the Mispah or Glenrosa soil form – depending on where one augers.
- The ***Dresden soil form*** comprises an orthic A-horizon that overlies a hard plinthic B-horizon. These soils are less that 300 mm deep. Figure 14 illustrates the Dresden soil form.
- The Glencoe soil form comprises an orthic A-horizon that overlies a yellow brown apedal B-horizon and hard plinthic B-horizon. These soils are mostly between 350 and 1000 mm deep. The deeper soils are ideal for dryland crop production. The hard plinthic B-horizon serves as an almost impermeable layer that keeps water in the soil profile and therefore plant available. Approximately 20 % of the area comprises this soil form.
- The Hutton soil form comprises an orthic A-horizon that overlies a red apedal B-horizon. Soil depth varies from 600 to more than 1500 mm. Most of the areas currently being ploughed (at the time of the site visit) comprise the Hutton soil form. Figure 15 illustrate this. The Hutton soil form comprises approximately 10 to 15 % of the area.

Figure 14 An example of the Dresden soil form found on the study area

Figure 15 Most of the areas that are being cultivated by the subsistence farmers are of the Hutton soil form

Many of the pylons that are positioned in this area will impact on the agricultural potential of the soils, specifically T93, T94, T105, T06, T107, T134 and T135. One must, however, see this in context:

i. These areas of medium to high agricultural potential are interspersed by low agricultural potential soils. In fact, the greater portion of the area is of low to medium agricultural potential. It is doubtful that these areas of higher agricultural potential are large enough to be able to accommodate an economically viable dryland production scheme.

ii. Small patches of land are currently being cultivated. Most of the medium to high agricultural potential soils are left fallow. The pylons should not have a major impact on the subsistence farmers.

iii. The farmers are not afraid to plough around structures as indicated by Figure 16.

It is doubtful that the positions of the pylons will adversely affect the food security of the area.

Figure 16 Farmers in dryland production areas often plough around structures that would impede the functionality of irrigation schemes

Worth mentioning is that a number of the pylons are situated near wetland systems. Pylons T150 and T153 are positioned on wetland soils. The Wasbank soil form characterises these two sites. The Wasbank soil form comprises an orthic A-horizon that overlies a hard plinthic B-horizon. The E-horizon shows signs of Fe accumulation (Figure 17), especially surrounding roots and preferential flow channels. The Fe is not accumulated in mottles or vesicles and therefore does not indicate a soft plinthic B-horizon. It does, however, indicate the presence of a wetland.

Figure 17 Iron accumulation in the Wasbank soil form indicates a wetland soil

4.4. Areas of Low Agricultural Potential

The majority of the pylons are positions on medium to low agricultural potential soils. These areas either comprise shallow and rocky soils as discussed in previous sections or mountainous regions. Pylons T47 to T58, T156 to T168 are located in mountainous regions. Figures 18, 19 and 20 illustrate the rocky soils and mountainous areas.

Figure 18 Area of medium to low agricultural potential that has previously been cultivated by subsistence farmers

Figure 19 Rocky area of low agricultural potential

Figure 20 Mountainous area that cannot be used for crop production

5. CONCLUSION AND RECOMMENDATIONS

The following pylons are situated next to centre pivots and may impact the edges of the centre pivots and therefore the agricultural potential of the area: T27, T28, T30, T34, T35, T38 and T39. If possible, it is advised that these pylons be moved south of their current position. The land to the south of the pylons is not being cultivated.

Pylons T38 and T44 are positioned in areas that are currently under cultivation. These pylons directly impact the agricultural potential of the area negatively and must be moved outside the cultivated areas. It is recommended that T38 be moved south of the current position. This should be doable if pylons T27 to T35 are moved south. Pylon T44 can only be moved north or north west. This will impact the positions of the pylons towards the east of pylon T44. The pylons east of T44 do not, however, influence the agricultural potential of the area significantly.

6. REFERENCES

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APPENDIX A:

MAP OF THE AREA SHOWING THE PYLON POSITIONS,
OBSERVATION POINTS AND CURRENT LAND USES

COMPILATION OF CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMMES FOR THE STEELPOORT TO MARBELHALL 400KV POWER-LINE AND THE STEELPOORT INTEGRATION PROJECT: HERITAGE RESOURCES ASSESSMENT

COMPILATION OF CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMMES FOR THE STEELPOORT TO MARBELHALL 400KV POWER-LINE AND THE STEELPOORT INTEGRATION PROJECT: HERITAGE RESOURCES ASSESSMENT

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Declaration:

I, J.A. van Schalkwyk, declare that I do not have any financial or personal interest in the proposed development, nor its developers or any of their subsidiaries, apart from the provision of heritage assessment and management services.

J A van Schalkwyk (D Litt et Phil)
Heritage Consultant
January 2013

EXECUTIVE SUMMARY

COMPILATION OF CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMMES FOR THE STEELPOORT TO MARBELHALL 400KV POWER-LINE AND THE STEELPOORT INTEGRATION PROJECT: HERITAGE RESOURCES ASSESSMENT

Eskom propose the development of the Steelpoort-Tubatse-Marblehall 400kV integration transmission line in order to strengthen the electricity supply in the region of Limpopo and Mpumalanga Provinces.

Previous impact assessments were done for sections of these routes (Schalkwyk 2007a, 2007b, 2009). In order for a final route to be selected, it was determined that a "walk down" of the route should be done to inspect the location of every tower structure that would be erected for the power line. Consequently an independent heritage consultant was appointed by **Iliso Consulting** to conduct this "walk down". In December 2012 a team of various specialists set out and over a period of five days the total route was surveyed.

The aim of this survey was to analyse and recommend heritage management mitigation measures and monitoring programmes for sites, features and objects within the corridor of the proposed power line. Information on the identified sites is presented in Section 3.

The following was found:

- A number of stone walled sites dating to the Late Iron Age were identified. On some the line just crosses over, whereas on others a tower structure will be erected (Section 3).
    - It is recommended that these sites are excavated by a suitably qualified archaeologist prior to the development taking place.
    - It is also recommended that an archaeologist is in attendance when construction takes place on the sites.

- One old farmstead was identified and is viewed to have a low significance on a regional level. However, in many cases graves are found in the vicinity of such old homesteads. However, due to the dense vegetation surrounding the buildings, it was difficult to determine if there are any graves located here.
    - It is recommended that these features are isolated by demarcating a 50m buffer zone around it, taking the outside of the buildings as starting point for determining the buffer.

- A number of informal cemeteries and burial places of differing size were identified. They are viewed to have a high significance on a local level (Section 3).
    - All cemeteries/burial places are located inside the corridor for the power line, or very close to it. These features should be left in place and isolated by demarcating a 10m buffer around them starting from the outermost graves that can be located.

As a result of the large number of heritage sites that might be impacted on, as well as some issues with the construction of the Steelpoort substation on the originally selected site, Eskom has decided to move the substation to a new location a few hundred metres north of the original position. Consequently, this new site was surveyed on 29 January 3013, resulting in an amendment being added to the original report.

- Although some stone walling occurs in the region of the new substation, there seems to be much less of it than on the previous site, most occurring to the west of the substation site. Consequently, this position presents a much better proposition for the development of the substation. As indicated on the map in Fig. 3, it is only feature no. 1 that is in close vicinity of the substation site. Most features occur west, higher up-slope and seem to

concentrate in the region of features no. 3 & 4, which is located well outside the development area.

- It is recommended that the area is cleared by hand in order to determine the full extent of the stone walling and that it is documented (mapped and photographed) before construction takes place.

J A van Schalkwyk
Heritage Consultant
January 2013

TECHNICAL SUMMARY

Property details	
Province	Mpumalanga & Limpopo Province
Magisterial district	Groblersdal, Nebo & Lydenburg
Topo-cadastral map	
Closest town	Groblersdal
Farm name & no.	Various
Portions/Holdings	Various

Development criteria in terms of Section 38(1) of the NHR Act	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	Yes
Construction of bridge or similar structure exceeding 50m in length	
Development exceeding 5000 sq m	
Development involving three or more existing erven or subdivisions	
Development involving three or more erven or divisions that have been consolidated within past five years	
Rezoning of site exceeding 10 000 sq m	
Any other development category, public open space, squares, parks, recreation grounds	

Development	
Description	Development of a 400kV electricity transmission line
Project name	Steelpoort – Marblehall (Tubatse Silimela) line

Land use	
Previous land use	Agriculture/Urban
Current land use	Agriculture/Urban

TABLE OF CONTENTS

LIST OF FIGURES

GLOSSARY OF TERMS AND ABBREVIATIONS

STONE AGE

Early Stone Age	2 000 000 - 150 000 Before Present (BP)
Middle Stone Age	150 000 - 30 000 BP
Late Stone Age	30 000 - until c. AD 200

IRON AGE

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Late Iron Age	AD 1300 - AD 1830

HISTORIC PERIOD

Since the arrival of the white settlers - c. AD 1840 in this part of the country

ASAPA	Association of Southern African Professional Archaeologists
C S-G	Chief Surveyor-General
EIA	Early Iron Age
ESA	Early Stone Age
LIA	Late Iron Age
LSA	Late Stone Age
MSA	Middle Stone Age
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency

COMPILATION OF CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMMES FOR THE STEELPOORT TO MARBELHALL 400KV POWER-LINE AND THE STEELPOORT INTEGRATION PROJECT: HERITAGE RESOURCES ASSESSMENT

1. INTRODUCTION

Eskom propose the development of the Steelpoort-Tubatse-Marblehall 400kV integration transmission line in order to strengthen the electricity supply in the region of Limpopo and Mpumalanga Provinces.

Previous impact assessments were done for sections of these routes (Schalkwyk 2007a, 2007b, 2009). In order for a final route to be selected, it was determined that a "walk down" of the route should be done to inspect the location of every tower structure that would be erected for the power line. Consequently an independent heritage consultant was appointed by **Iliso Consulting** to conduct this "walk down". In December 2012 a team of various specialists set out and over a period of five days the total route was surveyed.

The aim of this survey was to analyse and recommend heritage management mitigation measures and monitoring programmes for sites, features and objects within the corridor of the proposed power line. Information on the identified sites is presented in Section 3.

2. HERITAGE RESOURCES

2.1 **The National Estate**

The NHRA (No. 25 of 1999) defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-
    - ancestral graves;
    - royal graves and graves of traditional leaders;
    - graves of victims of conflict;
    - graves of individuals designated by the Minister by notice in the Gazette;
    - historical graves and cemeteries; and
    - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
    - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;

- objects to which oral traditions are attached or which are associated with living heritage;
- ethnographic art and objects;
- military objects;
- objects of decorative or fine art;
- objects of scientific or technological interest; and
- books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

2.2 **Cultural significance**

In the NHRA, Section 2 (vi), it is stated that ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature’s uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- sites of significance relating to the history of slavery in South Africa.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 **Site location and description**

The study area involves two sections of power line corridors, most of which follows exiting corridors. The longest line runs eastwards from south of Marblehall, across the Nebo plateau, across the Lulu Mountains and down into the Steelpoort River valley, where it is proposed to develop a substation. The second line runs from this substation in a north-westerly direction to the farm Syferfontein 136JS, where a new substation will be constructed.

As can be expected with a study area ranging across such a large area, the environment changes drastically from west to east. The west forms part of a highveld area typified by an undulating landscape. Going down the escarpment to the middle veld, the area is typified by mountains. In contrast, the eastern section is marked by mountains and hills, creating a broken type of environment.

Most of the region has been subjected to agricultural activities, with ploughing in the highveld and central regions chancing the environment drastically. One example is the Loskop Dam Irrigation Scheme, in which irrigation, based on 480km of canals, is practiced.

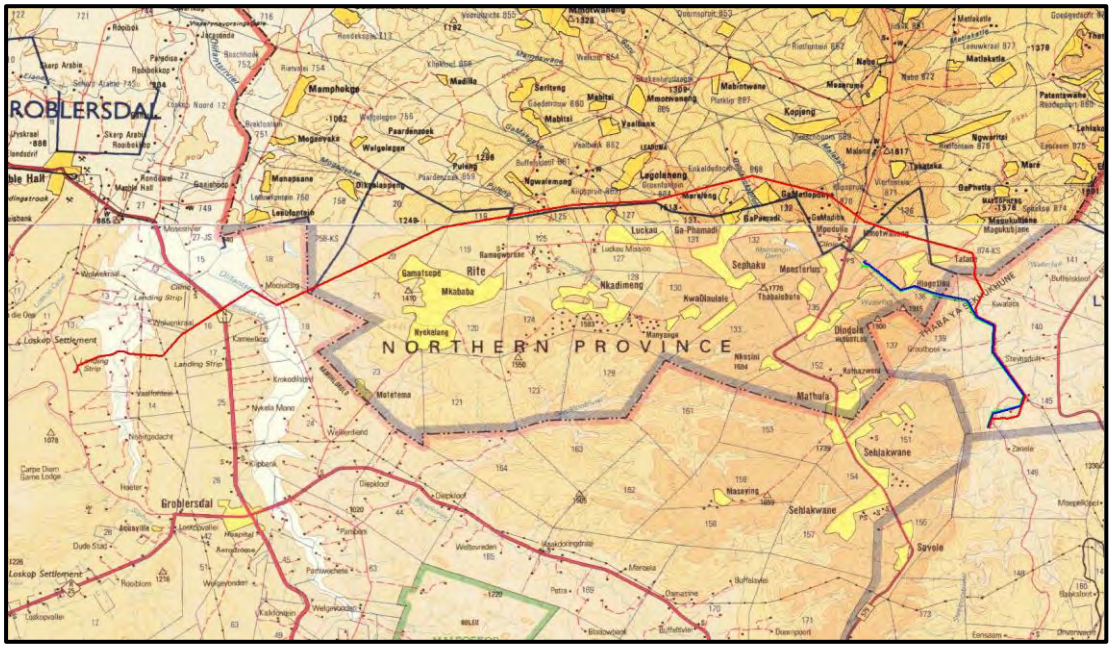
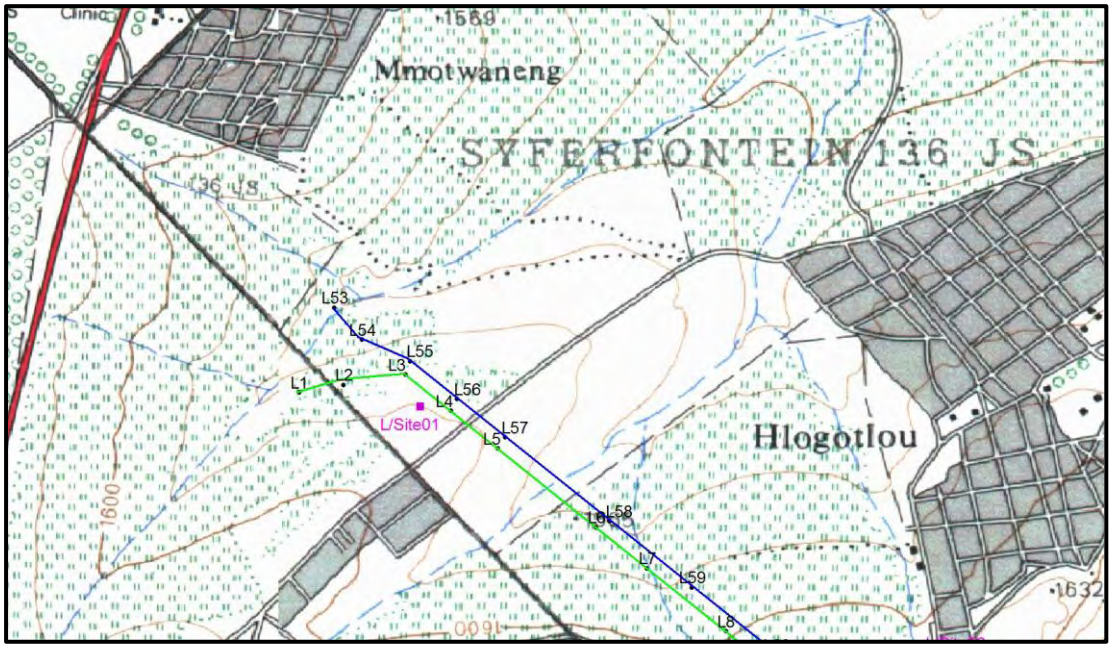


Fig. 1. Location of the study area in regional context.
(Map 2428, 2528: Chief Surveyor-General)

For ease of presentation, the different lines are presented in a number of maps below, following the route from west to east for the Marble Hall – Steelpoort line and east to west for the Steelpoort – Tubatse route.

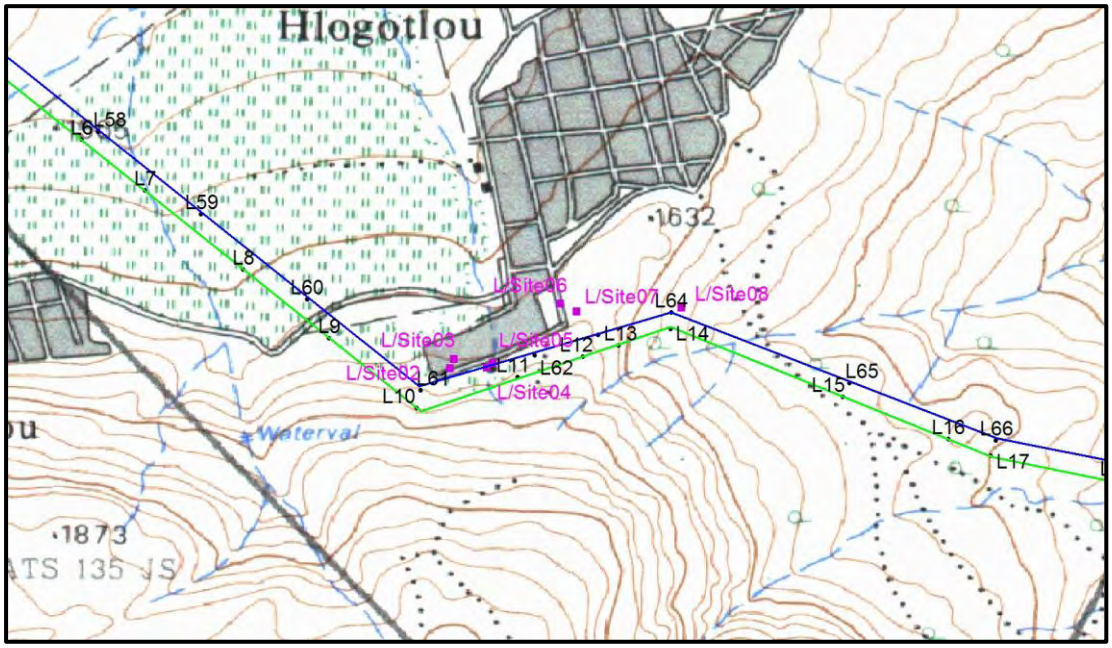
Map 1



- Graves & Cemeteries

Location	No. L/Site01	S 25.02626	E 29.75533
Description			
A formal community cemetery with probably more than 200 graves. Most have gravestones, but some are only marked with stone cairns.			
Significance	High on a local level – Grade III		
Mitigation			
As this is a large and well fenced cemetery, it is unlikely that the power line development would have an impact on it. **Recommendation**: Although the current alignment by-pass the cemetery, it is recommended that the site is fenced off with danger tape for the duration of the construction period.			

Map 2



- Graves & Cemeteries

Location	No. L/Site02 No. L/Site03 No. L/Site04 No. L/Site05 No. L/Site06 No. L/Site07	S 25.03825 S 25.03796 S 25.03796 S 25.03808 S 25.03622 S 25.03647	E 29.77394 E 29.77405 E 29.77511 E 29.77529 E 29.77741 E 29.77793
Description			
L/Site02: Three small graves, probably of three children. Very old, but still fenced off. L/Site03: A number of well-marked graves inside the yard of a house. L/Site04: A single marked grave next to some sisal plants. L/Site05: A single marked grave under a tree. L/Site06: A single marked grave adjacent to a house. L/Site07: A large community cemetery, developed in two different sections.			
Significance	High on a local level – Grade III		
Mitigation			
L/Site02: This site is probably inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it. L/Site03: As this site is inside the boundary of a homestead, the chances of it being impacted on by the power line is very unlikely. L/Site04: This site is inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it. L/Site05: This site is inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it.			

L/Site06: This site is probably outside the power line reserve, but close to a possible access route.
Recommendation:
It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it.

L/Site07: As this is a large and well fenced cemetery, it is unlikely that the power line development would have an impact on it.
Recommendation:
Although the current alignment by-pass the cemetery, it is recommended that the site is fenced off with danger tape for the duration of the construction period.


L/Site02


L/Site03


L/Site04


L/Site05

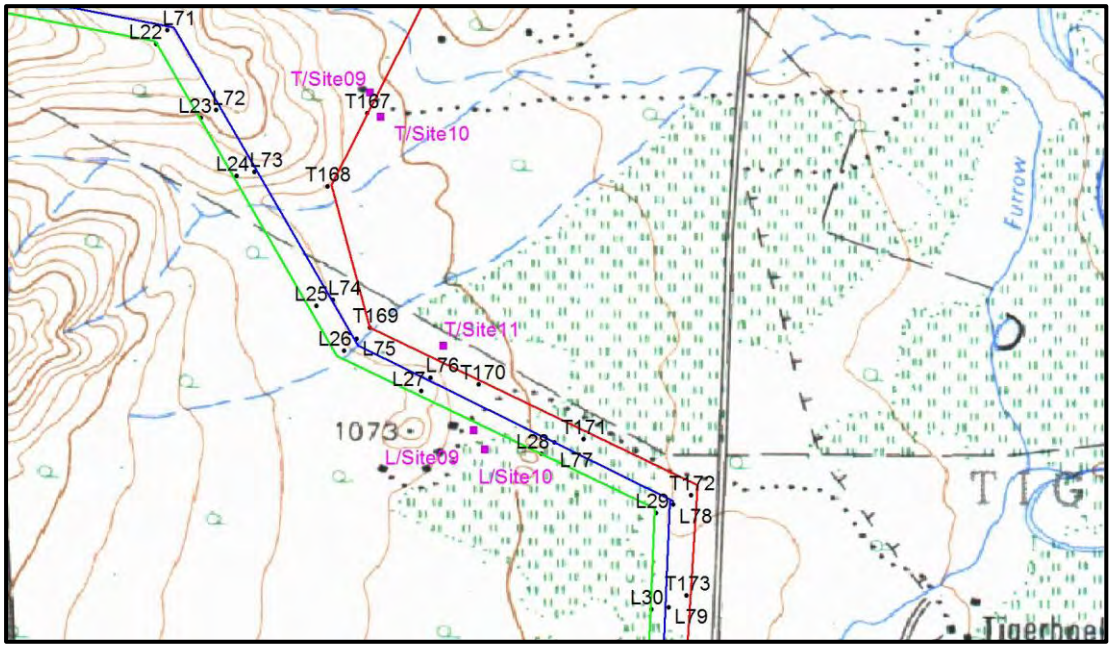

L/Site05


L/Site06

- Archaeological sites

Location	No. L/Site08	S 25.03647	E 29.78124
Description			
A heap of stones commonly referred to as an *isivivane*. It probably date to the Late Iron Age or early historic period and was a way in which boundaries were identified, especially where people crossed of a mountain range.			
Significance	High on a local level – Grade III		
Mitigation			
This site is very close to tower L64 as well as probably located inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it.			

Map 3



- Graves & Cemeteries

Location	No. T/Site09 No. T/Site10 No. T/Site11 No. L/Site09	S 25.04634 S 25.04711 S 25.05435 S 25.05702	E 29.81697 E 29.81732 E 29.81929 E 29.82026
Description			
T/Site09: A number of well-marked graves, fenced off with wire. T/Site10: A single marked grave next to a homestead. T/Site11: A single marked grave fenced off with a metal fence L/Site09: A small cemetery with graves dating to the recent past.			
Significance	High on a local level – Grade III		
Mitigation			
T/Site09: This site is probably inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it. T/Site10: This site is probably inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it. T/Site11: This site is probably inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it. L/Site09: This site is probably inside the power line reserve. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it.			

T/Site 09

T/Site 10

T/Site 11

L/Site 09

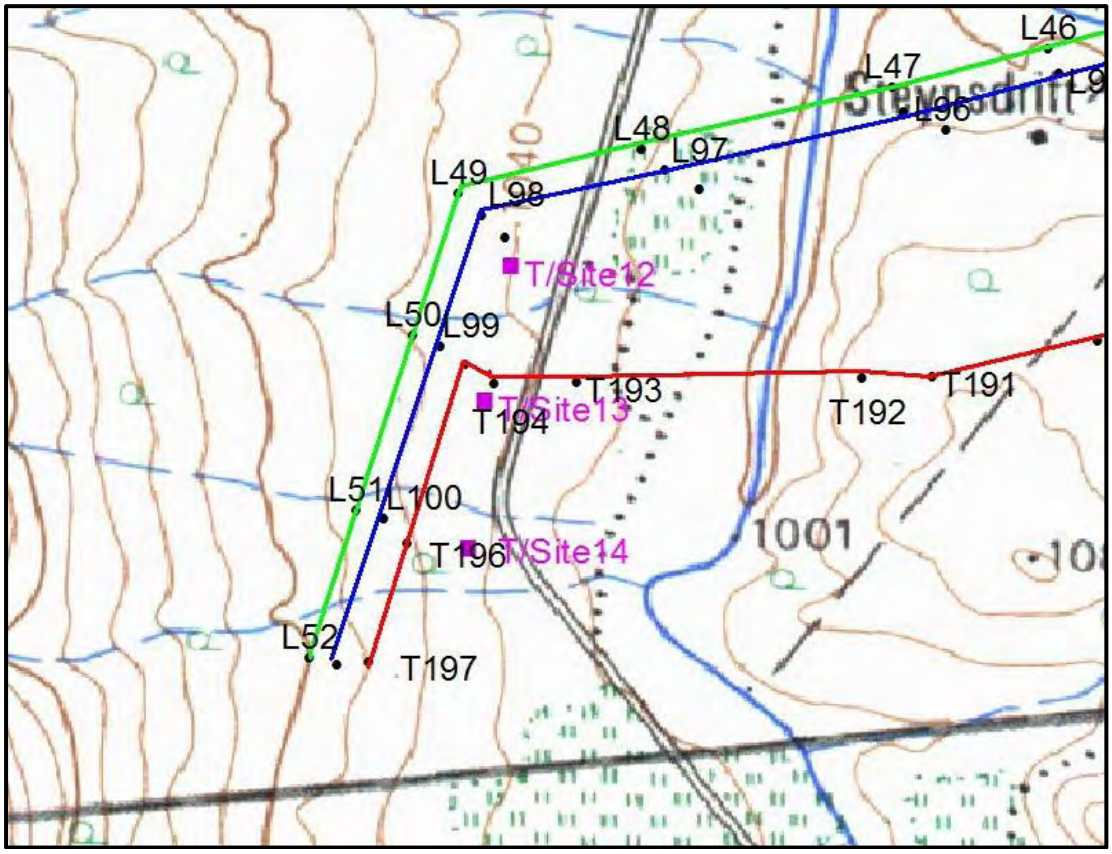
- Archaeological sites

Location	No. L/Site10	S 25.05762	E 29.82061
Description			
Stone walling occur all along the foot of the two hills. It probably dates to the recent past and formed part of homesteads, cattle enclosures and agricultural fields.			
Significance	High on a regional level – Grade III		
Mitigation			
These features are close to the power line reserve. Due to the dense vegetation currently on the site, it is difficult to determine the exact layout and position of the walls. **Recommendation**: It should be fenced off with danger tape, leaving a buffer of at least 10 metres around it.			

L/Site 10 (west)

L/Site 10 (east)

Map 4

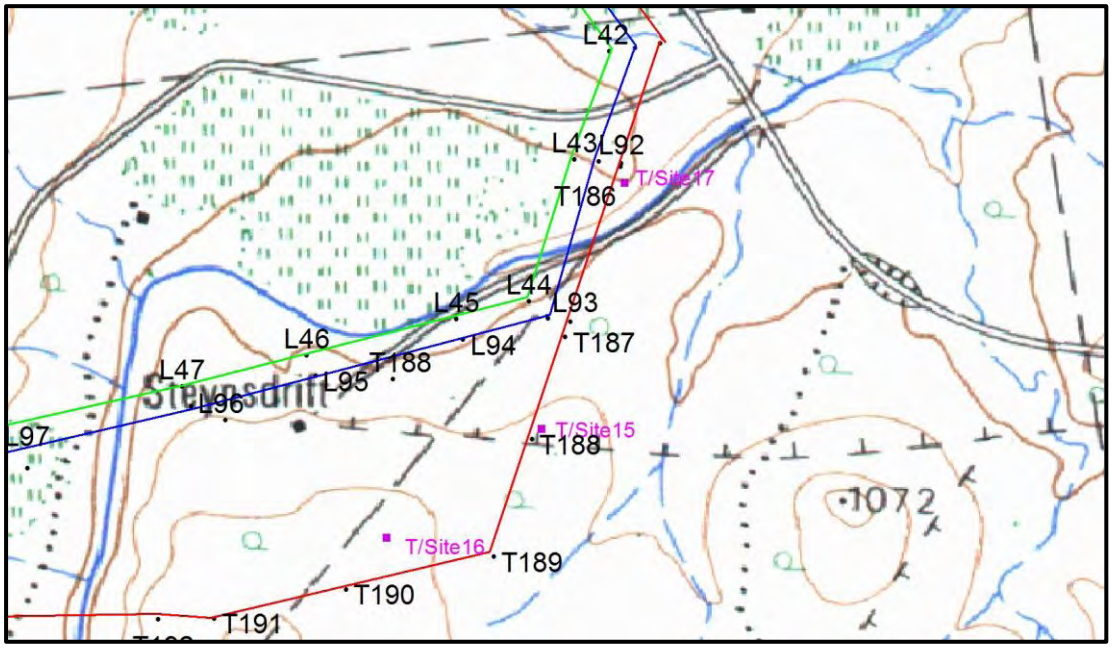


- Archaeological sites

Location	No. T/Site12-14	S 25.11248	E 29.82557
Description			
T/Site 13 & 14 indicate an area where a large settlement site occurs. It dates to the Late Iron Age and consists of homestead area, public areas such as a male gathering place and stock pens. It measures approximately 500 X 400 metres (north/south by east/west), with a small section on the western side of the road. The section identified as T/Site 12 represents the agricultural terracing and fields of the former, although some homestead areas can also be identified. It is approximately the same size as the previous section			
Significance	High on a regional level – Grade III		
Mitigation			
Both of these sites will be traversed by the power lines. In addition, it is planned to construct the substation on the settlement site. **Recommendation**: If the substation location cannot be move away from the archaeological site, the site should be excavated in full by an archaeologist. This would involve the documentation (mapping and photographing) of all features, as well as the archaeological excavation of sufficient features to fulfil requirements as laid down by SAHRA.			
Requirements			
A permit should be obtained from SAHRA for the possible impact on the site prior to the development taking place.			

 T/Site 13-14	 T/Site 12

Map 5



- Archaeological sites

Location	No. T/Site 15 No. T/Site 16 No. T/Site 17	S 25.10819 S 25.11071 S 25.10253	E 29.84185 E 29.83828 E 29.84378
Description			
T/Site 15: Stone walling which probably formed part of a homestead with a cattle kraal. It is estimate to be approximately 80 x 50 metres in size T/Site 16: Ephemeral stone walling with no distinctive layout. Due to the difficulty in determining the stone walling, its size could not be determined. T/Site 17: Strategic located stone walled site on ridge overlooking Steelpoort River, consisting of a large cattle kraal and smaller stone circles on the periphery. It is estimate to be 150 by 80 metres in size			
Significance	High on a regional level – Grade III		
Mitigation			
T/Site 15: This site is close to Tower 188 and also below the power line. **Recommendation**: If the tower cannot be moved, an archaeologist should be present when work is taking place in the vicinity. During the site visit the vegetation was very high and dense, making it difficult to determine the boundaries of the site. It is recommended that prior to construction taking place that the area surrounding the site is cleared by hand in order to determine the full extent of the site. T/Site 16: As this site is located some distance from the power line, it is unlikely that it would be impacted on by the development of the power line. T/Site 17: Tower numbers T186 and L92 are located on this site as well as being located below the line. **Recommendation**: It is strongly recommended that the line and the position of the towers are moved away from this site. If it cannot be moved, an archaeologist should be present when work is taking place in the vicinity. During the site visit the vegetation was very high and dense,		

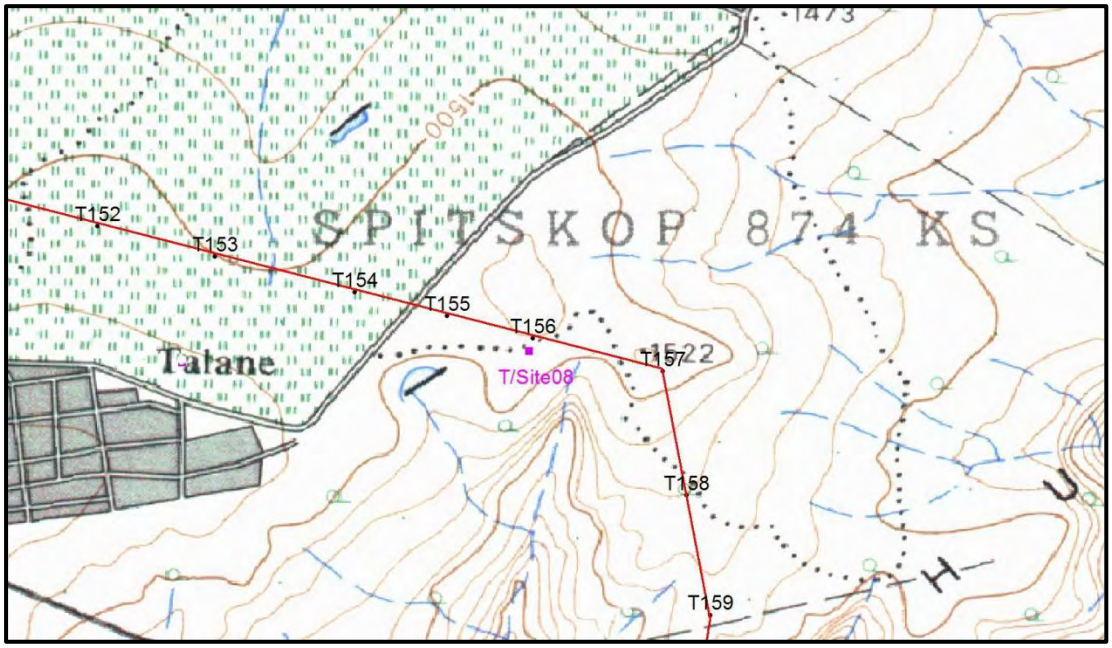
making it difficult to determine the boundaries of the site. It is recommended that prior to construction taking place that the area surrounding the site is cleared by hand in order to determine the full extent of the site.
Requirements
A permit should be obtained from SAHRA for the possible impact on the site prior to the development taking place.

T/Site 15

T/Site 16

T/Site 17

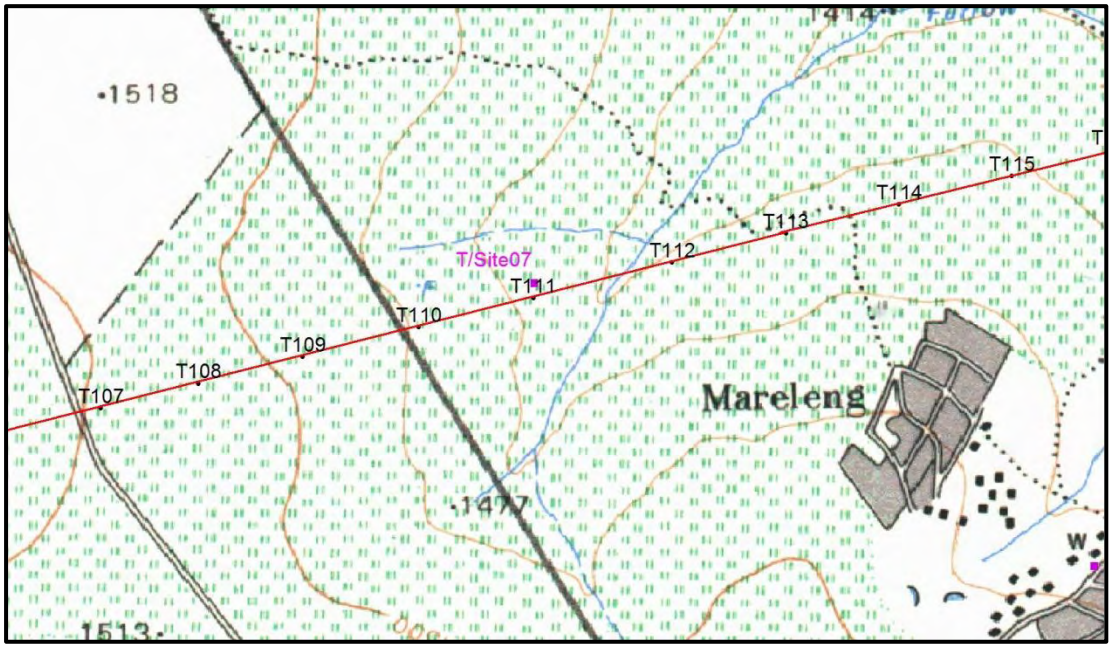
Map 6



- Graves & Cemeteries

Location	No. T/Site08	S 25.01692	E 29.81023
Description			
A formal community cemetery with probably more than 100 graves. Most have gravestones, but some are only marked with stone cairns.			
Significance	High on a local level – Grade III		
Mitigation			
As this is a large and well fenced cemetery, it is unlikely that the power line development would have an impact on it. **Recommendation**: Although the current alignment by-pass the cemetery, it is recommended that the site is fenced off with danger tape for the duration of the construction period.			

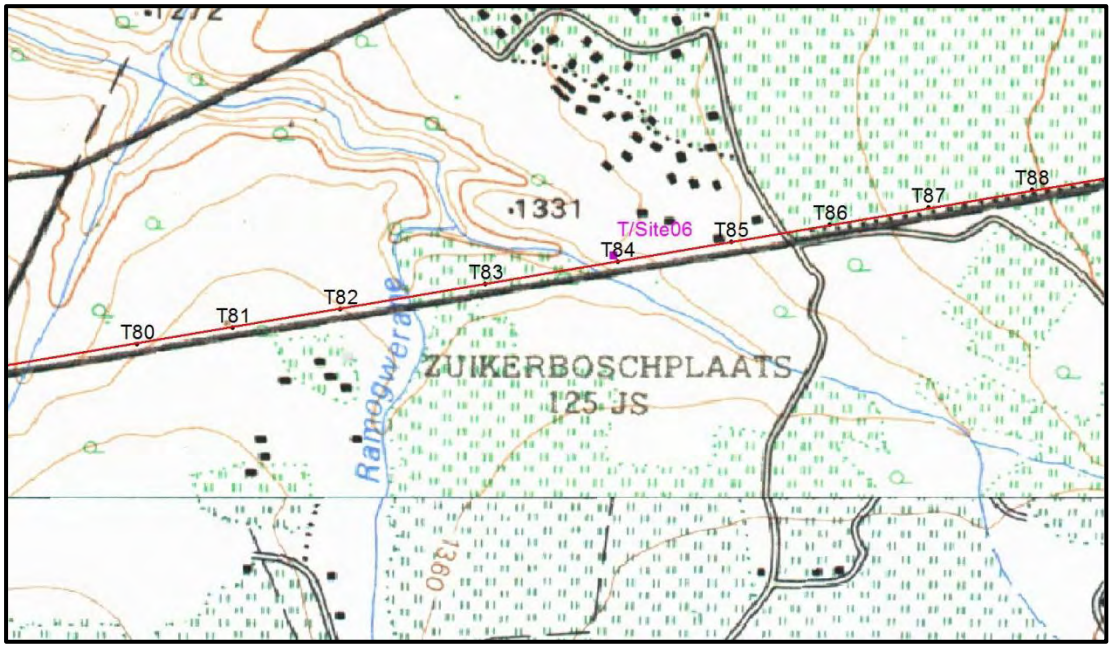
Map 7



- Graves & Cemeteries

Location	No. T/Site07	S 24.98028	E 29.65839
Description			
An informal burial place with an unknown number of graves marked only with stone cairns, located under a large tree.			
Significance	High on a local level – Grade III		
Mitigation			
This site is located close to the power line reserve as well as tower T111. **Recommendation**: Although the current alignment by-pass the burial place, it is recommended that the site is fenced off with danger tape for the duration of the construction period.			

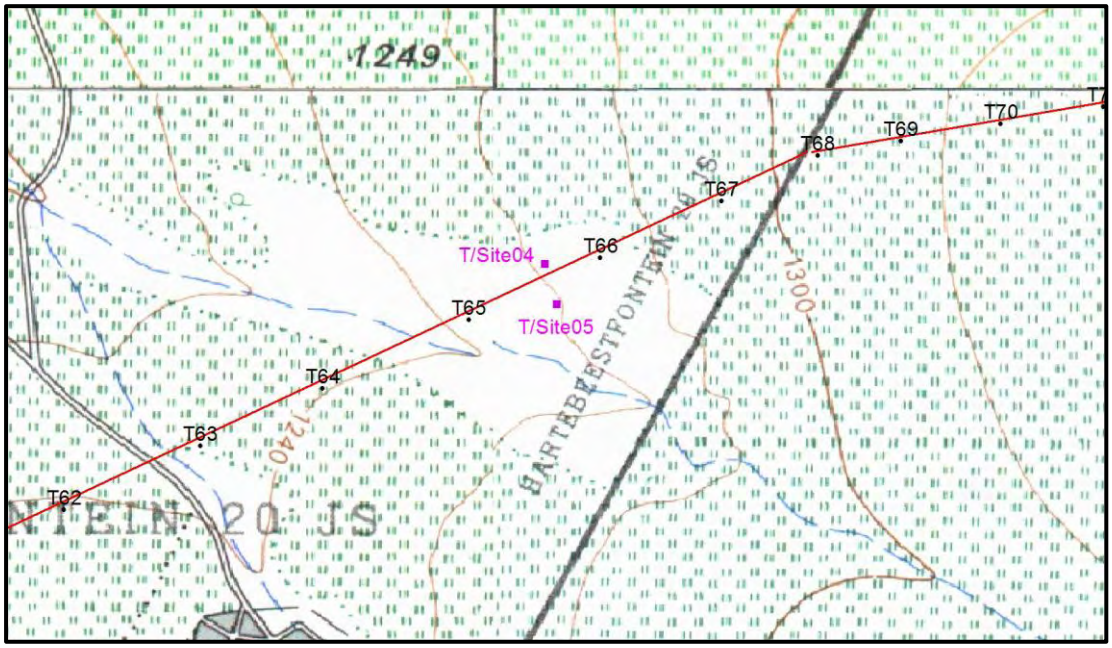
Map 8



- Archaeological sites

Location	No. T/Site06	S 24.99308	E 29.56529
Description			
A stone walled site that are used for the initiation of young boys. The various elements such as the central fire place, accommodation structures, etc. are clearly identifiable and also indicates that the site has been used in the recent past.			
Significance	High on a regional level – Grade III		
Mitigation			
Tower T 84 will be located on this site and the power line will cross it as well. **Recommendation**: It is recommended that the tower is moved to a location off the site. In addition it is recommended that the local community is briefed about the line crossing the site and that their consent is gained for the line to pass over it.			

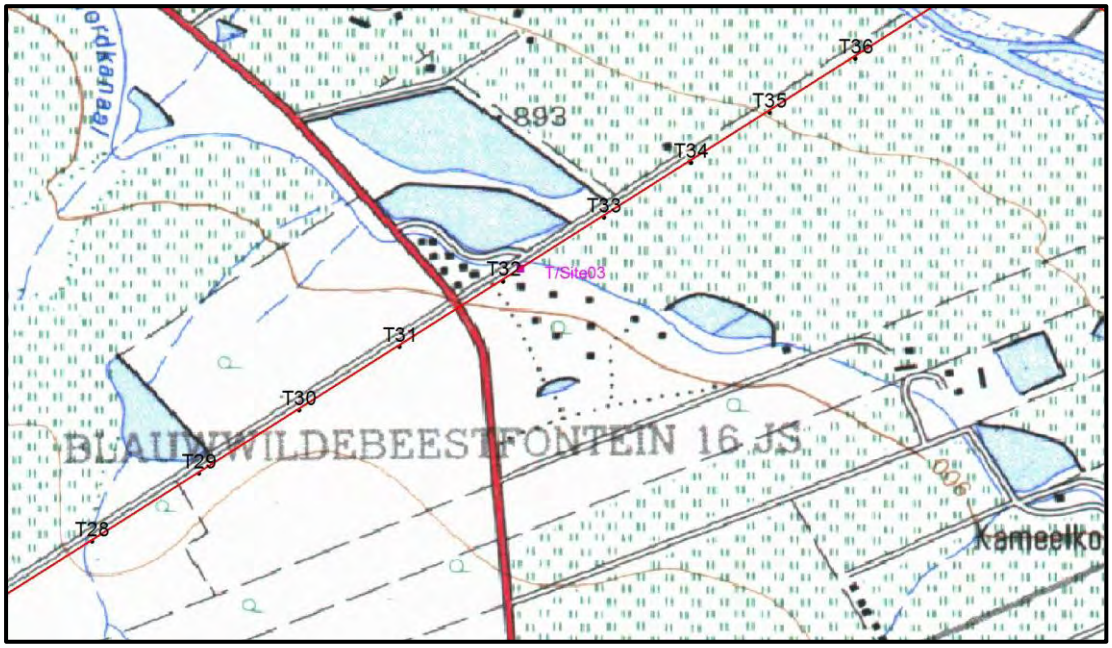
Map 9



- Graves & Cemeteries

Location	No. T/Site04 No. T/Site05	S 25.00625 S 25.00754	E 29.50139 E 29.50175
Description			
T/Site04: An informal burial place with three graves, two of which are marked with headstones. T/Site05: A single grave with a headstone, but with no inscription.			
Significance	High on a local level – Grade III		
Mitigation			
These two sites are located close to the power line reserve. **Recommendation**: Although the current alignment by-pass both, it is recommended that the sites are fenced off with danger tape for the duration of the construction period.			

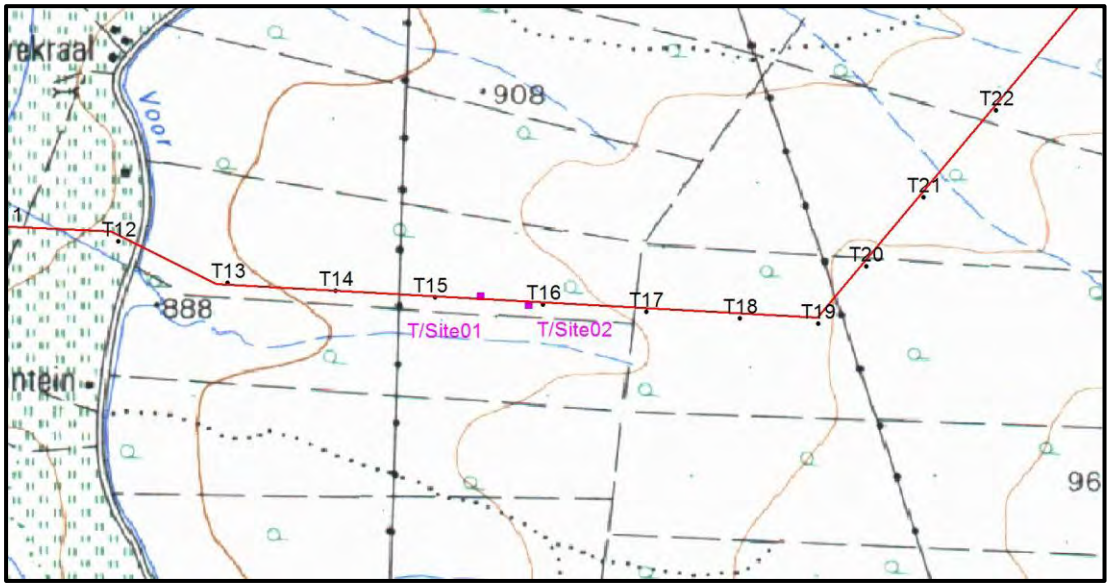
Map 10



- Archaeological sites

Location	No. T/Site03	S 25.04876	E 29.38458
Description			
The remains of a typical farm labourer homestead built with clay bricks. Due to the dense vegetation it is difficult to determine its size and layout			
Significance	High on a regional level – Grade III		
Mitigation			
This site is inside the power line reserve. Tower T 32 will be located close to this site and the power line will cross it as well. **Recommendation**: The site should be fenced off with danger tape, leaving a buffer of at least 50 metres, from the outermost visible remains of the structure, around it. During the site visit the vegetation was very high and dense, making it difficult to determine the boundaries of the site. It is recommended that prior to construction taking place that the area surrounding the site is cleared by hand in order to determine the full extent of the site.			

Map 11



- Graves & Cemeteries

Location	No. T/Site01 No. T/Site02	S 25.07610 S 25.07637	E 29.33858 E 29.34009
Description			
T/Site01: An informal burial place with an unknown number of graves, only a few of which are marked with headstones. T/Site02: A single grave with a headstone.			
Significance	High on a local level – Grade III		
Mitigation			
Both sites are located between towers T15 and T16 and are located inside the power line reserve. **Recommendation**: Although the current alignment by-pass both, it is recommended that the sites are fenced off with danger tape for the duration of the construction period. During the site visit the vegetation was very high and dense, making it difficult to determine the boundaries of the sites. It is recommended that prior to construction taking place that these areas are cleared by hand in order to determine the full extent of the burial sites.			

4. AMENDMENT TO THE SUBSTATION SITE

As a result of the large number of heritage sites that might be impacted on, as well as some issues with the construction of the Steelpoort substation on the originally selected site, Eskom has decided to move the substation to a new location a few hundred metres north of the original position. Consequently, this new site was surveyed on 29 January 3013, resulting in this amendment being added to the original report.

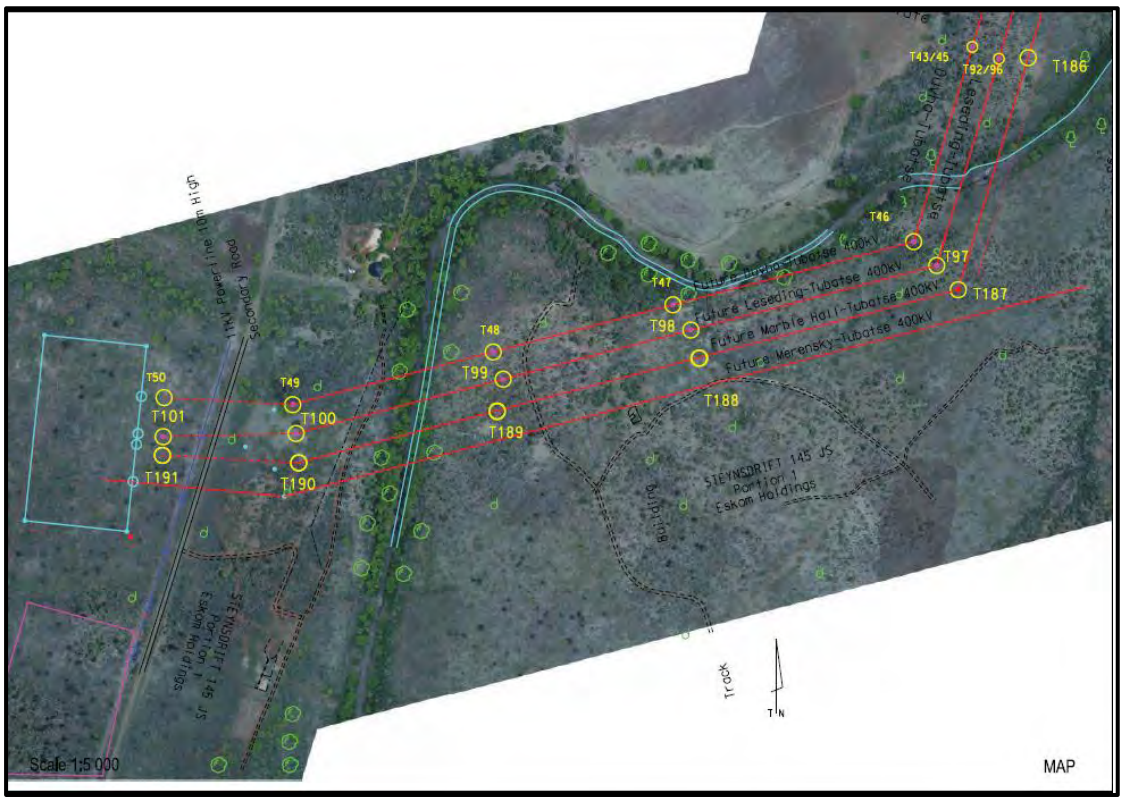


Fig. 2. New position and layout of the proposed substation.

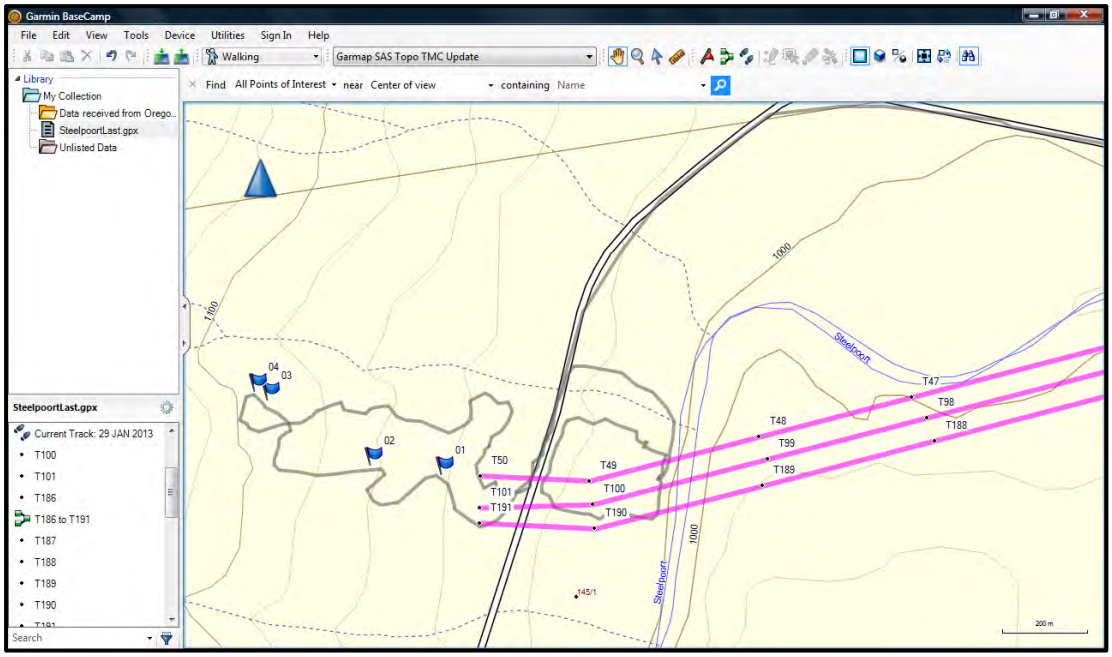


Fig. 3. Results of the survey for the new substation site.

- Archaeological sites

Location	No. 1 No. 2 No. 3 No. 4	S 25.10779 S 25.10759 S25.10622 S25.10604	E 29.82665 E 29.82507 E 29.82278 E 29.82249
Description			
Ephemeral stone walling with no distinctive layout. Due to the tall grass cover it was difficult to determine the exact nature and extent of the stone walling. It date to the Late Iron Age and can probably be related to the type of sites identified on the old substation site. However, there seems to be much less of it than on the previous site, most occurring to the west of the substation site. Consequently, this position presents a much better proposition for the development of the substation. As indicated on the map in Fig. 3, it is only feature no. 1 that is in close vicinity of the substation site. Most features occur west, higher up-slope and seem to concentrate in the region of features no. 3 & 4, which is located well outside the development area.			
Significance	High on a regional level – Grade III		
Mitigation			
It seems as if some stone walling occur on the site or just outside the boundary of the substation site. During the site visit the vegetation was very high and dense, making it difficult to determine the boundaries of the features. **Recommendation**: It is recommended that the area is cleared by hand in order to determine the full extent of the stone walling and that it is documented (mapped and photographed) before construction takes place.			
Requirements			
A permit should be obtained from SAHRA for the possible impact on the site prior to the development taking place.			




5. RECOMMENDED MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

5.1 **Objectives**

- Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the National Heritage Resources Act (Act No. 25 of 1999), should these be discovered during construction.

5.1.2 *Construction phase*

General management objectives and commitments:

- To avoid disturbing sites of heritage importance; and
- To avoid disturbing burial sites.

The following shall apply:

- Known sites should be clearly demarcated in order that they can be avoided during construction activities.
- The contractors and workers should be notified that archaeological sites might be exposed during the construction work.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

5.1.2 *Operation phase*

General management objectives and commitments:

- To avoid disturbing sites of heritage importance.

The following shall apply:

- Continued care should be taken to observe discovery of any sites of heritage significance during operation. Should any archaeological artifacts and palaeontological remains be exposed during operations, work on the area where the artefacts were found, shall cease immediately and the appropriate person shall be notified as soon as possible;
- Upon receipt of such notification, an Archaeologist or Palaeontologist shall investigate the site as soon as practicable. Acting upon advice from these specialists, the necessary actions shall be taken;
- Under no circumstances shall archaeological or palaeontological artefacts be removed, destroyed or interfered with by anyone on the site during operations; and
- The operator shall advise its workers of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51(1).

6. MITIGATION MEASURES

The aim of this survey was to analyse and recommend heritage management mitigation measures and monitoring programmes for sites, features and objects within the corridor of the proposed power line. Information on the identified sites is presented in Section 3. The significance of each feature was determined by application of the matrix presented in Appendix 1. This allows that similar features can be rated in similar manner. The following was found:

- A number of stone walled sites dating to the Late Iron Age were identified. On some the line just crosses over, whereas on others a tower structure will be erected (Section 3).
    - It is recommended that these sites are excavated by a suitably qualified archaeologist prior to the development taking place.

  - It is also recommended that an archaeologist is in attendance when construction takes place on the sites.

- One old farmstead was identified and is viewed to have a low significance on a regional level. However, in many cases graves are found in the vicinity of such old homesteads. However, due to the dense vegetation surrounding the buildings, it was difficult to determine if there are any graves located here.
  - It is recommended that these features are isolated by demarcating a 50m buffer zone around it, taking the outside of the buildings as starting point for determining the buffer.

- A number of informal cemeteries and burial places of differing size were identified. They are viewed to have a high significance on a local level (Section 3).
  - All cemeteries/burial places are located inside the corridor for the power line, or very close to it. These features should be left in place and isolated by demarcating a 10m buffer around them starting from the outermost graves that can be located.

As a result of the large number of heritage sites that might be impacted on, as well as some issues with the construction of the Steelpoort substation on the originally selected site, Eskom has decided to move the substation to a new location a few hundred metres north of the original position. Consequently, this new site was surveyed on 29 January 3013, resulting in an amendment being added to the original report.

- Although some stone walling occurs in the region of the new substation, there seems to be much less of it than on the previous site, most occurring to the west of the substation site. Consequently, this position presents a much better proposition for the development of the substation. As indicated on the map in Fig. 3, it is only feature no. 1 that is in close vicinity of the substation site. Most features occur west, higher up-slope and seem to concentrate in the region of features no. 3 & 4, which is located well outside the development area.
  - It is recommended that the area is cleared by hand in order to determine the full extent of the stone walling and that it is documented (mapped and photographed) before construction takes place.

7. REFERENCES

Data bases

Chief Surveyor General
Environmental Potential Atlas, Department of Environmental Affairs and Tourism.
Heritage Atlas Database, Pretoria.
National Archives of South Africa

Literature

Acocks, J.P.H. 1975. *Veld Types of South Africa*. Memoirs of the Botanical Survey of South Africa, No. 40. Pretoria: Botanical Research Institute.

Botha, S.J. (ed.) 1983. *A Proposed National Development Plan for Lebowa*. Pretoria: University of Pretoria.

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Mason, R.J. 1962. *Prehistory of the Transvaal*. Johannesburg: Witwatersrand University Press.

Richardson, D. 2001. *Historic sites of South Africa*. Cape Town: Struik Publishers.

Transvaal Native Affairs Department, 1905. *Short history of the native tribes of the Transvaal*. Pretoria: Government Printer.

Van Schalkwyk, J.A. 2007a. *Heritage impact assessment for the planned Steelpoort Pumped Storage Station, Lydenburg municipal district, Mpumalanga Province*. Unpublished report 2007kh002. Pretoria: National Cultural History Museum.

Van Schalkwyk, J.A. 2007b *Heritage impact assessment for the planned Steelpoort Integration project, Limpopo Province*. Unpublished report 2007/JvS/109. Pretoria: National Cultural History Museum.

Van Schalkwyk, J.A. 2009. *Heritage impact scoping report for the proposed Eskom Highveld North, West Lowveld strengthening project, Mpumalanga and Limpopo Provinces*. Unpublished report 2009/JvS/019. Pretoria.

Maps

1: 50 000 Topocadastral maps

APPENDIX 1: CONVENTIONS USED TO ASSESS THE IMPACT OF PROJECTS ON HERITAGE RESOURCES

Significance

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. Historic value			
Is it important in the community, or pattern of history			
Does it have strong or special association with the life or work of a person, group or organisation of importance in history			
Does it have significance relating to the history of slavery			
2. Aesthetic value			
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group			
3. Scientific value			
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage			
Is it important in demonstrating a high degree of creative or technical achievement at a particular period			
4. Social value			
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons			
5. Rarity			
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage			
6. Representivity			
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects			
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class			
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.			
7. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			
8. Significance rating of feature			
1. Low			
2. Medium			
3. High			

APPENDIX 2. RELEVANT LEGISLATION

All archaeological and palaeontological sites and meteorites are protected by the National Heritage Resources Act (Act no 25 of 1999) as stated in Section 35:

(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

In terms of cemeteries and graves the following (Section 36):

(1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

The National Heritage Resources Act (Act no 25 of 1999) stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III**: Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in section 3(3), which must be used by a heritage resources authority or a local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and the consequent responsibility for its management may be allocated in terms of section 8.

Presenting archaeological sites as part of tourism attraction requires, in terms 44 of the Act, a Conservation Management Plan as well as a permit from SAHRA.

(1) Heritage resources authorities and local authorities must, wherever appropriate, co-ordinate and promote the presentation and use of places of cultural significance and heritage resources which form part of the national estate and for which they are responsible in terms of section 5 for public enjoyment, education. research and tourism, including-

(a) the erection of explanatory plaques and interpretive facilities, including interpretive centres and visitor facilities;
(b) the training and provision of guides;
(c) the mounting of exhibitions;
(d) the erection of memorials; and
(e) any other means necessary for the effective presentation of the national estate.

(2) Where a heritage resource which is formally protected in terms of Part I of this Chapter is to be presented, the person wishing to undertake such presentation must, at least 60 days prior to the institution of interpretive measures or manufacture of associated material, consult with the heritage resources authority which is responsible for the protection of such heritage resource regarding the contents of interpretive material or programmes.

(3) A person may only erect a plaque or other permanent display or structure associated with such presentation in the vicinity of a place protected in terms of this Act in consultation with the heritage resources authority responsible for the protection of the place.

APPENDIX D

ESKOM'S STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES (ESKASABG3 REV 0)

ESKOM

STANDARD

		REFERENCE	REV
		ESKASABG3	**1**
TITLE:	**STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWERLINE SERVITUDES**	DATE: **MAY 2000**	
		PAGE **1** OF	**14**
		REVISION DATE: **MAY 2003**	

COMPILED BY	FUNCTIONAL RESP.	AUTHORIZED BY
.....	.....	.....
Corporate Environmental Affairs	**V Govender CEAM**	**T S Gcabashe CE (Designate)**

This document has been seen and accepted by:

Management Board Environmental Steering Committee (MB-ESC)
The Environmental Liaison Committee (ELC)

Contents

Page

1 Scope

This standard sets out the manner in which all initial powerline route clearing and any subsequent vegetation maintenance is to be performed within all Eskom powerlines servitudes.

It sets the minimum standards for bush clearing and maintenance of all powerline routes and indicates Eskom's rights and responsibilities.

2 Normative references

The following documents contain provisions that, through reference in the text, constitute requirements of this standard. At the time of publication the editions indicated were valid. All standards are subject to review and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent revisions of the standards listed below. Information on currently valid national and international standards may be obtained from the Information Centre at Megawatt Park and Technology Standardization Department.

ESKADABD1:Rev.1, *Environmental management systems.*

ESKASAAL0:Rev.0, *The safe use of pesticides and herbicides*.

SCSASAAZ9: Rev.0, *Clearing and maintenance of servitude routes*.

ESKPBAAD4:Rev.0, *Herbicide Management*.

ESKPVAAZ1:Rev.2, *Environmental management programme (EMP) procedure.*

CO/P 015:Rev.0, *Servitude corridor bush clearing and maintenance procedure*.

CD/P 070, *Pruning and cutting of trees near energised power lines.*

OPR 6204:Rev.0, *Operating regulations for high-voltage systems (ORHVS).*

Commercial Timber Growers Guideline for: *Maintenance and management agreement in forest plantation areas and servitude areas* (available from Eskom's Legal department).

3 Definitions

3.1 commercial timber growers: Timber growers, both individually or as represented by the Forest Owners Association, South African Wattle Growers Union or the South African Timber Growers Association and their personnel. (Commercial Timber Growers Guideline)

3.2 environment: The surroundings within which humans exist and that are made up of:

a) the land, water and atmosphere of the earth;

b) micro-organisms, plant and animal life;

c) any part or combination of (i) and (ii) and the int errelationships among and between them; and

d) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being. (National Environmental Management Act, 1998 (Act 107 of 1998))

3.3 environmental management programme (EMP): A programme that seeks to achieve a required environmental end state and describes how activities, that could have a negative impact on the environment, will be managed and monitored and impacted areas rehabilitated.

3.4 plantation: Any trees planted and managed by commercial timber growers for commercial purposes.(Commercial Timber Growers Guideline)

3.5 servitude: Eskom servitudes registered in the Deeds Office as well as rights obtained in terms of an agreement.

3.6 weeds and invader plants: Weeds and invader plants, as defined under Section 1 of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) and Government Notice R1048 of 25 May 1984 Part 2, or any list of invaders as may be agreed upon between Eskom and the Timber Industry or as identified by the Agricultural Research Council and the Plant Protection Research Institute (Handbook No.5 – Plant Invaders of Southern Africa).

4 Requirements

4.1 General requirements for all bush clearing of powerline servitude routes

The objective of powerline route bush maintenance is to ensure the safe mechanical and electrical operation of the powerline and to meet Eskom's legal, business and environmental obligations and to minimize the risk to affected landowners and the general public.

4.1.1 The following clause in Eskom's Standard Servitude shall be adhered to

"No tree shall be allowed to grow to a height in excess of the horizontal distance of that tree from the nearest conductor of any powerline or to grow in such a manner as to endanger the line should it fall or be cut down".

4.1.2 For all practical purposes, tree cutting shall be confined to the building restriction area as referred to in the servitude.

4.1.3 In terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993), "The supplier or user of powerlines shall control vegetation in order to prevent it from encroaching on the minimum safety clearances of the power lines and the owner of the vegetation shall permit such control".

4.1.4 The objective in clearing powerline servitudes of trees and bushes is to ensure the safe mechanical and electrical operation of the line and to change from incompatible to compatible vegetation.

4.1.5 The scope of works and/or requirements for bush clearing shall be determined in accordance with the procedure set out in section 4.2.

4.1.6 Bush clearing for new powerline projects shall be carried out in accordance with the standards set out in section 4.3.

4.1.7 Bush clearing for existing powerline servitudes shall be carried out in accordance with the standards set out in section 4.4.

4.1.8 All bush clearing that is to take place within a forest plantation shall conform to the Commercial Timber Growers Guideline: *Maintenance and Management Agreement in Forest Plantation Areas and Servitude Areas between Eskom and Commercial Timber Growers*.

4.1.9 To promote the implementation of a three year programme for bush clearing (herbicide) contracts.

4.1.10 In terms of Eskom's servitude agreement, Eskom (and/or its appointed contractor) has the right to enter and be upon the property at any time whether it to be to perform work on the property itself, or to gain access to any adjacent property. However, Eskom will exercise due diligence in its attempts to notify the owner of any intention to enter the property to cut trees and bush and endeavour to obtain consent to the proposed work.

4.1.11 In order to assist with access, Eskom may erect such gates as may be necessary, in consultation with the property owner. Under no circumstances shall access be gained by cutting or "dropping" fences. All gates shall be left closed and the Eskom servitude gates shall be securely locked at all times.

4.1.12 Indigenous bush and trees

a) Various species of indigenous trees and bush on private land are protected by law (National Forest Act, 1998 (Act 84 of 1998)) in terms of which it is necessary to obtain a permit from the relevant authority in order to cut them.

b) Provincial ordinances shall be adhered to where it is absolutely essential to cut protected indigenous trees. The necessary permits as well as the owner's written consent shall be obtained prior to commencement of any work.

c) Where there is any doubt as to whether a tree specie is protected or not, the Department of Environmental Affairs and Tourism or the local Eskom environmental practitioner in the area shall be consulted.

d) Indigenous trees and bushes that do not grow high enough to cause interference with the powerline or cause a fire hazard, shall not be cut down or trimmed.

4.1.13 Herbicide use

a) The use of herbicides shall be in compliance with the terms of The Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act 36 of 1947).

b) In terms of the above Act, only a registered pest control operator may apply herbicides on a commercial basis. All application of herbicides shall be carried out under the supervision of a registered pest control operator.

c) The Eskom Corporate Policy (ESKPBAAD4) and Standard (ESKASAAL0) on Herbicide use shall be adhered to.

d) A daily register shall be kept of all relevant details of herbicide usage and such register maintained by the relevant Eskom custodian.

4.1.14 General

a) Deep valleys and environmentally sensitive areas that do not allow vehicle access, or legally protected areas, shall not be cleared of vegetation provided that the vegetation poses no threat to the operation and reliability of the powerline. In the case of the construction of new powerlines a one metre "trace-line" may be cut through the vegetation for stringing purposes only and no vehicle access shall be allowed along the cleared "trace-line".

b) Reasonable measures to prevent soil erosion shall be implemented at all times. If soil erosion does take place within the servitude area as a direct result of an act or omission by the land owner/user or Eskom, corrective measures, in consultation with the other party, shall be implemented and the cost borne by the party at fault.

c) Rivers, watercourses and other water bodies shall be kept clear of felled trees, bush cuttings and debris. Where possible, the integrity of riverbanks shall be maintained.

d) Aesthetic consideration shall be taken into account where powerlines cross major roads and rivers or enter dense bush or woodland. An attempt will be made to ensure that all clearing will be performed in a manner so as to leave a screen of vegetation in the servitude on each side of the road or river or at the start of the dense bush or woodland.

e) Trees, shrubs, grass, natural feat ures and topsoil, that are not removed, shall be protected from damage during operations. Scalping of the earth, or any necessary disturbance, shall be allowed for access roads only.

f) The specification for re-vegetation of disturbed areas will be issued on an area specific basis by Eskom.

g) It shall be ascertained from the property owner concerned whether he/she wishes to retain the cut trees and bushes. If not, they shall be removed or disposed of or treated (chipping) in an appropriate manner to the satisfaction of the owner. Burning shall not be permitted under **any** circumstance.

h) Where it is desirable to cut trees beyond the servitude building restriction width, the consent of the owner shall be obtained where no special agreement exists.

j) Any damage to property, including but not limited to, crops, stock, fencing and gates, shall be compensated, repaired or replaced at the contractor's expense, to the satisfaction of Eskom and the landowner.

k) Where possible, vegetation clearance for servitudes shall be performed so that the servitude boundaries are curved and undulating (narrow at tower positions and wide at the lowest point of the conductor). See figure 1 below.

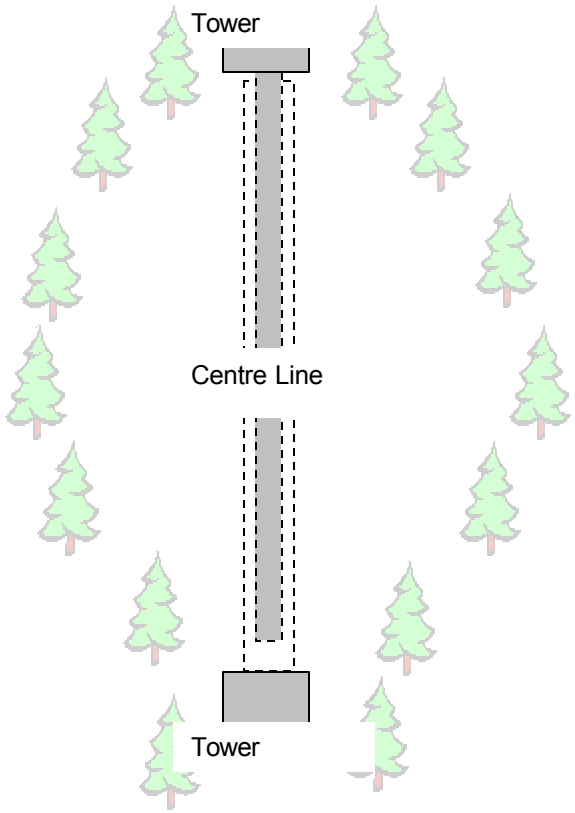


Figure 1 (refer to section 4.1.14.k)

l) The contractor/Eskom shall:

1) remain on all existing roads and tracks and within the servitude area and not deviate therefrom;

2) keep Eskom gates locked and leave property owners' gates closed or as agreed to in writing between Eskom and the land owner;

3) not interfere with the property owners' activities;

4) request permission for the use of water;

5) provide appropriate toilet facilities;

6) not make fires;

7) not litter;

8) not drop fences;

9) not collect firewood without consent; and

10) not disturb or remove stones/rock from the site (i.e. archaeological and heritage sites).

4.1.15 Warranty shall be obtained from the contractor that

a) He or she knows and understands the dangers involved in clearing bush in or around powerlines and the dangers of the spread of fire.

b) He or she understands and will comply with Eskom procedures.

c) He or she understands that he/she must be authorized by the relevant Eskom representative, in writing in terms of Eskom's ORHVS regulations. Eskom must declare him or her competent.

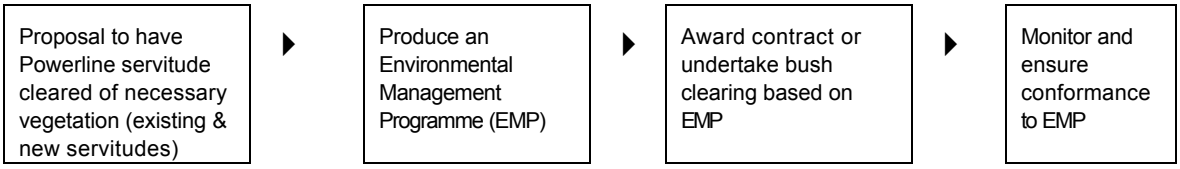
d) He or she is a competent person and is a re gistered pest control operator or shall ensure that any chemical clearing shall be done under the supervision of a registered pest control operator.

e) He or she is able to and shall comply with, all legislation pertaining to the nature of the work to be done and all things incidental thereto.

f) He or she shall appoint a land owner liaison officer, who shall personally contact all affected land owners and users telephonically or in writing and obtain their permission before any trees or bushes are cut, regardless of any previous arrangements or agreements. This shall not be applicable in the case where Eskom has undertaken this requirement.

g) For all affected powerlines a list of property owners shall be supplied, by Eskom, to the contractor to enable him to obtain the owners' consent.

4.2 Procedure to be followed in determining bush clearing requirements



An environmental management programme (EMP) shall be developed and implemented for each bush clearing contract awarded or internal project undertaken. This shall be done for new powerline construction projects as well as for existing powerline servitude maintenance. The following steps shall be undertaken in preparing the EMP for the required bush clearing operation:

4.2.1 Collection of environmental information on the powerline route

The following information about the powerline shall be collected.

No.	Item	Yes	No
1	Map of powerline route (either a 1:50,000 map with annotated powerlines and towers, spanning plans / profiles, compilation plans, or route map)		
2	Eskom's legal requirements (servitude conditions, wayleave and other contract conditions)		
3	Veld fire risk areas (that affect the quality of supply)		
4	Vegetation types along the powerline route		
5	Soil types along route		
6	Herbicide register (of chemicals used on the servitude in the past)		
7	Register of past contracts or work undertaken in terms of bush clearing		
8	Affected landowners' property details, names, addresses, telephone numbers and land use. Complaints / communication register with affected landowners. A record of their "Special conditions" with regard to bush clearing.		
9	Sensitive environmental areas (wet lands, private game farms, nature reserves, national parks, natural heritage sites, archaeological / historical sites, endangered / protected species {fauna & flora} forest plantations, cultivated lands, indigenous forests etc.)		
10	Technical specifications and dimensions regarding tower types		
11	A register of the number of fires, flash-overs (as a result of vegetation) and interference by vegetation that resulted in reduced quality from supply of the powerline in question		

All this required information should be collected before proceeding further.

4.2.2 Identify and/or predict the bush clearing problems and actions to be taken to solve them

Have all the problems associated with bush clearing on the powerline route been identified?

a) The existing or potential problem areas shall be indicated on a sketch plan (see annex B) based on a site inspection of the powerline route (existing or proposed). For each issue identified, the action to be taken shall be determined.

b) Action to be taken shall be based on the information obtained in **4.2.1** and shall conform to the standard set out in sections 4.3 and 4.4 depending on whether the bush clearing is for a new powerline construction project or maintenance of an existing powerline servitude respectively.

c) The actions to be taken shall be based on scientific and technical knowledge and experience. The actions shall strike a balance between ensuring the protection of the environment, minimal damage to landowner's property and shall ensure the integrity of the powerline's quality of supply

d) The consequences of each action taken shall be determined and justified.

e) The assessment results shall be documented (see annex A).

f) Once an assessment of the powerline route has been undertaken and the required actions are determined, these shall be discussed with the affected landowners. Their concerns with regard to the proposed actions shall be addressed.

Once the assessment of the powerline route has been undertaken it shall be integrated into the project documentation (contract scope of work or work instruction).

4.2.3 Integration into the project/operational systems, documentation and contracts

a) For each action required, detailed specifications (see sketch plan in annex B) shall be drawn up including:

1) the site to be cleared (a description of the property and/or powerline).

2) the area to be cleared (the width to be cleared under powerline, access road, servitude width and the area around structures).

3) the height to be cleared (for cutting of grass and reeds, access road, strip under powerline, servitude width as well as trimming of trees).

4) other requirements (property owners' special requirements)

5) removal of vegetation (requirements for the removal or chipping or cutting-up and stacking of the cut vegetation).

6) timing (when bush clearing is to take place ie time of year, day and time – if required).

7) notification (all land owners/users shall be notified and their consent obtained before entering property to carry out bush clearing, and any other special requirements).

b) The actions in 4.2.3(a) constitute the EMP and it shall be integrated into the scope of work or work description as part of tender documents and subsequent contracts or a work instruction when undertaken by Eskom staff.

4.2.4 Appointment of Project Manager and award of contract

a) Once the EMP has been prepared and the contract scope of works, o r work instruction determined, a project manager shall be appointed, an enquiry shall be prepared and issued and a contract awarded when external contractors are used, or a work instruction issued when the work is to be done by Eskom staff, and the bush clearing implemented. All contracts for bush clearing shall be in terms of Eskom's commercial requirements.

b) The project manager shall:

1) manage the contract in terms of the contract or work instruction requirements;

2) resolve disputes between land ow ners and those carrying out the bush clearing;

3) report all incidents in terms of the Group's standard for the reporting and investigation of incidents; and

4) ensure that those carrying out the bush clearing understand the requirements of the contract/ work instruction.

c) The project manager shall inform the relevant Customer Service Centre Manager, in the case of Distribution, and the applicable Regional Manager in the case of Transmission, of the proposed bush-clearing project. The following details shall be furnished to them: the project location, the time period, the project manager and contractor's names and contact details.

4.2.5 Monitoring and audit

a) **Monitoring:** There shall be a monitoring programme in place to not only ensure conformance with the EMP through the contract/work instruction specifications but also to monitor environmental issues and impacts that have not been accounted for in the EMP, that are, or could result in significant environmental impacts for which corrective action is required. Monitoring shall form part of the contract or work instruction. The period and frequency must be stipulated. The project manager shall ensure that the monitoring is carried out.

b) **Audit:** The requirement for an audit shall be stipulated in the contract or work instruction. It shall be undertaken within a specified period after completion of the work but before the contract is signed off. The audit shall be used to identify non-conformances for which corrective action shall be taken. Corrective actions shall take place before the contract is signed off. The audit shall also be used to identify findings that can be used to improve further EMPs for bush clearing. The auditor shall be appointed by the project manager.

4.3 Bush clearing requirements for new powerline construction projects

a) The minimum standards to be used for bush clearing for new powerline construction are listed in the table below. These specifications shall be used in conjunction with the EMP that has been compiled.

Item	Standard	Follow up
Centre line of proposed powerline	Clear to a maximum (depending on the tower type and voltage) of an 8 m wide strip of all unwanted vegetation along the centre line. Vegetation to be cut within 100 mm of the ground. Treat stumps with herbicide.	Re-growth shall be cut within 100 mm of the ground and treated with herbicide as necessary.
Inaccessible valleys (trace line)	Clear a 1 m strip for access by foot only for the pulling of a pilot wire by hand.	Vegetation not to be disturbed after initial clearing – vegetation to regrow.
Access road	Clear a maximum (depending on the tower type and voltage) 5 m wide strip for vehicle access within the maximum 8 m width, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Proposed tower position and Proposed support/stay wire position	Clear all vegetation within proposed tower position and within a maximum (depending on the tower type and voltage) radius of 5 m around the position, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Indigenous vegetation within servitude area (outside of the maximum 8 m strip)	Area outside of the maximum 8 m strip and within the servitude area, selective trimming or cutting down of those identified plants posing a threat to the integrity of the proposed powerline.	Selective trimming
Alien species within servitude area (outside of the maximum 8 m strip)	Area outside of the maximum 8 m strip and within the servitude area, cut all vegetation within servitude area and treat with appropriate herbicide.	Cut and treat with appropriate herbicide.

4.4 Bush clearing requirements for the maintenance of existing powerline servitudes

a) The minimum standards to be used for bush clearing for existing powerline maintenance are listed in the table below. These specifications shall be used in conjunction with the EMP that has been compiled.

Item	Standard	Follow up
Centre line of existing powerline	Clear a maximum (depending on the tower type and voltage) of an 8 m strip of all unwanted vegetation (all alien and invader vegetation and trees that could grow and interfere with the powerline or could make contact with conductors or structure in the event of falling over) along the centre line. Vegetation to be cut within 100 mm of the ground. Treat stumps with herbicide.	Re-growth shall be cut within 100 mm of the ground and treated with herbicide as necessary.
Inaccessible valleys	No clearing	No clearing
Access road	Maintain a maximum (depending on the tower type and voltage) 5 m wide strip for vehicle access, including de-stumping/ cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Tower position and support/stay wire position	Clear all vegetation within proposed tower position and within a maximum (depending on the tower type and voltage) radius of 5 m around the position, including de-stumping /cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Indigenous vegetation within servitude area (outside of the maximum 8 m strip)	Selective trimming or cutting down of those identified plants interfering or posing a threat to the integrity of the powerline.	Selective trimming
Alien species within servitude area (outside of the maximum 8 m strip)	Cut all vegetation within servitude area and treat with appropriate herbicide.	Cut and treat with appropriate herbicide.

Annex A

(normative)

Bush clearing checklist to determine actions required (see 4.2.2)

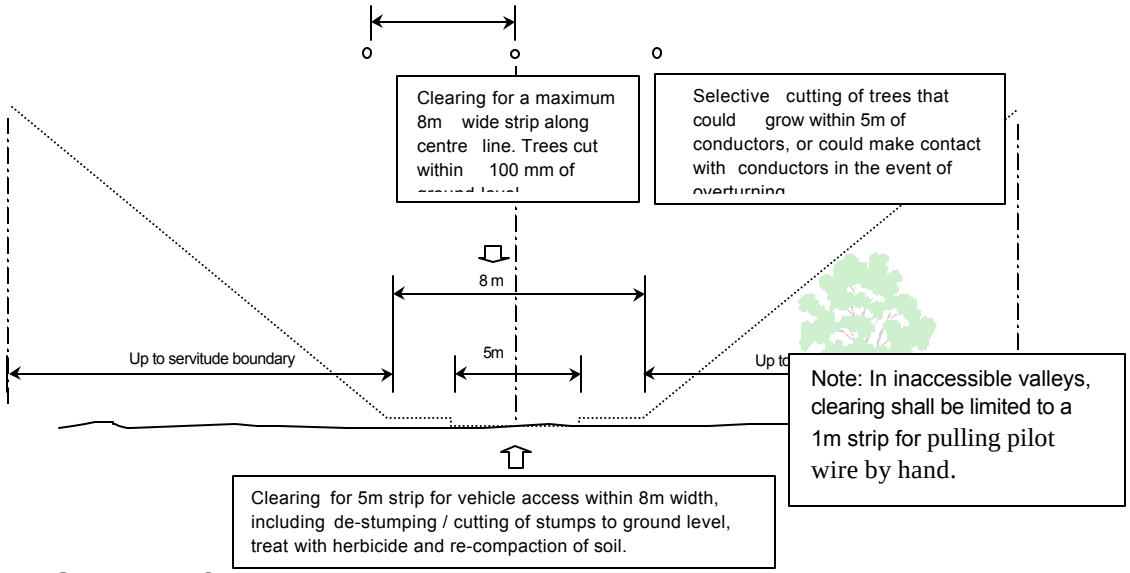
Draw a sketch (see annex B)

No.	Issue	Grass	Declared weed	Invader	Reeds	Sugar cane	Forest plantation	Other	Indigenous	Action to be taken	Justification
	Access road										
	Tower position										
	Stay wire position										
	Under and 2 m beyond outer phases										
	Within servitude/ wayleave area										
	River crossings vegetation										
	Road crossings vegetation										
	Land owner/user requirements										
	General comments (erosion, soil type)										

Annex B
(normative)

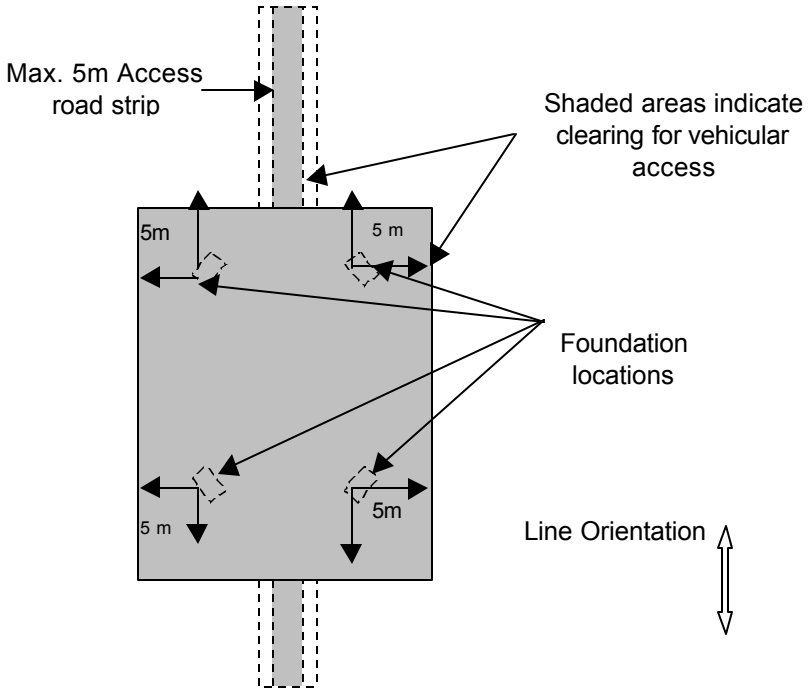
Sketch plan for bush clearing specifications

B.1 Sketch plan for bush clearing along powerline servitude



B.2 Standard for all vegetation clearance at tower positions

Clear all vegetation within proposed / existing tower position and within a maximum (depending on the tower type and voltage) radius of 5m around the position, including de-stumping / cutting stumps to ground level, treating with a herbicide and re-compaction of soil.



Annex C
(normative)

Minimum clearances and general servitude widths

Maximum voltage	Minumum safety clearance (OHSA, No. 85 of 1993)	Servitude building restriction widths (measured from the centre line of the powerline) *
11 kV	0,20 m	9 m to 11 m
22 kV	0,32 m	11 m
88 kV	1,00 m	11 m
132 kV	1,45 m	15,5 m
275 kV	2,35 m	22 m to 23,5 m
400 kV	3,20 m	23,5 m to 27,5 m
765 kV	5,50 m	40 m
533 kV (d.c.)	3,70 m	15 m
Cross rope suspension		27,5 m

* Refer to the powerline deed of servitude or other agreement for the exact dimension of the powerline servitude width in question.

APPENDIX E

ESKOM'S TRANSMISSION LINE TOWERS AND LINE CONSTRUCTION PROCEDURES (TRMSCAAC1 REV 3)

ESKOM

TRANSMISSION

SPECIFICATION

REFERENCE **TRMSCAAC1** REV **3**

TITLE: **TRANSMISSION LINE TOWERS AND LINE CONSTRUCTION**

DATE: **MARCH 2001**

PAGE **1** OF **57**

REVISION DATE: **MARCH 2004**

COMPILED BY	FUNCTIONAL RESP.	AUTHORIZED BY
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This document has been seen and accepted by:

Name	Designation

Note: Concerns queries and comments on this document should be referred to the compiler

CONTENTS **Page**

1. Scope

This specification details the requirements for the design, detailing, fabrication, testing, supply, delivery and erection of transmission line towers and foundations, together with the erection of all conductors and associated line hardware and fittings.

2. Definitions

a) The "*Employer"* is the party for whom the *works* are to be executed and in this specification means Eskom and where applicable, includes Eskom's successor in title but not, except with the written content of the *Contractor*, any assignee of Eskom.

b) The "*Contractor"* is the party appointed by the *Employer* to "Provide the Works".

c) The "*Project Manager"* is the person appointed by the *Employer* from time to time to act in the capacity and notified, by name and in writing by the *Employer* to the *Contractor*, as required in "The NEC Engineering and Construction Contract".

d) The "*Supervisor"* is the person appointed by the *Employer* from time to time to act in the capacity and notified, by name and in writing by the *Employer* to the *Contractor*, as required in "The NEC Engineering and Construction Contract".

3. Normative references

The following documents are to be read in conjunction with this specification. In cases of conflict, the provisions of this specification shall take precedence. Unless otherwise stated, the latest revision, edition and amendments shall apply.

ASCE Manual No. 52	Guide for design of steel transmission towers
BS 183:1972	Specification for general purpose galvanised steel wire strand.
BS 443:1982	Specification for testing zinc coatings on steel wire and for quality requirements.
BS 970	Specification for wrought steels for mechanical and allied engineering purposes.
BS EN 287-1:1992	Approval testing of welders for fusion welding. Part 1: Essential variables, range of approval examination and testing, acceptance requirements, re-tests, period of validity. Annexes on steel groups, welders test certificate, procedure specification and job knowledge.
BS EN 288-3:1992	Specification and approval of welding procedures for metallic materials. Part 3: Welding procedure tests for the arc welding of steels.
ECCS	Recommendations for angles in lattice transmission towers, No. 39.
SABS 82:1975	Bending dimensions of bars for concrete reinforcement.
SABS 135:1991	ISO metric bolts, screws and nuts (hexagon and square) (coarse thread free fit series).
SABS 182-5:1979	Zinc-coated steel wires for conductors and stays.
SABS 471:1971	Portland cement (ordinary, rapid-hardening and sulphate-resisting).
SABS 626:1971	Portland blast furnace cement.
SABS 675:1993	Zinc-coated fencing wire.
SABS 471:1971	Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire). (Appendix C to apply).
SABS 831:1971	Portland cement 15 (ordinary and rapid hardening).
SABS 920:1985	Steel bars for concrete reinforcement.

SABS 1083:1976	Aggregates from natural sources.
SABS 1200-GE:1984	Precast concrete (structural).
SABS 1431:1987	Weldable structural steels.
SABS 1491-1:1989	Portland cement extenders, Part 1: Ground granulated blast furnace slag.
SABS 1491-2:1989	Portland cement extenders, Part 2: Fly ash.
SABS 1491-3:1989	Portland cement extenders, Part 3: Condensed silica fume.
SABS 1466:1988	Portland fly ash cement.
SABS 0100-1:1992	The structural use of concrete. Part 1: Design.
SABS 0100-2:1992	The structural use of concrete, Part 2: Materials and execution of work.
SABS 0144:1978	Detailing of steel reinforcement for concrete.
SABS 0162-1:1993	The structural use of steel, Part 1: Limit-states design of hot-rolled steelwork.
SABS 0162-2:1993	The structural use of steel, Part 2: Limit-states design of cold-formed steelwork.
SABS 0162-3:1993	The structural use of steel, Part 3: Allowable stress design steelwork.
SABS Method 862	Slump of freshly-mixed concrete.
SABS Method 863	Compressive strength of concrete (including making and curing of the test cubes).
ESKCAAB4	Zinc coated earth conductor, guy and stay wire for transmission lines
ESKASABG3	Bush clearance and maintenanace within overhead powerline servitudes.
TRMSCABC9	Design, manufacturing and installation specification for transmission line labels.
TRMASAAJ7	Earthing of transmission lines.
TRMASACB2	Standard for the installation of overhead ground wire with optical fibre (OPGW)
NWS 1074	Guy strand grips for transmission lines.
NWP 3402	Powerlines in the vicinity of aerodromes and hazards to aircraft.

Department of Agriculture Bulletin No. 399 ISBN0621082589, A primer on soil conservation.

Environmental Conservation Act No. 73 of 1989.

Fencing Act No 31 of 1963.

SAISC, South African steel construction handbook.

4. Environmental

4.1 General

4.1.1 Supervision

The *Contractor* shall give or provide all necessary superintendence during the execution of the *works*. The *Contractor* or a competent and authorised appointee approved of in writing by the *Project Manager* (which approval may at any time be withdrawn) shall be on the *works* at all times when work is being performed or when the *Employer* shall reasonably require it. The *Contractor* shall employ only such persons that are competent, efficient and suitably qualified with related experience in the environmental field. The *Employer* shall be at liberty to object to and require the *Contractor* to remove from the *works* any person, who in the *Project Manager's* opinion, misconduct's himself or is incompetent in the proper performances of his duties.

4.1.2 Precautions against damage

a) In accordance with applicable legislation, the *Contractor* shall take all reasonable precautions for the protection of life and property on, or about, or in connection with the *works.*

b) The *Contractor* shall comply strictly with the "Special Conditions" stipulated by the landowners in the negotiated Options.

c) The *Contractor* shall comply with all the conditions specified in the Environmental Management Plan (EMP) during construction. In general, soil disturbance should be kept to a minimum. The disturbance of land contour banks or other erosion control structures shall be avoided.

d) No damage shall be caused to any crops unless both the landowner and the *Supervisor*, prior to the work commencing agree upon the extent of the intended damage.

e) There shall be no littering of the veld. The *Contractor* shall provide suitable containers for any waste.

f) No fires shall be allowed on site under any circumstances.

g) The *Contractor* shall be held liable for all damage arising from actions or negligence on the part of his workforce and any such damage shall be repaired immediately.

h) Any additional agreement concluded between the *Contractor* and a landowner not relating to Providing the Works, must be in writing and a copy made available to the *Supervisor* within 48 hours of such an agreement being concluded.

i) Any environmental incident as specified in the EMP, or accident during construction of the *works* shall be immediately reported to the *Supervisor*.

4.2 Sanitation

The Contractor is to provide portable toilet facilities for the use of his workforce at all work sites. Under no circumstances shall use of the veld be permitted. To prevent the occurrence of measles in cattle, employees may require to be examined for tapeworm and treated, or treated irrespective of whether they are infested or not. Proof of such treatment is to be supplied to the *Supervisor*. The drug "Niclosamide" (Yomesan, Bayer) is freely available and highly effective against tapeworms in humans. It does not however, prevent re-infestation and regular examination and/or treatment is required.

4.3 Wildlife

a) It is illegal to interfere with any wildlife, fauna or flora as stipulated in the Environmental Conservation Act No 73 of 1989.

b) When stipulated in the EMP, two colour bird diverters are to fitted on both earthwires along the indicated spans at 25m intervals.

4.4 Access

a) The *Supervisor* shall, together with a representative of the *Contractor*, negotiate with each landowner the access to reach the servitude and each tower position. The access agreement will be formalised in the form "TPL 004/005 - Property Access Details" and signed by the three parties. The *Contractor* will mark the proposed route and/or a competent representative will accompany the equipment when opening the access. Any deviation from the written agreement shall be closed and re-vegetated immediately.

b) The *Contractor* shall signpost the access roads to the tower positions, immediately after the access has been negotiated.

4.4.1 Use of existing roads

a) Maximum use of both the existing servitudes and the existing roads shall be made. In circumstances where private roads must be used, the condition of the said roads must be recorded prior to use (e.g. photographed) and the condition thereof agreed by the landowner, the *Supervisor* and the *Contractor*.

b) All private roads used for access to the servitude shall be maintained by the *Contractor* and upon completion of the *works*, be left in at least the original condition.

c) Access shall not necessarily be continuous along the line, and the *Contractor* must therefore acquaint himself with the physical access restrictions such as rivers, railways, motorways, mountains, etc. along the line. As far as possible, access roads shall follow the contour in hilly areas, as opposed to winding down steep slopes.

d) Access is to be established by vehicles passing over the same track on natural ground, multiple tracks are not permitted. Access roads shall only be constructed where necessary at watercourses, on steep slopes or where boulders prohibit vehicular traffic.

e) The *Contractor* is to inform the *Supervisor* before entering any of the following areas:

i) Naturally wet areas: vleis, swamps, etc.

ii) Any area after rain.

iii) Any environmentally sensitive area.

f) If access is across running water, the *Contractor* shall take precautions not to impede the natural flow of water. If instructed, the *Contractor* is to stone pitch the crossing point. There shall be no pollution of water. Access across running water and the method of crossing shall be at the approval of the *Supervisor* and the landowner.

g) Where in the opinion of the *Supervisor* and/or *Project Manager*, inordinate and irreparable damage would result from the development of access roads, the *Contractor* shall use alternative construction methods compatible with the access and terrain, as agreed with the *Project Manager.*

h) Existing water diversion berms are to be maintained during construction and upon Completion be repaired as instructed by the *Supervisor.*

i) Where access roads have crossed cultivated farmlands, the lands shall be rehabilitated by ripping to a minimum depth of 600mm.

4.4.2 Construction of new roads

a) Where construction of a new road has been agreed, the road width shall be determined by need, such as equipment size, and shall be no wider than necessary.

b) In areas over 4% sideslope, roads may be constructed to a 4% outslope. The road shall be constructed so that material will not be accumulated in one pile or piles, but distributed as evenly as possible. The material shall be side-cast as construction proceeds, and shall not be side-cast so as to make a barrier on the downhill side. The cut banks shall not overhang the road cut, and shall if necessary be trimmed back at an

angle which would ensure stability of the slope for the duration of the *works*. The sides or shoulders of roads shall not act as a canal or watercourse.

c) Water diversion berms shall be built immediately after the opening of the new access road. In addition, water outlets shall be made at intervals where berms are installed, and suitably stone pitched if instructed by the *Supervisor*.

d) No cutting and filling shall be allowed in areas of 4% sideslope and less.

e) Existing land contours shall not be crossed by vehicles and equipment unless agreed upon, in writing, by the landowner and the *Supervisor.*

f) Existing drainage systems shall not be blocked or altered in any way.

4.4.3 Closure of roads

a) Upon completion, only roads as indicated by the *Supervisor* shall be closed.

b) In areas where no cut or fill has been made, barriers of earth, rocks or other suitable material shall effect closure.

c) In areas 30 % slope and less, the fill of the road shall be placed back into the roadway using equipment that does not work outside the roadcut (e.g. back-hoe). In areas of greater that 30 % slope, the equipment shall break the road shoulder down so that the slope nearly approximates to the original slope of the ground. The cut banks shall be pushed down into the road, and a near normal sideslope shall be re-established and re-vegetated.

d) Replacement of earth shall be at slopes less than the normal angle of repose for the soil type involved.

4.4.4 Construction of water diversion berms

a) Water diversion berms shall be spaced according to the ground slope and actual soil conditions, but no greater than the following:

- Where the track has a slope of less than 2% : 50m apart
- Where the track has a slope of 2% - 10% : 25m apart
- Where the track has a slope of 10% - 15% : 20m apart
- Where the track has a slope of more than 15% : 10m apart

b) Berms shall be suitably compacted to a minimum height of 350mm.

c) The breadth of the water diversion berm shall be 4m at the base, and extend beyond the width of the road for 2m on the outlet side to prevent water flowing back into the road. It shall be angled to a gradient of 1% to enable the water to drain off slowly.

d) Berms are to constructed so that a canal is formed at the upslope side.

e) Where the in-situ material is unsuitable for the construction of water diversion berms, alternative methods of construction must be investigated and proposed by the C*ontractor* and submitted to the *Project Manager* for acceptance.

f) Borrow pits - The *Contractor*'s decision as to the location of borrow pits, shall be at the *Supervisor*'s acceptance. The *Contractor* shall be responsible for the rehabilitation and re-vegetation of the borrow pits. It is the *Contractor*'s responsibility to negotiate the royalties for the borrow pits with the landowner.

4.4.5 Levelling at tower sites

a) No levelling at tower sites shall be permitted unless approved by the *Supervisor*.

b) The steep slopes formed by the cutbanks and respective fillings when building the tower platforms are to be trimmed back to an angle that ensures stability of the slope. When the ground is loose, berms are to be built on the top of the slope, 2m long logs

spaced evenly must be pegged across the down-slope, re-vegetated with appropriate local grass seeds together with fertiliser.

4.5 Gates

4.5.1 General

a) Attention is drawn to the Fencing Act No. 31 of 1963 as amended, in particular with regard to the leaving open of gates and the dropping of fences for crossing purposes, climbing, and wilful damage or removal of fences.

b) At points where the line crosses any fence in which there is no suitable gate within the extent of the line servitude the *Contractor* is to, on the *Supervisor's* instruction, provide and install a servitude gate as detailed in the relevant drawing. The *Contractor* will mark these crossing points when the tower positions are being pegged.

c) Where applicable game gates are to be installed in accordance with the relevant drawing.

d) All vehicles shall pass through gates when crossing fences, and the *Contractor* shall not be allowed to drop fences temporarily for the purpose of driving over them. No construction work shall be allowed to commence on any section of line, unless all gates in that section have been installed. Installation of gates in fences on major road reserves shall comply with the ordinances of the relevant Provisional Authority. No gates may be installed in National Road and Railway fences.

4.5.2 Installation of gates

a) Care shall be taken that the gates shall be so erected that a gap of no more than 100mm to the ground is left below the gate.

b) Where gates are installed in jackal proof fencing, a suitable reinforced concrete sill as shown on the drawing shall be provided beneath the gate.

c) The original tension is to be maintained in the fence wires.

d) Where required, the *Contractor* shall replace rusted or damaged wire strands on either side of the gate with similar new wiring to prevent the movement of animals. The extent of the replacement shall be on the *Supervisor's* instruction.

4.5.3 Securing of gates

a) The *Contractor* shall ensure that all servitude gates used by him are kept closed and locked at all times.

b) The *Contractor* shall provide locks for all servitude gates, and when the line is taken over these locks shall be recovered by the *Contractor* and replaced by locks supplied by the *Employer.* The *Contractor* shall also ensure that all existing farm gates used by him are kept closed. The *Contractor* shall provide the *Supervisor* with keys for the above locks. No keys shall be provided to landowners to avoid conflict situations between neighbouring landowners.

4.6 Construction - within the servitude

a) All foundation excavations shall be kept covered or barricaded in a manner acceptable to the *Supervisor* to prevent injury to people and livestock. Failure to maintain proper protection of excavations may result in the suspension of excavation work until proper protection has been restored.

b) Material removed from the excavation, which is not suitable or not required for backfill may be spread evenly over or adjacent to the tower position. If in the opinion of the *Supervisor* the excavated material is not suitable for spreading it shall be disposed of as directed by the *Supervisor*. Spreading of subsoil will not be permitted. All excavated soil suitable for backfill will be returned to the excavation by backfilling with the subsoil first and the topsoil last.

c) All other construction waste, nuts, bolts, surplus concrete, etc. shall be removed from the tower sites and servitude. Plastic, litter and conductor offcuts etc. are to be removed immediately from site to avoid injury to farm animals and wildlife.

d) No surplus concrete or concrete washing is allowed to be dumped on the servitude and at tower locations. No concrete washing is allowed in watercourses.

4.7 Camp-sites

a) The *Contractor* will be responsible for negotiating the position of his camp-sites and the conditions under which the camps may be established, with the landowner. The *Contractor* will be responsible for the proper management of the camps. Notwithstanding, it is required that the entire camp is fenced and the gates shall be locked after hours and over weekends. Proper sanitation and cooking facilities are to be provided. The *Contractor* shall ensure that the water used at the camp-sites is of drinkable quality.

b) Litter shall be disposed to an appropriate site.

c) Sewerage and waste-water at the camp-sites have to be removed to an approved sewerage farm.

d) The *Contractor* shall have the diesel tank protected underneath by plastic sheeting and a trench or bund wall around it to avoid ground pollution. In case of ground pollution a certified contractor shall remove the soil to an approved toxic site or the ground treated chemically. In both cases a certificate is to be supplied to the *Project Manager.*

e) The compacted ground shall be rehabilitated by ripping to a minimum depth of 600mm. The site shall be cleaned and left as it was found and to the satisfaction of the *Supervisor* and landowner.

4.8 Batching plants

a) The *Contractor* shall be responsible for negotiating the site of his batching plant (if required) and the conditions under it may be established, with the landowner. The *Contractor* shall be responsible for the proper management of the batching plant.

b) Upon completion of *works*, the ground of the batching plant area shall be rehabilitated and the site cleaned and left as it was found and to the satisfaction of the *Supervisor* and landowner.

c) The use of local water for concrete must first be negotiated with the landowner and the appropriate authorities. Such water is to be analysed and accepted by the *Project Manager* before use.

5 Line survey

5.1 Plans and profiles

The route of the line will be surveyed by the *Employer*, who will provide all necessary route plans and templated profile drawings, on which, tower types and the position thereof will be indicated.

5.2 Marking of route

The line route will be marked by the *Employer* with iron pegs at each angle, and on-line reference pegs along the straights, at approximately 2 000m intervals, and will, in most cases, be inter-visible.

5.3 Survey beacons at bend points

At bend positions, the original iron pegs indicating the centre line of the transmission line route are on no account to be disturbed or removed, as these are required for servitude registration purposes. The *Contractor* is to, during foundation installation, concrete the bend pegs in position.

5.4 Survey by the *Contractor*

a) The pegging of tower positions, and where necessary, the establishing of self supporting tower leg extensions and guy anchor positions for guy towers, shall be carried out by professional land surveyors or registered surveyors.

b) The *Contractor*, on completion of each 20km or suitable section of the line, is to supply records of all distances measured for each individual tower position. These should agree with the profiles, and any discrepancy reported immediately.

c) It is the *Contractor's* responsibility to inform the *Supervisor* immediately, should

i) there is any discrepancy between the topography shown on the profiles and the actual ground;

ii) errors be found, for example where a tower position is physically in “lands” and the profile states "no tower in land";

iii) new features have appeared since the completion of the survey and the production of the profiles, such as roads, telephone or power lines etc. which could create clearance problems;

iv) the *Contractor*, in his opinion, finds that the site chosen is not suitable for a tower position, or the tower type indicated on the profiles is not suitable for the tower position e.g. excessive side slope.

d) It is the *Contractor*'s responsibility to ensure that the surveyor is familiar with the limitations and restrictions of the tower types and construction methods used.

5.5 Pegging by the *Contractor*

5.5.1 Procedure

a) The *Contractor* shall undertake the pegging of the transmission line tower positions along the intended line route. Pegging shall proceed far in advance of foundation nomination and construction.

b) Every tower centre position is to be marked with a steel peg ±1.2m high and painted white. The pegs are to carry a tag showing the tower number, tower type and height. The pegs are to be left in position until the tower is assembled.

5.5.2 Setting out of angle towers

All angle towers must be positioned in such a way that the centre phase conductor is on the centre line of the servitude.

5.5.3 Correct placing of towers

It is the *Contractor*s responsibility to ensure that accepted survey methods are used, and that checks are done to ensure the correct placing of towers.

- **NOTE:** As numerous numbers appear on the profile drawings, the *Contractor* is to ensure that the actual span distances add up to the length of the straight or section of line between two bends. Any distance which are shown from a line point to a tower are to be taken as unchecked.

6. Foundations

6.1 Design

6.1.1 Soil and rock classification

a) **Hard Rock:** hard to very hard solid or moderately fractured continuous rock, and including hard to very hard rock of any other description which meets the strength requirements of clause 6.1.2

b) **Soft Rock:** weathered or decomposed very soft to soft continuous rock, and including rock of any other description which does not satisfy the requirements for classification under clause 6.1.1 a) above.

c) **Type '1' soils:** competent soil with equal or better consistency (strength or toughness) than one would encounter in stiff cohesive soils or dense cohesionless soils above the water table. This soil must have a broad balanced texture (constituent particle sizes) with high average combinations of undrained shear strength and internal angle of friction, with minimum values of 80kN/m² and 30° respectively. The minimum natural specific weight shall not be less than 18kN/m³.

d) **Type '2' soils:** a less competent soil than type "1", with equal or weaker consistency than one would encounter in firm to stiff swelling cohesive soils, or dry poorly graded loose to medium dense cohesionless soils above the water table. The minimum undrained shear strength shall be 40kN/m², and the minimum natural specific weight shall not be less than 16kN/m³.

e) **Type '3' soils:** dry loose cohesionless soil or very soft to soft cohesive soil.

f) **Type '4' soils:** submerged cohesionless and cohesive soils. This includes all soils below the permanent water table, including soils below a re-occurring perched water table, or permeable soils in low-lying areas subjected to confirmed seasonal flooding.

6.1.2 Geotechnical design parameters

Pad and pier, steel grillage, precast concrete, pad and plinth for guyed tower mast supports and dead man anchors.

- **For hard rock**
- The maximum bearing or toe pressure at foundation depth shall be 2 000kPa.
- **For soft rock**
- The maximum bearing or toe pressure at foundation depth shall be 800kPa.

- **For soil**

		Type '1'	Type '2'	Type '3'	Type '4'
Maximum soil bearing pressure	kPa	300	150	100	50
Maximum toe bearing pressure	kPa	375	200	125	65
Frustum angle for suspension towers	degrees	30	20	0	0
Frustum angle for strain towers	degrees	25	15	0	0
Density of backfill	kg/m^3	1800	1600	1400	1000
Density of reinforced concrete	kg/m^3	2400	2400	2400	1500

- **NOTE:** For maximum soil bearing pressure and maximum toe bearing pressure, use the tabled pressure or 80% of the ultimate tested bearing pressure determined from appropriate tests.

6.1.3 Foundation design loads

The ultimate simultaneous tower design loads shall be used for foundation design purposes. The foundation loads thus calculated shall be further factored upwards for foundation design purposes by a load factor equal to 1.2 for lattice steel self-supporting type towers. For guyed towers the guy anchor loads shall be factored by a load factor of 1.3 minimum and the mast plinths loads by a factor of 1.1. The foundations shall in addition be designed for the most critical cases that would result from the occurrence of the maximum permissible tolerance situations as listed in clause 6.2.4.3

6.1.4 Drilled foundations, including piles and rock anchors

Soil /rock design parameters for final design and construction of drilled foundations shall be determined by pile tests, foundation tests or comprehensive soil /rock investigations as described in clause 6.1.5. The *Contractor* is fully responsible for the final foundation designs. As a guide only, "average" parameters are set out below.

i) In type '1' or type '2' soils, a skin friction with a maximum of 80kPa in a type '1' soil, and a maximum of 40kPa in a type '2' soil, may be used. The skin friction values that are used shall not exceed 80% of the ultimate friction determined from appropriate soil tests in accordance with clause 6.1.5.

ii) In soft rock, when non-shrink grout or concrete is utilised, a maximum skin friction of 135kPa may be used in all piles or anchors. A 37° frustum shall be used to check anchor group pull out resistance. The skin friction value shall not exceed 80% of the ultimate friction determined from appropriate rock tests in accordance with clause 6.1.5.

iii) In hard rock, when non-shrink grout or concrete is utilised, a maximum skin friction of 350kPa may be used in anchors with a maximum diameter of 150mm. A 45° frustum shall be used to check anchor group pullout resistance. The skin friction value shall not exceed 80% of the ultimate friction determined from appropriate rock tests in accordance with clause 6.1.5.

iv) The depth of any pile(s) in a pile group in soils, shall be so calculated to resist the uplift force on the pile or pile group. For a type '1' soil, a 30° frustum for suspension towers, and a 25° frustum for angle strain towers may be assumed. Similarly for a type '2' soil, a 20° frustum for suspension towers, and a 15° frustum for angle strain towers may be assumed. Assumed material densities to be as per clause 6.1.2.

v) No horizontal shear resistance on the piles or pile cap shall be assumed for re-compacted excavated soil. The lateral resistance of undisturbed soil shall be ignored in the top 300mm from ground line, and taken as the lesser of 100kPa or 80% of the permissible bearing determined from appropriate tests from 300mm to the bottom of the pile cap. If the pile cap is not capable of restraining the entire horizontal base shear, the piles and pile cap shall be

designed to resist the shears and moments introduced from the pile cap to the individual piles. A soil bearing pressure of 200kPa in type '1' or 100kPa in type '2' soil shall be allowed under the pile cap. End bearing components for compressive loads shall not be considered in soil replacement type piles with a diameter less than 750mm.

6.1.5 Soil and rock tests

a) In addition to the minimum soil/rock investigation requirements, tests shall be carried out by the *Contractor*, if so required by the *Project Manager*, to confirm a soil or rock type classification and shall be conducted in accordance with accepted, good geotechnical engineering practices, and shall include but not be limited to the following:

i) Standard penetration tests or Dutch Cone penetrometer tests.

ii) Visual classification of soils

iii) Determination of present and probable water table level.

iv) Laboratory and/or site tests to determine soil friction angles and cohesion values.

v) Laboratory tests to determine stress-strain modules of soils and rock.

vi) Laboratory and/or site tests to determine soil unit weights.

vii) Laboratory and/or on site tests to determine the soil texture i.e. whether the soil is predominately clay, silt, sand or gravel.

viii) Continuous rock cores with recovery values and drilling times.

The standard penetration tests and recovery of soil samples shall be obtained in each soil strata encountered or at 1.5m intervals whichever is the less. Rock cores shall extend a minimum of 3.5m into sound rock.

b) The soil/rock investigation shall be conducted to recognised standards to ensure that all encountered soil and/or rock strata are identified and delineated by area along the line route. It shall be the *Contractor*'s responsibility to perform adequate soil/rock investigations to the satisfaction of the *Supervisor* to determine the soil/rock suitability at each site.

6.1.6 Foundation systems

6.1.6.1 General

a) Before foundation excavation commences the *Contractor* shall submit to the *Project Manager*, drawings and relevant design calculations of all the proposed foundations intended for use. Acceptance by the *Project Manager* does not relieve the *Contractor* of his responsibility for the adequacy of the design, dimensions and details. The *Contractor* shall be fully responsible for his designs and their satisfactory performance in service. A registered Civil Engineer or Civil Engineering Technologist, duly authorised to do so on behalf of the *Contractor*, shall accept responsibility for all foundation designs and drawings submitted to the *Project Manager,* and shall sign all drawings accordingly. If the *Employer* provides foundation designs and/or drawings, a registered Civil Engineer or Civil Engineering Technologist, acting on behalf of the *Contractor*, shall check and assume responsibility for such designs and/or drawings. All foundation design loads are to be shown on the relevant foundation drawing.

b) No foundation shall be constructed without the *Project Manager* acceptance. All drawing revisions must be submitted to the *Project Manager* before being issued for construction purposes.

c) Only with the specific permission of the *Project Manager,* may more than one design per soil or rock type of any foundation system for a tower type be utilised.

d) The *Project Manager,* for specific applications, may consider proprietary foundation systems not covered by this specification.

e) A ground slope of up to and including 12 degrees to the horizontal in any direction shall be assumed at all foundation positions for design purposes.

6.1.6.2 Pad and pier foundations for self-supporting towers

a) The foundations shall be designed to withstand, with less than 20mm of differential settlement or displacement, the maximum foundation reactions resulting from the withstand loadings stated in the Works Information, with the dead weight of the tower included at unity factor of safety.

b) The foundations shall be designed for the maximum combinations of compression, uplift and horizontal shear forces. In addition, a 650mm maximum projection of the pier and stub above ground level shall be incorporated in the design. The stub only is to be encased in concrete; the tower steel above the diagonal members is not to be encased.

c) All concrete subjected to tension, where the permissible tensile stress is exceeded, shall be adequately reinforced with deformed reinforcing steel bars. The design shall be in accordance with the requirements of SABS 0100. The maximum permissible tensile stress in the concrete shall be 1.75mPa. Piers shall be reinforced for their full length with the reinforcing properly anchored in the pad. The minimum number of longitudinal bars provided in a pier shall be four 12mm diameter bars with a minimum yield stress of 450mPa. The links shall be 8mm diameter mild steel bars at a maximum spacing equal to the smallest lateral dimension of the section, less 100mm.

a) Pads designed with a full 45° core may be utilised. All faces of such a core where the permissible tensile stress in the concrete is exceeded are to be adequately reinforced to prevent the development of tension cracks.

d) The foundation shall be designed to resist the vertical compression load at the bottom of the foundation. The foundation shall be checked to ensure that "punch-through" of the stubs shall not occur. The maximum soil bearing pressure allowed due to the vertical compressive load, plus the mass of the foundation, less the mass of the soil displaced by the foundation, shall not exceed the values specified in clause 6.1.2 for the soil type involved.

e) In addition to the vertical compression and tension loadings, the foundations shall be designed for the overturning moment and resultant soil toe pressure due to the remaining horizontal base shears applied at the top of the foundation, including the maximum foundation projection. The lateral resistance of the backfill on the pier or stub, at any particular section of the pier or stub, shall be calculated by using an effective pressure equal to the backfill soil weight density, multiplied by the depth of that section. The maximum soil toe pressure shall not exceed the value specified in clause 6.1.2 for the soil type involved.

f) The foundation shall be designed to resist the vertical uplift load, by means of the mass of the foundation plus the nett mass of the soil frustum acting from the bottom of the foundation base. Bracing shears may be neglected in the case of suspension towers, but shall be considered in the pier design in the case of strain towers.

g) The structural steelwork shall be firmly keyed into the concrete by means of adhesion between steel and concrete and bolted-on cleats. A maximum of 50% of the maximum leg load, either in tension or compression, may be transferred from the steel stub angle to the concrete utilising a maximum bond stress of $0.8N/mm^2$, and neglecting the top 500mm of the pier. The balance of the load shall be transferred by means of bolted-on cleats. The cleats shall be so positioned on the structural steel member, so as to limit punching shear in the concrete due to both tension and compression load cases. When calculating the number and size of cleats required the maximum contact pressure between cleat and concrete shall not exceed 10mPa. The number of cleat bolts required shall be calculated in accordance with clause 7.1.12.4.

h) The least lateral dimension 'd' of a pier shall not be less than the greater of 300mm or L/6, where 'L' is the lesser of the vertical height measured from top of pad level to the top of the concrete pier, or the vertical height measured from founding level to the top of the concrete pier when a pad is not utilised. For circular pier sections, 'd' represents the diameter and for square or rectangular sections 'd' represents the length of the shortest side.

6.1.6.3 Pad and plinth foundations for guyed tower centre supports

a) The mast support foundations for guyed towers shall be designed to withstand, with less than 20mm of settlement, the maximum foundation reactions resulting from the loadings stated in the Works Information, with the dead weight of the tower included at unity factor of safety.

b) The minimum depth of the mast support foundation/s shall be 750mm in type '1' and type '2' soil, and 1000mm in type '3' and type '4' soil. The soil at the bottom of the foundation shall resist all stresses resulting from the vertical compressive loads and toe pressures due to horizontal shears. The mass of the foundation less the mass of the soil displaced by the foundation, shall be included in the vertical load applied. The maximum soil toe pressure shall not exceed the values specified in clause 6.1.2.

c) The foundations shall be designed for the maximum combinations of compression and horizontal shear forces. In addition, a 900mm projection of the plinth above ground level in the case of cross rope suspension type towers, and a 650mm projection in the case of guyed 'V' type towers, shall be incorporated in the design to allow for leg extension increments.

d) All concrete subjected to a tension where the permissible tensile stress is exceeded, shall be adequately reinforced with steel reinforcing bars in compliance with SABS 920. The design shall be in accordance with the requirements of SABS 0100.

e) Anchoring of the tower bases of guyed "V" towers shall be by means of anchor bolts. The maximum shear on anchor bolts shall be $0{,}65f_y$. If the anchor bolts must resist compression loads from the base plate, the compression load shall be resisted by mechanical anchorage, and not by adhesion between steel and concrete, unless deformed bars are utilised for anchor bolts.

6.1.6.4 Drilled foundations

The *Contractor* shall have equipment for, and personnel knowledgeable and experienced in, the evaluation and construction of this type of foundation.

a) General

i) The *Contractor* shall allow for the testing of two separate piles/anchors in each of the soil or rock conditions for which they have been designed. Pile/anchor tests as described in clause 6.1.6.4 e) below, if so required by the *Project Manager*, are to be successfully tested to the *Project Manager's* satisfaction prior to construction of cast-in-situ pile/anchor foundations.

ii) All design clauses in 6.1.3 relating to drilled concrete foundations shall apply.

iii) Piles must be designed to limit ground line vertical deflection, at maximum loadings, to less than 12mm.

iv) The minimum centre to centre spacing of any two piles in a group of piles, shall be three pile diameters of the pile with the larger diameter, unless otherwise accepted by the *Project Manager.*

v) The structural steelwork shall be firmly keyed into the concrete by means of bolted-on cleats. The adhesion between steel and concrete shall not be relied upon to transmit the load to the foundation. The cleats shall be so positioned on the structural steel member, so as to limit punching shear in the concrete due to both tension and compression load cases. When calculating the number and size of cleats required the maximum contact pressure between cleat and concrete shall not exceed 10mPa. The number of cleat bolts required shall be calculated in accordance with clause 7.1.12.4

b) Single cast-in-situ piles

Foundations utilising one cast-in-situ concrete pile will be considered by the *Project Manager* if the following criteria are met:

i) If a pile cap is not utilised, the pile shall have a minimum diameter of 350mm in order that the structural steel attachment of the tower can be accommodated without conflict with the reinforcing steel. Should a pile cap be utilised, the minimum pile diameter shall be 250mm.

ii) The pile shall be constructed vertically, and shall be designed for the maximum combinations of uplift and compression loadings, and the total horizontal base shears associated with the vertical loadings. Total shear applied at the top of the foundation, including the 650mm maximum projection above ground level, is to be included. Lateral load design bending moments shall be calculated taking into account possible plastic soil deformation. Raked piles will be accepted under special conditions only.

iii) The pile shall be designed to ensure that it acts as a rigid pile. Horizontal deflection at the top of the projected pile under ultimate loading shall be limited to 5mm.

iv) The pile shall be reinforced for its entire length, in order to resist the applied axial and bending forces, and sufficient reinforcing hoops shall be provided to support the vertical reinforcing and resist shear forces in the concrete. Reinforcing may be curtailed.

c) Multiple cast-in-situ piles

Foundations utilising multiple cast-in-situ piles of a minimum diameter of 250mm, will be considered by the *Project Manager* if the following criteria are met:

i) A minimum of two vertical piles per leg are used, connected to the structural steelwork by means of a reinforced concrete pile cap. Raked piles will be accepted under special conditions only.

ii) The piles and pile cap shall be designed for the maximum combinations of uplift and compression loadings, and the total horizontal base shears associated with the vertical loadings, including leg shear. Lateral load design bending moments shall be calculated taking into account possible plastic soil deformation.

iii) The piles shall be reinforced for their entire lengths in order to resist the applied axial and bending forces and sufficient reinforcing hoops shall be provided to support the vertical reinforcing. The reinforcement shall extend into the pile cap sufficiently, and shall be suitably anchored to ensure full utilisation of reinforcement from pile cap to pile. The pile cap shall be reinforced to withstand the shear and bending forces applied by the structural steelwork. Reinforcing may be curtailed.

iv) Allowance shall be made for all possible group effects when two or more piles, with a centre to centre spacing of less than three pile diameters, are used in a group.

d) Rock anchors

Foundations utilising grouted rock anchors will be considered by the *Project Manager* if the following criteria are met:

i) A minimum of four vertical rock anchors shall be used and connected to the structural steelwork by means of a reinforced concrete pile/anchor cap. Inclined rock anchors shall not be used without the *Project Manager's* prior acceptance.

ii) The rock anchors shall be designed to resist the full axial forces imparted by the maximum combinations of uplift and compression loadings, and additional axial loads due to the total horizontal base shear. The design shall incorporate a 650mm minimum projection of the foundation above ground level. The rock anchors shall not carry any shear load.

iii) The pile/anchor cap shall be designed to resist the total horizontal base shear. No horizontal shear resistance shall be assumed for re-compacted excavated soil. The base of the pile cap shall be extended to a minimum of 150mm below the top of sound rock over its full area irrespective of horizontal shear resistance requirements.

iv) The rock anchors shall be reinforced for their entire length in order to resist the applied axial forces and the reinforcing extends into the pile cap sufficiently and is suitably anchored to ensure full utilisation of reinforcement from pile/anchor cap to anchor. The cap shall be

reinforced to withstand the shear and bending forces applied by the structural steelwork. The rock anchor reinforcing steel shall be debonded, by a method accepted by the *Project Manager* for a length of 100mm above and 300mm below the pile cap base.

v) Rock anchors shall only be installed in hard rock, or sound competent soft rock. Proposals to utilise rock anchors in materials such as shale etc. must be specifically accepted by the *Project Manager* after a pile/anchor test, as described in clause 6.1.6.4 e) below, has been conducted. An additional test to verify that the pile cap will resist the entire horizontal base shear may also be required if so specified by the *Project Manager.* The lateral pressure on the leading face of the cap in rock, as well as the friction on the two side faces in rock, shall be the lesser of 135kPa or 80% of the permissible value determined from appropriate tests.

vi) The use of grout mixes, including proprietary mixes, must be accepted by the *Project Manager* prior to the use of such. Documented evidence of use in other similar applications, which have been accepted by a recognised authority, shall be submitted as proof of suitability. In-situ rock anchor testing shall be carried out as specified in clause 6.1.6.4 e) below.

vii) Rock anchors with diameter smaller than 85mm shall only be installed in sound competent rock where the holes have uniform diameters, straight sides and special grouts is used (epoxy or similar with 50mPa minimum strength) as approved by the *Project Manager*. In-situ rock anchor testing shall be carried out as specified in clause 6.1.6.4 e) below.

e) Cast-in-situ pile/anchor test requirements

i) Prior to construction of any cast-in-situ pile/anchor foundations, the *Contractor* shall, if so instructed by the *Project Manager*, install in each general soil or rock type encountered, and at any additional locations, a test cast-in-situ pile/anchor for the purpose of verifying the concrete/soil or grout/rock frictional resistance values. The test pile/anchor shall not be part of a final foundation.

ii) The *Contractor* shall prepare the test procedure and supply all equipment and personnel to perform the tests. All pile/anchor tests shall be conducted to failure of the pile/anchor. The pile/anchor test procedure, based on the following requirements, shall be prepared by the *Contractor* and shall be submitted to the *Project Manager* for acceptance prior to the tests.

- The test beam supports shall be placed outside the uplift influence zone of the pile/anchor to be tested and the distance from the outside of the pile/anchor (or pile/anchor group) to the test beam support shall not be less than "r".

$r = (l + c) \tan \varnothing$

where:

l = depth of pile/anchor (or pile/anchor group) with respect to the underside of the pile/anchor cap.

c = depth of pile/anchor cap excavation.

Ø = frustum angle.

- The *Project Manager* may request that the piled/anchor foundation as a whole be tested, but load tests shall generally be carried out on single piles/anchors with or without pile/anchor caps.
- The maximum design load shall be applied to the piled/anchor foundation during the test in appropriate increments to 50%, 75% and 90%, each for a minimum holding period of 5 minutes and finally, 100% for at least half an hour. Successive load increments shall not be applied and the maximum test load shall be held until the rate of movement under the acting load has stabilised at a rate of movement not exceeding 0,5mm in 5 minutes for a pile and 0,2mm in 5 minutes for an anchor.
- The piled/anchor foundation will be considered to have passed provided the total movement does not exceed 5mm during the entire test up to and including the maximum design load. The anchor foundation will be considered to have passed provided the total movement does not exceed 2mm during the entire test up to and including the maximum design load. The residual movement once all load has been removed must be recorded prior to the determination of the failure load.
- Two micrometers shall be placed on either side of the pulling rod, in order to eliminate errors due to rotation of the foundation. The datum frame supports shall also be positioned a similar distance from the test pile/anchor as the test beam supports above. The average reading of these gauges will represent the actual creep. Should this method, for any authentic reason prove impracticable, then a suitable approved alternative method may be used.

iii) Pile/anchor tests shall be conducted in the presence of the *Supervisor*. Upon completion of the pile/anchor test, the pile shall be removed by the *Contractor* for examination, and properly disposed of, or cut-off at least 600mm below ground level and backfilled, or as directed by the *Supervisor*.

iv) Pile/anchor foundations constructed by the *Contractor*, prior to acceptance by the *Project Manager* of the pile/anchor test results, will be subject to modification or replacement by the *Contractor* should the pile/anchor fail the test.

6.1.6.5 Grillage or steel plate type foundations

The *Contractor* shall have equipment for, and personnel knowledgeable and experienced in, the evaluation and installation of this type of foundations.

a) Such a type of foundation shall consist of one or more steel stubs connected to a steel grillage or plate at the base.

b) Grillage and steel plate foundation design parameters

i) The grillage or steel plate shall consist of structural steel members conforming to SABS 1431, or as otherwise accepted by the *Project Manager*, and shall be hot dipped galvanised after fabrication as per SABS 763.

ii) Steelwork for grillage or steel plate type foundations shall, after galvanising, be treated with an acceptable paint or epoxy compound. All damaged protection to the steelwork shall be repaired prior to the commencement of the backfill operation.

iii) If the grillage consists of an open grill, the spaces between the members shall not exceed the minimum plan width of any one such member. The gross area of such a grillage may be used for end bearing and uplift considerations.

iv) The grillage and plate type foundations shall be designed in accordance with similar loading conditions, settlement criteria and soil/rock design parameters, as is applicable to pad and chimney type foundations as per clauses 6.2.1, 6.1.6.1 and 6.1.6.2. If they are to be used as guy anchors, they shall, in addition to the above, satisfy the design and test requirements as per clause 6.1.6.7.

v) The grillage shall be set on a 100mm thick level bed of well-compressed fine gravel or sand to provide an even distribution of load.

vi) In grillage or plate type foundations where horizontal shear loads are not transferred by truss action to the base, special shear members, or concrete covering to the single leg stub may be required, to engage the passive lateral resistance of the adjacent compacted soil. Should such concrete encasement be required, it shall be not less than 75mm thick, and shall extend from a point 150mm above ground level down to 600mm below ground level.

vii) The depth of excavation shall be carefully trimmed to the proper level. Should the required depth of excavation be exceeded, the excavation shall be backfilled to the required level with 10mPa concrete.

viii) Grillage or steel type foundations shall not be used under conditions that indicate aggressive tendencies with respect to exposed steel.

6.1.6.6 Precast concrete type foundations

The *Contractor* shall have equipment for, and personnel knowledgeable and experience in, the evaluation and installation of this type of foundation.

a) Such type of foundation shall consist of one or more steel stubs or links connected to one or more precast concrete units.

b) Precast concrete design parameters

i) Precast concrete units used for foundation purposes shall conform to the requirements of SABS 1200GE, with ordinary steel reinforced members being designed in accordance with the relevant requirements of SABS 0100.

ii) Precast concrete type foundations shall be designed in accordance with similar loading conditions, settlement criteria and soil/rock design parameters, as is applicable to pad and pier type foundations as per clauses 6.2.1, 6.1.6.1 and 6.1.6.2. If they are to be used as guy anchors, they shall in addition to the aforementioned satisfy the design and test requirements as per clause 6.1.6.7.

iii) The precast unit or units shall be set on a 100mm thick level bed of well-compressed fine gravel or sand to provide an even distribution of load.

iv) The depth of excavation shall be carefully trimmed to the proper level. Should the required depth of excavation be exceeded, the excavation shall be backfilled to the required level with 10mPa concrete.

6.1.6.7 Guy anchors

a) General

i) The *Contractor* shall be responsible for the type of anchors chosen and the design thereof. Anchors requiring or relying on post tensioning will not be allowed. The design of guy anchors shall be subject to the *Project Manager* acceptance.

ii) Unless otherwise specified, the anchors shall be capable of resisting a tension as stated in the enquiry/contract documents, and also satisfy the test requirements as described in clause 6.1.6.7 b) below.

iii) Owing to the dissimilarities in anchor performance and conventional foundation performance in uplift conditions, the *Contractor* shall exercise extreme caution in utilising soil / rock parameters stated in clause 6.1.2 for the design of anchors. Full-scale load tests shall be utilised to determine actual soil holding capacities of anchor designs. The depth of dead man type anchors shall be determined with respect to the dead man and not the attachment point.

iv) Concrete anchors shall meet the requirements stated in clause 6.1.7.

v) Steelwork of the guy anchors shall be so selected by the *Contractor* to have the following minimum properties:

All ferrous material representing the final product shall have a minimum Charpy V-notch impact energy of 20 joules at 25°C and a minimum impact energy of 8 joules at -10°C. Ductility of all ferrous material at room temperature shall be sufficient to provide a minimum elongation in a 50mm gauge length, including the fracture, of 18%. Grade 300 WA steel which, when tested, meets the above requirements may be accepted at the *Project Manager's* discretion.

vi) Guy anchors shall be installed in such a manner that the legs of the U-bolt are in the vertical plane.

vii) The total anchor assembly (link plus reinforcing steel) for single in line drilled anchors less than 250mm in diameter shall be hot dip galvanised. The entire link assembly for single in line drilled anchors greater or equal to 250mm in diameter shall be hot dip galvanised. All galvanising shall be in accordance with SABS 763 with a minimum coating weight of 600 grams/m^2. Ultimate permissible anchorage bond stresses shall be reduced by 30% to allow for the galvanising.

viii) For single in line-drilled anchors less than 250mm in diameter, the top 1 000mm of the soil/rock profile at least shall be ignored for anchorage purposes. For single in line drilled anchors greater or equal to 250mm in diameter, the top 500mm of the soil/rock profile at least shall be ignored for anchorage purposes.

b) Cast-in-situ anchor foundation test requirements

i) Prior to the installation of any cast-in-situ anchor foundations, the *Contractor* shall, if so instructed by the *Project Manager*, install in each general soil type encountered and at any additional locations, a test cast-in-situ anchor for the purpose of verifying the concrete/soil frictional resistance values.

ii) The test anchor shall not be part of a final foundation.

iii) The *Contractor* shall prepare the test procedure, and supply all equipment and personnel to perform the test. The anchor test procedure, based on the following requirements, shall be submitted to the *Project Manager* for acceptance prior to the test.

- The test beam supports shall be placed outside the uplift influence zone of the foundation to be tested and the distance from the outside of the anchor foundation to the test beam support shall not be less than "r".

  r = l tan Ø

  where:

  l = depth of anchor (or anchor group)

  Ø = frustum angle.

- The maximum design load shall be applied to the anchor foundation during the test in appropriate increments to 50%, 75% and 90%, each for a minimum holding period of 5 minutes and finally, 100% for at least half an hour. Successive load increments shall not be applied and the maximum test load shall be held until the rate of movement under the acting load has stabilised at a rate of movement not exceeding 2,5mm in 5 minutes. The maximum test load shall also be held until the rate of movement under the applied load has stabilised at a rate of movement not exceeding 2,5mm in 5 minutes. The foundation will be considered to have passed provided the total movement does not exceed 50mm during the entire test period. The residual movement, once all load has been removed, must be recorded at the end of the test.

iv) Anchor tests shall be conducted in the presence of the *Supervisor.*

v) Anchor foundations installed prior to acceptance by the *Project Manager* of the anchor test results, will be subject to modification or replacement by the *Contractor* should the anchor fail the test.

6.1.6.8 Foundations for concrete or steel poles

a) General

i) The *Contractor* shall be responsible for the design of all foundations for pole structures.

ii) The foundations shall be designed to withstand the maximum combinations of induced factored moment, compression and torsion. The dead weight of the pole shall be included at unity factor of safety.

iii) All foundation designs are to be accepted by the *Project Manager* prior to the utilisation of any such design for pole installation purposes.

b) Testing

i) Prior to the construction of any pole foundations, the *Contractor* shall, if instructed by the *Project Manager* install in each general soil type encountered and at any additional locations, test poles for the purpose of carrying out full scale load tests to determine the moment carrying capacity in each soil type.

ii) The test pole and foundation shall not be part of a final foundation.

iii) The *Contractor* shall prepare the test procedure, and supply all equipment and personnel to perform the tests. The tests shall be conducted in the presence of the *Supervisor.*

iv) The pole foundation shall be capable of withstanding the full design moment for 5 minutes with a displacement at ground level of less than 5mm.

v) The test shall be continued to failure of either the pole or the foundation i.e. either a creep rate greater than or equal to 2mm per minute of the pole measured at ground level, or a pole tip deflection greater than or equal to 10° with respect to the original point of intersection of the pole with the ground.

vi) Upon completion of the test, the pole shall be either removed or broken down to at least 600mm below ground level and properly disposed of.

6.1.7 Concrete and grouts

6.1.7.1 General

a) Concrete foundations shall be designed based upon a concrete strength of 25mPa at 28 days.

b) Concrete mix designs shall be proportioned to obtain a minimum required strength of 25mPa at 28 days, and a target strength of 35mpa, with a maximum water cement ratio of 0,59. No individual 28 day concrete test cube result shall fall below 85% of the specified strength. In the absence of any previous statistical data, the mix designs shall be proportioned to attain a characteristic strength of 33mpa at 28 days. Notwithstanding the above requirements, the minimum cement content shall be 340 kg/m^3.

c) Grout mix designs for rock anchors shall be proportioned to attain a minimum strength of 35mPa at 28 days with any expansive additives included. The use of epoxy grouts is to be used only with the *Project Manager's* approval.

d) Water shall be clean and free from all earthy, vegetable or organic matter, acids or alkaline substances in solution or suspension.

6.1.7.2 Cement types

a) Concrete shall be batched utilising common cement types manufactured in accordance with SABS ENV 197-1

b) The minimum cement class used in concrete will be class 32.5

c) CEM I - Class 52.5 and accelerating admixtures shall not normally be utilised for concrete batching. Their use will only be considered by the *Project Manager* in unusual circumstances, in order to expedite tower erection to facilitate conductor stringing. The *Contractor* shall make test cubes and arrange for their testing, to confirm the concrete strength, and obtain acceptance from the *Supervisor* before proceeding with other activities.

d) Site blending will be acceptable provided the following criteria is met:

i) Proportion of Portland Cement and Extenders are within industry norms (i.e. 50% replacement for slag and 30% replacement for Fly Ash).

ii) The cementatious materials can be weighted into the mix with an accuracy of 2% or better. In special cases the *Project Manager* may require that the replacement value indicated in **i)** above be increased.

e) The cement utilised for grout mixes shall be of a "non-shrink" type. Any shrinkage-compensating admixture shall only be used with the *Project Manager*'s acceptance.

f) Cement extenders used must comply to the following SABS specifications:

- Ground granulated blastfurnace slag (slag) – SABS 1491-1
- Fly Ash (FA) SABS 1491-2
- Condense silica fume SABS 1491-3

g) In aggressive environments where concrete is subject to chemical attack, extenders must be considered to improve resistance to chemical attack (refer to SABS 0100 –2).

6.1.7.3 Aggregates

a) Fine and coarse aggregate shall be obtained from sources accepted by the *Project Manager* and shall be assessed in accordance with SABS 1083.

b) Fine aggregate shall be natural sand or other accepted inert material with similar characteristics, composed of clean, hard, strong, durable, uncoated particles. Fine aggregates shall be free from deleterious amounts of soft, flaky or porous particles, loam, soft shale, clay lumps or organic material.

c) Fine aggregates shall be selected from local sources to provide a reasonably uniform grading of the various size fractions. Fine aggregates having a large deficiency or excess of any size fraction, shall be avoided to the extent practicable.

d) Coarse aggregate shall consist of crushed stone, gravel or other accepted inert material of similar characteristics having hard, strong, durable, uncoated pieces free from deleterious substances.

e) Coarse aggregates up to 26,5mm nominal size, may be single-sized stone. Coarse aggregates up to 40mm nominal size, shall be blended consisting of two parts by volume of single-sized 40mm stone to one part by volume of single-sized 20mm stone. The content of fine material (less than 4,75mm) in coarse aggregate shall be less than 10% by mass.

f) The void content of fine or coarse aggregate shall not exceed 48%. Aggregate shall not contain any materials that are reactive with any alkali in the aggregate itself or in the cement, the mixing water or in water in contact with the finished concrete or grout in amounts sufficient to cause excessive localised or general expansion of the concrete or grout.

Notwithstanding the limits on chlorides as per SABS 1083 (BS 882), the acid soluble chloride as NaCl level in aggregate as a percentage by mass shall not exceed the limits given in the following table:

CONCRETE TYPE	COARSE AGGREGATE	FINE AGGREGATE
Reinforced with OPC	0.05%	0.10%
Reinforced with SRPC	0.02%	0.05%

Note: These limits shall be subject to the overall limit for the concrete as mixed.

h) The maximum nominal aggregate size for concrete batching shall be as follows:

- unreinforced concrete: 37,5mm
- reinforced concrete excluding piles: 26,5mm
- piles: 19mm
- grout: 10mm

6.1.7.4 Workability

a) Concrete mix designs and batching shall be conducted in a manner to achieve adequate workability, to ensure that the concrete will be dense, without voids of honeycomb.

b) The design mix workability of the concrete, as determined by the “Slump Test”, shall meet the following requirements by application:

- unreinforced concrete: 25mm – 75mm
- reinforced concrete for conventional foundations and pile caps: 50mm – 100mm
- reinforced concrete for cast in-situ piles: 100mm – 150mm
- reinforced concrete for cast in-situ inclined piles/anchors: 150mm – 200mm

c) The consistency of grout mixtures shall be proportioned so that the mixture is pourable. The fine aggregate to cement ratio shall not exceed 3:1 irrespective of workability.

d) Any admixtures proposed by the *Contractor* shall be subject to the *Project Manager's* acceptance.

6.1.8 Reinforcing steel

a) All main reinforcing steel shall conform to SABS 920 Type C, Class 2, Grade II hot rolled deformed bars with a minimum yield stress of 450mPa. The minimum bar size utilised shall be 10mm.

b) All secondary reinforcing for stirrups, hoops and spirals, shall as a minimum conform to SABS 920 Type "A" hot rolled bars of plain cross-section of mild steel with a minimum yield stress of 250mPa.

c) At the *Contractor*'s option or as required by design, Type B or Type C reinforcing steel may be utilised. The minimum bar sizes utilised shall be at least 0,25 times the largest main reinforcing bar, or 0,01 times the average of the cross-sectional dimensions of the concrete with a minimum diameter of 6mm allowed.

6.2 Construction

6.2.1 Soil and rock type nomination

a) The *Contractor* shall be responsible for ensuring that the subsoil at each foundation location is suitable to withstand the design loading which will be imposed upon it by the foundation, and shall be responsible for any subsidence or failure of foundations due to insufficient care having been taken in the examination of the soil, the likely influence of other naturally occurring factors in the immediate and surrounding area of the tower, and the construction of the foundations. The acceptance by the *Supervisor* of foundation installations shall not relieve the *Contractor* of this responsibility.

b) The *Contractor* shall be responsible for the adoption of an acceptable method of soil/rock investigation in the presence of the *Supervisor*, and he shall delegate this work to a competent member or members of his staff who have suitable related qualifications and experience. Unless otherwise indicated in the Works Information, the minimum soil investigation requirement shall be the excavation of a test pit next to each foundation position, to allow for the in-situ inspection of the soil and the assessment thereof. The test pits shall be excavated outside the zone of influence of the appropriate foundation, and shall be taken down to a depth equal to the lesser of the depth of the foundation system to be constructed or 3m. In addition, appropriate soils tests as described in clause 6.1.5 shall be carried out where further clarification is required for the correct identification of a soil category. The soil type foundation nominations based on the aforementioned procedures shall take place well in advance of actual foundation installation, so as not to disrupt construction activities, and to allow for the possibility of having to conduct laboratory tests on suspect soils and/or rocks.

c) Due to the fact that combinations of two or more of the soil or rock classifications as described in clause 6.1.1 could occur at any one foundation position, including rock boulders in a soil matrix, the soil or rock nomination in terms of one of the six classifications in clause 6.1.1 shall then be conservatively based on the load transfer capability in terms of clause 6.1.2 of the soil and/or rock encountered over the depth of influence of the approved foundation system.

For example, a combination of a type '1' soil and soft rock over the depth of influence of an approved type '1' soil foundation design shall be nominated as a type '1' soil condition, and the approved type '1' soil foundation system installed. By following this procedure, the soil or rock nomination at each foundation position must be one of the six classifications as described in clause 6.1.1 and this shall in turn define which system design is to be installed

d) The test pit shall be suitably backfilled immediately after the relevant inspections and tests have been completed.

e) Where site conditions, such as difficult access or environmentally sensitive areas, etc. preclude the excavation of a test pit, alternative soils identification procedures shall be proposed by the *Contractor* and acceptance obtained from the *Supervisor.* Should the foundation conditions at the actual foundation location be found to differ from those identified at the corresponding test pit, the *Contractor* shall immediately inform the *Supervisor* and a revised assessment made. The acceptance by the *Supervisor* of the soil type foundation nomination shall not relieve the *Contractor* of this responsibility.

6.2.2 Excavation

a) At each tower or pole position, the *Contractor* shall excavate, construct the appropriate foundation and backfill the excavation as required. Excavation in this instance shall be the removal of soil/rock by any accepted means for the purpose of constructing a particular foundation system, including conventional pad and pier type foundations, spread footings, piles, anchors, grillages, etc.

b) No excavation work, other than for soil investigation, shall be commenced on a section of line until the following conditions have been met:

i) The *Contractor* has submitted a schedule of tower leg ground levels and proposed leg extension lengths to the *Project Manager.*

ii) The *Contractor* has submitted the proposed foundation and soil type schedule to the *Project Manager.*

iii) If drilled cast-in-situ piles or rock anchors are proposed, soil samples and pile/anchor tests have been conducted, if so instructed by the *Project Manager.*

c) Excavations shall be made to the full dimensions required, and shall be finished to the prescribed lines and levels. The bottom or sides of excavations upon or against which concrete is to be poured shall be undisturbed. If, at any point in excavation, the natural material is disturbed or loosened, it shall be filled with 10mPa concrete, including the application of a blinding layer at the base of foundations where these eventualities are likely to occur during the construction process. Soil backfilling will not be accepted.

d) In soil which is incapable of withstanding the design loads which will be imposed upon it by a pad and pier type of foundation, the *Contractor* shall propose a method of increasing the effective bearing area of the foundation. This may entail the installation of a foundation with a larger pad, or other suitable solutions proposed by the *Contractor*. Any such proposal shall be submitted to the *Project Manager* for acceptance prior to excavation.

e) When the material at foundation depth is found to be partly rock or incompressible material, and partly a soil or material that is compressible, all compressible material shall be removed for an additional depth of 200mm and filled with 10mPa concrete.

f) The excavations shall be protected so as to maintain a clean subgrade until the foundation is placed. Any water, sand, mud, silt or other objectionable material which may accumulate in the excavation including the bottom of pile or anchor holes, shall be removed prior to concrete placement.

g) Excavations for cast-in-situ concrete, including pile caps cast against earth, shall be concreted within seventy-two hours after beginning the excavations. In addition to this general requirement, pile and/or anchor holes that are not adequately protected against the elements to the satisfaction of the *Supervisor*, shall be cast on the same day that drilling/excavation has taken place. Excavations that remain unconcreted longer than seventy-two hours may, at the option of the *Supervisor*, be required to be enlarged by 150mm in all dimensions.

h) The excavations shall be kept covered or barricaded in a manner accepted by the *Supervisor* to prevent injury to people or livestock. Failure to maintain proper protection of excavations may result in the suspension of excavation work until proper protection has been restored.

i) The *Contractor* is to notify the *Supervisor* upon completion of the excavation for the foundations. No concrete is to be placed until the excavation, shuttering and reinforcing steel has been inspected and accepted in writing by the *Supervisor.*

6.2.3 Backfilling

a) After completion of foundation construction, the *Contractor* shall backfill each excavation with suitable material. The *Supervisor* shall accept the materials used for backfill, the amounts used and the manner of depositing and compaction of the materials.

b) The material to be utilised for compacted backfill shall be deposited in horizontal layers, having a thickness of not more than 300mm before being compacted. In backfilling, the pad of the foundation shall be covered, first with a 200mm layer of well-graded material containing no pieces larger than 20mm, before any coarse material is deposited.

The material to be compacted shall contain no stones more than 150mm in diameter, and be free from organic material such as trees, brush, scraps, etc.

c) The distribution of materials shall be such that the compacted material will be homogenous to secure the best practicable degree of compaction, impermeability and stability.

d) Prior to and during compaction operations, the backfill materials shall have the optimum moisture content required for the purpose of compaction, impermeability and stability.

e) The material shall be mechanically compacted to a minimum of 90% of the density of the undisturbed material.

f) The surface of the backfill around the foundation shall be carried to such an elevation that water will not accumulate.

g) Material removed from the excavation, which is either not suitable or not required for backfill, shall be spread evenly over or adjacent to the site, or be disposed of as directed by the *Supervisor*. Spreading of subsoil in agricultural areas will not be allowed. Excavated soil suitable for backfill will be returned to the excavation by backfilling with the subsoil first and the top soil last.

h) Where the excavated material is considered to be unsuitable for backfill, such as a material with a high clay content or a sandy material with little variation in particle size, the *Contractor* shall propose a suitable method of soil improvement for consideration and acceptance by the *Supervisor* prior to being implemented. The properties of the soil may be improved by the addition of stabilising agents such as Portland cement in the case of sandy soils and slaked lime in the case of clayey soils. Backfill material stabilised in this way shall be mixed in the ratio of one part cement or lime per ten parts of soil. This material shall be properly mixed, moistened, placed and compacted in the same manner as excavated material.

6.2.4 Concrete foundations

6.2.4.1 Supply of materials

The *Contractor* shall supply all concrete and concrete materials required for construction, including aggregates, cement, water, admixtures (if any), shuttering, reinforcing steel, all embedded steel components and materials for curing concrete.

6.2.4.2 Prior acceptance

a) Well in advance of construction, the *Contractor* shall select the location of aggregate sources for concrete, and obtain representative samples of all aggregates. A representative sample shall consist of a blend of twelve separate samples from each aggregate stockpile. The representative samples shall be divided into two portions, one set of which shall be examined and accepted by the *Supervisor* and maintained on site during concreting operations. The second set which shall be delivered by the *Contractor* to the Portland Cement Institute, or other laboratory accepted by the *Project Manager*, for examination of suitability of the aggregate in accordance with SABS 1083 and preparation of concrete trial mi x design in accordance with the requirements of clause 6.1.7. Prior to any concrete placement the *Contractor* shall submit the trial mix designs and results of seven and twenty-eight day test cube strengths to the *Project Manager* for acceptance.

b) If ready-mixed concrete is to be used, the *Contractor* shall obtain, from the ready-mix supplier, aggregate test reports and mix designs that satisfy the requirements of clause 6.1.7 and test cube strength reports of all mix designs and submit to the *Project Manager* for acceptance prior to placement of any concrete. A ready-mix concrete supplier that does not have SABS 979 recognition shall only be used with the *Project Manager's* acceptance, and thereafter only after satisfying the above requirements.

6.2.4.3 Tolerances for concrete construction

The intent of this paragraph is to establish tolerances that are consistent with construction practice, and the effect that permissible deviations will have upon the structural action or operational function of the structure. Where tolerances are not stated for any individual structure or feature, permissible deviations will be interpreted in conformity with the provisions of this paragraph. The *Contractor* shall be responsible for setting out and maintaining concrete excavations, shuttering and structural steelwork within the tolerance limits so as to ensure completed work within the specified tolerances. Concrete work, that exceeds the tolerance limits specified shall be remedied, or removed and replaced.

a) Variation in structure location

- Transverse to centre-line: less than 50mm
- Longitudinal displacement: less than 300mm

b) Variation in relative vertical elevation of structural steelwork (one leg to another)

- less than 5mm

c) Variation in horizontal distance between structural steelwork from that computed

- Adjacent legs: less than 5mm
- Diagonal legs: less than 7mm

d) Rotation - maximum deviation of transverse axis of structure from bisector of interior line angle

- less than 0º 12'

e) Elevation - variation of tower base from centre-line peg

- minus 150mm
- plus 1 000mm

f) Height of concrete foundations above ground level

- min. 150mm
- max. - per design

g) Variation in relative placement of foundation components from those indicated on drawings, including piles, shuttering, structural steelwork

- less than 50mm

h) Tolerances for placing reinforcing steel

- Variation of protective cover: 5mm
- Variation from indicated spacing: 25mm

i) Tolerances for guy anchors

Guy anchors shall be installed such that the attachment point of the a nchor is within 250mm of the correct calculated position. The attachment point shall be a minimum of 150mm and a maximum of 650mm above the ground level.

Guy anchors designed for use with anchor rods extending below ground level shall have the anchor rod installed in line with the guy wire slope, within 5% or such lesser tolerance as required by design.

j) Tolerances for pole foundations

Pole foundations shall be constructed such that the pole, and the associated foundation works are within 50mm of the correct calculated position.

6.2.4.4 Workmanship

Concrete shall be proportioned, mixed, placed and finished in such a manner as to be free of honeycomb, segregation and other defects of workmanship.

6.2.4.5 Formwork

a) Forms shall be of wood, metal or other suitable material.

b) The forms shall be mortar-tight and shall be designed, constructed, braced and maintained such that the finished concrete will be to true line and elevation, and will conform to the required dimensions and contours. They shall be designed to withstand the pressure of concrete, the effect of vibration as the concrete is being placed and all loads incidental to the construction operations without distortion or displacement.

c) Where the bottom of the form is inaccessible, provision shall be made for cleaning out extraneous material immediately before placing the concrete.

d) All exposed corners of the concrete shall be chamfered approximately 20mm. A suitable nosing tool may be used for horizontal chamfers only if approved by the *Supervisor.* All form work dimensions shall be checked, and if necessary, corrected before any concrete is placed.

e) All forms shall be treated with a form-release agent accepted by the *Supervisor* before concrete is placed. Any material, which will adhere to, discolour or be deleterious to the concrete, shall not be used.

6.2.4.6 Proportioning of concrete

a) The concrete mix shall consist of ordinary Portland cement, fine aggregate, coarse aggregate and water proportioned in accordance with the mix design accepted by *Project Manager*. Adjustments in these proportions may be directed at any time when found necessary as a result of field tests of the concrete. No change in proportioning shall be made unless instructed by the *Supervisor*. As an alternative to the use of ordinary Portland cement, the *Project Manager* may consider the use of other approved types of cement or blends thereof.

b) No change in the source, character or gradation of materials shall be made without notice to the *Supervisor* and without a revised proportioning mix design being prepared and accepted by the *Project Manager* prior to use of the materials.

c) During the concrete operations, the concrete mixture shall be tested for each batch by the *Contractor* to determine the slump of the fresh concrete in accordance with SABS Method 862. Records of slump tests shall be supplied to the *Supervisor*.

d) Test cubes shall be prepared, in accordance with SABS Method 863 at the initiation of concrete placement of each mix design and every day that concrete is batched thereafter. Test cubes

shall only be made out of a concrete batch at the point of discharge. If the *Contractor* does not make use of independent facilities for the crushing of test cubes and the reporting there-on, then suitable on-site facilities for the crushing of test cubes must be provided by the *Contractor*, and the Supervisor shall witness such tests.

Additional test cube sets shall be prepared and crushed as directed by the *Supervisor.* Each set of test cubes shall consist of four cubes.

One to be crushed at seven days, two to be crushed at twenty eight days and one to be held as a spare in the event of a suspect result from one of the other three cubes. The written results of the test cube strength tests shall be immediately forwarded to the *Supervisor* upon receipt.

e) All cement shall be batched by mass. Cement shall be measured to within 2% accuracy.

f) Aggregates may be batched by mass or by volume, provided that volumetric batching equipment is calibrated at the start of concrete operations by weighing a typical discharge. The quantities of aggregate batched shall be measured within 3% accuracy. Adjustments of fine aggregate volumes due to "bulking" shall be accounted for in batching.

g) The amount of moisture in the aggregates shall be determined daily by a method accepted by the *Supervisor*, and the water requirements as per the mix design altered accordingly.

h) Water quantities, including aggregate moisture allowances, shall be determined within 2% accuracy. The use of water meters for dispensing water shall be subject to the *Supervisor's* acceptance.

6.2.4.7 Mixing of concrete

a) Concrete shall be mixed sufficiently to ensure that the various sizes of aggregate are uniformly distributed throughout the mass, and each particle of aggregate is adequately coated with cement paste of uniform consistency. Concrete delivered to site that lacks homogeneity should be mixed for a longer time or discarded, as directed by the *Supervisor.*

b) For mixers of one cubic metre or less, the mixing time shall be not less than ninety seconds after all ingredients have been charged in the mixer. For mixers of larger capacities, minimum-mixing times shall be increased by fifteen seconds for each additional half cubic metre of mixer capacity, or fraction thereof.

c) Concrete delivered to the job site shall be mixed en-route. Mixing shall be rigorously controlled for agitating time, mixing time and overall time upon arrival at the foundation site. Concrete discharge shall be completed within one and one-half hours after introduction of the water to the cement and aggregate.

d) In exceptional cases only, the *Contractor* may at his own risk add water to a concrete mix at the point of delivery. The maximum amount of water that may be added at site is three litres per cubic metre of concrete. At no time shall the water:cement ratio of 0.59 be increased.

e) Non-shrink grout shall be mixed in a suitable mechanical grout mixer/pump accepted by the *Supervisor.*

6.2.4.8 Placement of reinforcing steel

a) After acceptance of the excavation by the *Supervisor*, the *Contractor* shall install all the reinforcing steel required for foundations. Reinforcing steel shall be fabricated and bent in strict accordance with the drawings and SABS 82.

b) Reinforcing steel, before being positioned, shall be thoroughly cleaned of mill scale and any coatings that will destroy or reduce bond.

c) Reinforcing steel shall be accurately positioned and secured against displacement during placing and vibrating of concrete. Reinforcing bars shall be tied at all intersections with no less than No.18 gauge annealed wire. Reinforcing bars shall be lapped forty-five diameters at all splices, unless shown otherwise on the drawings. Reinforcing steel shall be provided and placed as detailed on the drawings. Unless otherwise shown on the drawings, the minimum cover to the main reinforcing bars in a slab, pile cap, chimney, pile or anchor, shall be 50mm. Use of suitable accepted spacers or supports shall be made, to ensure that the minimum concrete cover to the reinforcement is maintained during the placement of concrete.

6.2.4.9 Placement of embedded items

a) The *Contractor* shall install all required embedded items shown on the drawings, prior to placing of concrete. Structural steelwork or holding down bolts shall be accurately positioned and securely held in place during the placement of concrete. The minimum cover to all embedded items, but excluding angle stubs, shall be 150mm. The minimum cover to angle stubs and cleats shall be 75mm unless otherwise shown on the drawings.

b) Angle stubs may be supported on the bottom of excavations by either precast concrete slabs set at the correct level by placing suitable grout or concrete underneath it, or on a previously placed binding layer installed up to the correct level. The precast slab shall be square in plan with a side dimension of 300mm, and a depth of 75mm, and shall be constructed using reinforced concrete with a minimum characteristic strength of 25mPa. The placing of loose rubble, stones, bricks, etc. under the precast slab will not be acceptable.

c) Structural steelwork or anchor bolts shall be embedded such that the top of the concrete of the foundation correctly coincides with the designed level.

d) Earthing requirements are to be as per the latest revision of specification “TRMASAAJ7 – Earthing of Transmission Lines”.

6.2.4.10 Placement of concrete

a) No concrete for foundations shall be placed until each foundation has been inspected and accepted by the *Supervisor.* The foundation at the time of this inspection shall be ready for concrete placement including reinforcing steel, embedded items and any necessary shuttering.

b) All surfaces of the foundation upon or against which concrete is to be placed shall be free from mud and/or loose or disturbed material. A blinding layer of 10mpa concrete not less than 50mm thick is to be installed on all bottom surfaces of a type ‘3’ or type ‘4’ foundations.

c) The surfaces of dry absorptive materials, against which concrete is to be placed, shall be moistened prior to the placing of concrete to prevent moisture being drawn from the fresh concrete.

d) At least two suitable concrete vibrators shall be ready for operation at the site prior to placement of concrete.

e) Freshly mixed concrete shall be handled, transported and deposited in such a manner as to prevent segregation or loss of material. When discharging by chute, the slope of the chute shall be uniform throughout its length and shall not be flatter than 1 in 3 or steeper than 1 in 2. Baffles shall be provided at the end of the chute to ensure a vertical discharge into the foundation. The maximum discharge height shall be three metres, and for heights in excess of this, a tremie pipe shall be used.

f) Placement of concrete shall not commence when the air temperature is below 2°C and rising, or below 5°C and dropping.

g) The temperature of the concrete mixture immediately before placement shall not exceed 32°C. Concrete exceeding this temperature shall be discarded. During hot weather concreting operations, the *Contractor* shall take the temperature of each batch of concrete.

h) No concrete shall be placed which has taken its initial set, regardless of whether the specified one and one-half hour period has elapsed or not. If a retarder, accepted by the *Project Manager*, has been used, the one and one-half hour period may be exceeded provided the concrete has not taken its initial set. The *Contractor* must dispose of waste concrete in a place acceptable to the *Supervisor.*

i) If concrete must be placed under water, a suitable watertight tremie, accepted by the *Supervisor*, of sufficient length to reach the bottom of the excavation shall be used. The tremie shall be free of water when filled with concrete to the bottom of the excavation. The tremie shall be kept full of concrete during the entire placing operation. The discharge end of the tremie must not be lifted out of the freshly placed mass of concrete until placement has been completed.

j) Concrete shall be thoroughly settled and compacted into a dense homogeneous mass throughout the whole depth of each layer being consolidated, using internal vibrators. Excessive vibration, causing segregation, is to be avoided. Concrete vibrators shall not be used to move concrete.

k) The concrete in cast-in-situ piles must be vibrated from the bottom upwards.

l) Unless authorised by the *Supervisor*, the *Contractor* shall not place concrete, unless the *Supervisor* is present during the entire placement operation.

m) When alternative foundations consisting of multiple cast-in-situ piles and pile caps are utilised, the *Contractor* shall at approximately one tower in twenty, open up on two sides of the completed foundation of one leg, the pile cap and top 500mm of the piles, if so instructed by the *Supervisor.* If the foundation is rejected for any reason, the *Contractor* shall open up as many additional foundations as determined by the *Supervisor*, as is necessary to fully assess the problem. Foundations accepted are to be backfilled using 10mPa concrete up to a level at least 150mm above the base of the pile cap.

6.2.4.11 Construction joints

a) In general, foundations shall be placed monolithically. Construction joints are to be avoided. If construction joints cannot be avoided and are accepted by the *Supervisor*, the *Contractor* may be permitted to make a construction joint if the following criteria are met:

i) The concrete is reinforced and the reinforcing steel will develop full bond strength both sides of the construction joint. No construction joints will be allowed in unreinforced concrete.

ii) In single cast-in-situ piles, the construction joint is located one third the depth of the excavation, ±300mm and at least 150mm below the bottom of the structural steelwork or anchor bolts.

iii) In multiple cast-in-situ piles, the construction joint is to be 75mm, and in rock anchors 100mm, above either the base of the pile cap excavation or the top of blinding level. If the piles are constructed after the excavation for the pile cap has taken place, suitable ring shutters of the same diameter of the piles shall be used to construct the above mentioned pile/anchor projections.

b) No construction joints will be allowed in pile caps.

c) At all construction joints, the surfaces of the previously placed and hardened concrete shall be thoroughly cleaned of all foreign matter, and primed with a 15mm thick layer of a wet mix of cement and sand in equal proportions, in the presence of the *Supervisor* before new concrete is placed. The grout coating shall be brushed over the concrete surface to ensure thorough coverage, particularly between the reinforcing bars. The new concrete shall be placed before the grout coating has taken its initial set.

6.2.4.12 Concrete finish

a) The top surface of the foundation shall be at least a wood float finish, and shall be contoured to shed water.

b) All concrete placed against shuttering shall be free from irregularities, fins, rock pockets or other imperfections. Any rock pockets, porous or defective concrete shall be removed to the extent instructed by the *Supervisor* and repaired by filling with concrete, cement mortar or dry packed, as instructed by the *Supervisor.*

c) All exposed concrete shall be shuttered to a minimum of 150mm below ground level.

6.2.4.13 Concrete curing

a) The *Contractor* shall provide means of maintaining concrete in a moist condition for at least seven days after the placement of concrete. Exposed surfaces shall be kept thoroughly wet 24 hours a day for this period.

b) At the *Contractor*'s option, concrete may be cured either by retaining shuttering in place and applying a liquid curing compound which forms a moisture retaining membrane on unshuttered concrete surface, or by removing shuttering and applying a curing compound as described to all exposed concrete surfaces. Curing compounds utilised shall be of a type accepted by the *Project Manager*. Notwithstanding these requirements, formwork shall not be removed until at least 36 hours after the final placement of the concrete against such formwork. The *Contractor* shall remove formwork in such a way that shock and damage to the concrete is avoided.

6.2.4.14 Steelwork

a) All galvanised structural steel at the steel/concrete interface shall be cleaned with a suitable cleaner before painting with two protective coats of paint acceptable to *Project Manager*. This protection shall extend 500mm above and 400mm below the top surface level of the protruding foundation blocks.

b) In the case of concrete foundations, no part of the structural steelwork of the tower shall be buried or come into contact with the soil.

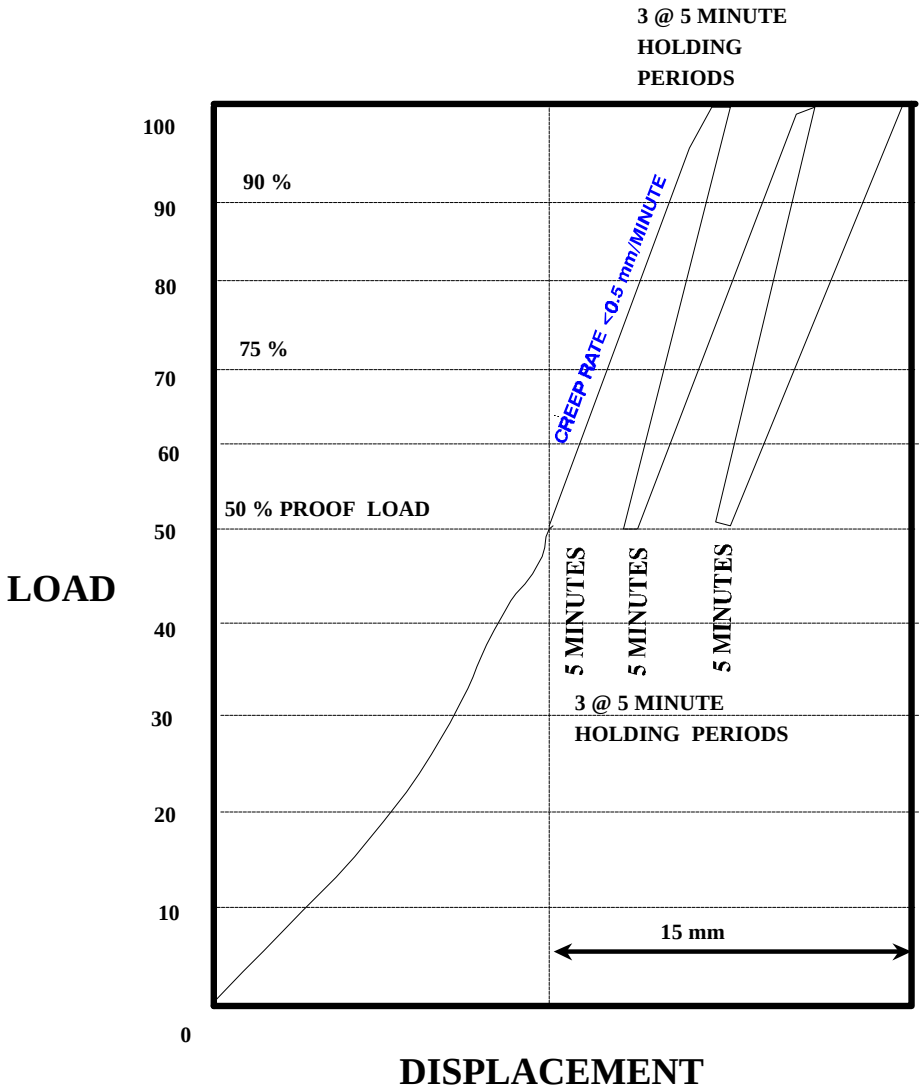
c) Anchors utilising steel extending below ground line shall be galvanised and then painted with two coats of an accepted bitumastic paint, or be encased in concrete with at least 50mm cover. In addition to this requirement, the hot dip galvanised steel guy anchor link plate or bar utilised for the deadman type of anchor foundation, shall be epoxy coated from 300mm below top of concrete level to the top end of the link above ground level. Apply in accordance with the manufacturer's specifications one coat of galvanising epoxy primer followed by one coat of aluminium filled epoxy paint.

6.2.5 Construction proof load tests

6.2.5.1 Guy anchors

a) The *Contractor* shall provide equipment on site, during the installation of the guy anchors, capable of loading the anchor to a load equal to the unfactored foundation reaction for critical loading conditions.

b) Where instructed by the *Supervisor*, the *Contractor* shall apply a construction proof load test equal to the unfactored foundation reaction for critical loading conditions to the completed anchors. The method of the load application shall be subject to the *Project Manager's* acceptance. All anchor tests shall be conducted in the presence of the *Supervisor.*



100 % Proof load = unfactored foundation reaction for critical loading condition

c) The load shall be applied to the anchor in appropriate increments to 50%, 75%, 90% and 100% of the proof test load, and then unloaded to 50% and again loaded to 100% of the proof test load, twice, i.e. during two further cycles of loading. The *Contractor* shall monitor anchor movement along the guy slope. Successive load increments shall not be applied until the rate of creep is less than or equal to 0,5mm/minute. The three cycles of loading from 50% to 100% shall each be of duration of not less than 5 minutes. The anchor shall be considered acceptable if the total creep from 50% to 100% load over 3 cycles is less than 15mm. If the

creep exceeds 15mm, the anchor shall be modified or replaced by the and re-tested.

a) *Contractor* shall provide equipment on site during the construction of the pole foundation

b) *Supervisor*, the shall apply a construction proof load test of two-thirds the maximum design moment to the completed pole.

The pole foundation shall be loaded in increments of 50%, 75%, 90% and 100% and then

ground level, additional load shall be applied until the creep is less than the stated limit. The three 50% loads and three 100% loads shall each be maintained on the pole for 5 minutes. If

holding period. The pole foundation shall be considered acceptable if the total ground level creep from 50% to 100% load over 3 cycles is less than 30mm. If the creep exceeds 30mm, *Contractor* and re-tested.

All pole foundation tests shall be conducted in the presence of the

7. Towers

Design

7.1.1 By the

a) *Employer* provides tower drawings (including but not limited to analysis, member *Contractor* to verify *Employer* accepts no responsibility for the completeness,

b) *Employer* prior to

7.1.2 By the *Contractor*

The shall be fully responsible for his designs and their satisfactory performance in service. Acceptance by the does not relieve the *Contractor* adequacy of the design, dimensions and details.

b) Where the *Employer* , they are as a guide only to the *Contractor* shall be as shown on the conceptual drawings. The *Contractor* towers with respect to mass and aesthetics.

c) Tower test loads will be provided in the Works Information. The towers shall be designed to withstand all the specified loads, and shall be capable of withstanding construction loads during

7.1.3 Design requirements for lattice towers

a) Tower body and leg extensions shall be as specified in the Works Information. The tower body extensions shall be designed in such a way that the leg extensions may be used with either the

b)

towers shall be designed for all combinations of leg extensions and positions used with standard tower and body extensions. All leg extensions shall be detailed for use in combination with

c)

d) Base assemblies for guyed towers shall fit mast extensions for all tower heights.

e) Unless otherwise specified, when using guyed tower ball and socket fittings, these shall be cast in an acceptable malleable iron or steel. The radius of the hemispherical ball shall be approximately ten percent smaller than the radius of the hemispherical socket.

f) All members shall be capable of withstanding wind induced vibration when assembled and erected as part of a structure.

g) The following miscellaneous requirements shall be incorporated into the tower components.

i) Bolted construction is required and welded joints are not to be used.

ii) Tower members shall have flat surfaces uppermost where practicable. Pockets and depressions likely to hold water shall be avoided and, where unavoidable, shall be properly drained.

iii) Splices in main legs of towers shall be located immediately above bracing members.

iv) Splices shall be provided in all foundations to facilitate the use of stub extensions and to ensure a practical splicing position for repairing main leg failures. The centre of this splice shall be approximately 500mm above ground level.

v) Flat bars, round rods and tubes shall not be used for tower members.

vi) All long members shall be of sufficient section that, after punching or drilling, they will withstand ordinary rough handling during erection.

vii) A minimum of two bolts shall be provided for the connection of any member, including redundants, having a flange width equal to, or greater than 90mm.

viii) The top tension members of all crossarms, and earth conductor peaks on double circuit towers, shall be connected by a minimum of two bolts irrespective of design requirements.

ix) The maximum unsupported horizontal length of members shall not exceed the following:

- For angle section 45 x 45 x 3 = 1 500mm.
- All larger sections shall be governed by the slenderness ratios specified in 7.1.12.3.

x) The design of the lower portion of towers shall be such as to reduce the danger of livestock being caught in the angles between tower members.

On self-supporting towers a flat member, 50mm wide, shall be provided above the intersection of the main leg and the diagonal, such that the open distance along the upper edge of this member is not less than 120mm and not more than 140mm.

The design of the lower portion of the masts on all guyed-V towers will incorporate a steel mesh guard, or other accepted device, of not less than one metre in height and effectively closing the gap between the two mast columns preventing livestock entrapment.

h) Redundant bracing systems shall be arranged so that the secondary forces in any redundant member will be carried to the intersection of a non-redundant member with the leg or any other main member of the tower. When only one redundant member braces a leg or main member at a point, it shall be designed for an axial compressive load of 2,5% of the maximum load in the leg or main member it braces. When two redundant members, in planes normal to each other, are connected to a leg or main member at the same point, they shall be designed for an axial compressive load of 1,5% of the maximum load in the leg or main member they brace.

i) Bracing patterns using triangulated axial force systems are preferred to distribute the forces applied to the structure in a tension/compression fashion according to their geometry and member stiffness'. If "open panels" are used, bending stresses due to unbraced forces shall be considered.

j) A well proven non-linear large deflection computer programme, which takes into account secondary forces due to displacements, shall be used for the analysis of guyed structures.

7.1.4 Tower code numbers and marking

a) New tower designs accepted for manufacture will be allocated a tower code number consisting of three digits, e.g. 422. This number is to be used in conjunction with the tower type letters and tower descriptions given in the schedules to form the titles of the various towers.

- For example:

  Suspension tower type 422 A

  0° - 15 ° Angle strain tower type 422 B

These titles are to be used on all correspondence, drawings, test reports, etc., relating to a particular tower.

b) Each tower member shall be allocated an identifying number by the manufacturer, which shall correspond, to the number on the appropriate tower erection drawing.

c) The tower code number and the tower type letter are to be clearly stamped on every member of the tower as a prefix to the member mark number. All steelwork shall carry a manufacturer's identification marking consisting of a maximum of three letters. This shall be of the same letter height as the number code. Acceptance of the marking shall be obtained prior to usage. These marks shall be stamped before galvanising and be clearly legible after galvanising and erection, e.g.: on back to back members these markings shall be on the flange without stitches.

7.1.5 Tower steel

a) Structural steel for all tower members, including all stubs and cleats embedded in concrete shall conform to SABS 1431 Grade 300 WA or 350 WA, and shall be hot dip galvanised after fabrication.

b) When tower designs utilising a mixture of Grade 300 WA and Grade 350 WA are offered by the *Contractor*, all member sizes designated Grade 350 WA in any one tower design shall be strictly Grade 350 WA. It is the *Contractor*'s responsibility to ensure that only one grade of steel is used for any one-member size on any one tower.

c) Certified mill test reports of the chemical and mechanical properties of the steel for the full quantity required for fabrication shall be obtained from the steel supplier. Copies of these reports shall be retained at the *Contractor*'s works for review.

d) The means of marking and segregating Grade 300 WA and Grade 350 WA steel during receipt, storage and fabrication, shall be supplied to the *Project Manager* for acceptance prior to the first delivery of Grade 350WA steel.

e) The *Contractor* shall cut samples from deliveries of Grade 350 WA steel and conduct mechanical tests upon the samples to ensure that the steel is Grade 350 WA. The frequency of testing shall be subject to acceptance by the *Project Manager*.

f) Only structural shapes included in the latest edition of the "South African Steel Construction Handbook", published by the South African Institute of Steel Construction, shall be used. Availability of shapes selected is the sole responsibility of the *Contractor*.

g) To facilitate the transport of tower members, these shall be limited to a maximum length of 12,5m.

7.1.6 Bolts, nuts and washers

a) Bolts and nuts shall be of mild steel Grade 4.6, and manufactured in accordance with SABS 136, and shall be hot dip galvanised.

b) After galvanising, bolt holes shall be not less than 1,2mm larger in diameter than the corresponding bolt diameter.

c) Bolts of different diameters can be used on the same tower, provided that bolt sizes are not mixed in any one connection or plate. The minimum size of bolt shall be 16mm.

d) The threaded portions of all bolts shall project through the corresponding nuts by an amount not exceeding 15mm and not less than 3mm.

e) No threaded portion of any bolt shall occur within the thickness of the parts bolted together. To ensure this a single washer of suitable thickness shall be placed under the nut.

f) The minimum thickness of washers shall be 3mm and the maximum thickness shall be 6mm.

g) No lock nuts or spring washers shall be used on the tower.

h) Where a pin-type connection is made at the top of masts on guyed structures, it shall be of a type secured by means of a bolt, nut and split pin. The split pin shall be of stainless steel, with a minimum diameter of 20% of the bolt diameter.

7.1.7 Shackles and extension links

a) The *Contractor* is to provide each tower with shackles and extension links for insulator string attachments of a size and strength suitable for attaching the conductor insulator assemblies, and earth conductor hardware assemblies to the tower at the appropriate positions.

b) Shackles, split pins and extension links shall be designed and fabricated according to the relevant specifications.

c) Shackles for insulator string attachments shall be of the correct length, to connect the insulator hardware supplied to the attachment point on the tower.

d) The shackles shall be of the type secured by means of a bolt, nut and split pin. The split pin shall be of stainless steel, with a minimum diameter of 5mm.

e) The orientation shall be as follows:

- Suspension shackle for earth and phase conductors: When viewed on the transverse face, the legs of the shackle are to be in the vertical plane and at right angles to the direction of the line.
- Strain shackle for earth and phase conductors: When viewed on the transverse face, the legs of the shackle are to be in the vertical plane parallel to the direction of the line.

7.1.8 Anti-climbing devices

a) Anti-climbing devices shall be designed for each tower. These are to be attached at a height of approximately 3m, but not less than 2,5m above ground level.

b) Where long leg extensions are used, an anti-climbing device shall be installed on individual legs at a height of not less than 3m and not more than 5m above ground level.

c) Anti-climbing devices shall be formed by stringing onto projecting steel supporting members, fencing wire consisting of 2,5mm double-strand uni-directional twist pattern, galvanised steel barbed wire. Spacing between strands shall not be more than 100mm centres, the first being not more than 100mm from the tower face, and forming an overhang of not less than 500mm beyond the outer face of the tower. This overhang distance shall be maintained at the tower corners. On small anti-climbing devices such as on legs of guyed "V" towers, twin single strand barbed wire may be used.

d) The strands of barbed wire shall be secured at intervals, not exceeding 2m, by spacers formed by pieces of the same barbed wire bound to the strung barbed wire by galvanised binding wire. Where barbed wire other than galvanised steel is specified, the spacers and binding wire shall be compatible.

e) Where the design of the towers is such that they can be climbed on the inner face, a similar anti-climbing device shall extend from the inner face of the tower.

7.1.9 Step bolts

a) One leg of each tower shall be equipped with step bolts at approximately 400mm centres, starting immediately above the anti-climbing devices and extending to the highest crossarm of the tower. The bolts shall be fixed to the main leg members of the tower by means of two hexagonal nuts. The length of the cylindrical section of each step bolt shall not be less than 150mm, as measured from the outside face of the main leg to the bolt head. Holes for step bolts shall be on all leg extensions from ground level up. No step bolts shall be installed below the anti-climbing device except for construction purposes.

b) The bolts shall be uniformly spaced, continuous and in line over gusset plates. Where 20mm tower bolts are used 16mm step bolts may be fitted in a 21,5mm hole, but at connections only. In the connection this bolt shall be ignored when calculating the number of bolts required.

c) In the case of double circuit towers, two diagonally opposite legs shall be equipped with step bolts and shall extend to the underside of the top crossarm.

7.1.10 Tower types

a) Designs must be submitted for each of the tower types called for in the Works Information.

b) Weights shall be given for all towers, including all steelwork, stubs, bolts, nuts, washers, shackles, extension links, anti-climbing device steelwork, mast base assemblies, guys, guy attachment assemblies and guy attachment protection assemblies.

7.1.11 Mass of tower and foundation steelwork

The calculations of mass for angles and other rolled shapes shall be in accordance with the mass per metre listed in the latest edition of the "South African Steel Construction Handbook" published by the South African Institute of Steel Construction. All plate material shall be based on a mass density of 7 850kg/m³. Lengths used to determine mass of members shall be based on the detailed lengths shown on the final, accepted shop drawings and not on the "ordered overall lengths". Material lost from clips, back-cuts, blocks, holes etc., shall not be deducted from the mass of a member or plate. Of the above-calculated mass, 3,5% of the uncoated material shall be used for the mass of the zinc coating (galvanising). The estimated tower mass is to include leg extensions, stubs, bolts, nuts, washers, shackles, anti-climbing device steelwork and galvanising.

7.1.12 Tower member design

7.1.12.1 General

The tower members shall be designed in accordance with ASCE Manual No. 52, "Guide for design of steel transmission towers", or alternatively, ECCS Manual No. 39, "Recommendations for angles in lattice transmission towers", except as limited in this specification.

7.1.12.2 Definitions

- L = The unsupported length of a member, without adjustment for end fixity conditions
- r = Radius of gyration (i, as per SAISC tables)
- fy = Minimum guaranteed yield stress/Maximum allowable design stress.
- ft = Tensile stress
- fb = Bearing stress
- ASCE = American Society of Civil Engineers.

7.1.12.3 Limiting L/r ratios

- Leg members and main chord members in crossarm/bridge and earth conductor peak - 120.
- All other members carrying calculated stress — 200.
- Redundants not carrying calculated stress — 250.

7.1.12.4 Maximum allowable design stresses

- The maximum allowable design stresses for angle shapes shall be as follows:

Steel grade	Member thickness	fy
300 WA	≤ 25mm	300mPa
350 WA	≤ 16mm	350mPa
350 WA	> 16mm ≤ 25mm	345mPa

- The maximum allowable design stresses for bolts shall be as follows:
- Shear on unthreaded portion of bolt — 250mPa

  On multiple bolt connections allowance must be made, in accordance with either SABS 0162, ASCE Manual No. 52 or ECCS No. 39, for the group effect, which will tend to decrease the permissible shear on the bolts.
- Tension on net area of bolt — 400mPa.

7.1.12.5 Tension design

a) "Tension-only systems" are not permitted. Each member shall be designed for the forces it attracts from the externally applied loads, due to its location and stiffness.

b) If unequal angles are used, they should be connected by the long leg when practicable. When the outstanding leg exceeds the connected leg, the net area shall be determined as for an equal angle based on the connected leg.

7.1.12.6 Bearing design

Bearing on contact area (bolt diameter × material thickness) f_b = 575mPa.

7.1.12.7 Member thickness

a) The outline or main chord members of a tower shall have a minimum thickness of 5mm regardless of bolt size. The minimum thickness of steel sections using 16mm bolts shall be 3mm. When using 20mm to 24mm bolts, the minimum thickness for any member shall be 4mm.

b) Where members of the same size but of different thickness are to be used in the same tower design the difference in thickness shall be more than 1mm.

7.1.12.8 Spacing of bolts

a) Minimum edge distance

The following minimum distances measured from the centre of the hole to an edge shall be maintained:

Bolt diameter	Rolled edge	Sheared edge	Flame cut edge
16mm	23mm	25mm	29mm
20mm	28mm	30mm	35mm
24mm	34mm	36mm	44mm

b) Minimum bolt spacing

Bolt diameter	Spacing
16mm	40mm
20mm	50mm
24mm	60mm

The distance from the centre of a bolt to the face of the outstanding flange of an angle or other member shall be such as to permit the use of a socket spanner for tightening the nut.

7.1.13 Guy strands and guy attachments

7.1.13.1 Guy strands

a) Guy strands used for guyed towers shall be of the same quality as for "Stranding rope for bridges and guys" as described in the latest edition of the Haggie Steel Ropes Limited catalogue, with a "Single strand" design. Furthermore, the guy strand shall conform to the relevant technical requirements specified by the *Employer*. The *Contractor* shall specify the ultimate tensile strength of the strand material selected. Wires shall be hot-dip galvanised before stranding. The individual wires shall be adequately preformed prior to stranding to ensure the wires maintain their respective positions when the strand is cut.

b) The minimum breaking strength of the guy strand selected shall be the greater of:

$$\frac{\text{Maximum guy tension produced by governing transverse load}}{0,7}$$

or

$$\frac{\text{Maximum guy tension produced by governing longitudinal load}}{0,85}$$

c) In the non-linear analysis of the guyed tower, the actual cross-sectional area and proper modulus of elasticity of the guy strand selected shall be used. The modulus of elasticity shall be taken as 159GPa for steel stranded guy wires.

d) Pre-tensioning of the guy strands will not be permitted in the tower analysis.

7.1.13.2 Guy attachments

a) The guy attachments shall be capable of developing the minimum breaking strength of the guy strand.

b) The thickness and contour of tower and anchor attachment points shall be co-ordinated with the guy attachments, to ensure that excessive bending forces or stress concentrations are not transferred to the guy grips.

c) The grip connecting the guy strand to the anchor shall provide continuous adjustment, parallel to the guy line, of 450mm. Once the tower has been erected, plumbed, and the conductors strung and sagged, the adjustment shall be sealed or locked to avoid the possibility of tampering. The grip connecting the guy strand to the tower may be similar in design, but non-adjustable.

d) Final acceptance shall be obtained from the *Project Manager* for the types of guy attachments selected. Test reports, certifying the results of ultimate strength tests, cycle load tests, vibration tests and impact tests as well as material and fabrication specifications, tests and drawings are to accompany requests for acceptance.

e) The guy attachment link which exits the foundation shall be either a single galvanised steel round bar with a suitable forged eye link or a single galvanised steel plate with suitable attachment holes. Galvanising shall be in accordance with SABS 763, with a minimum coating weight of 600grams/m^2

7.1.14 Design drawings and calculations

7.1.14.1 Before acceptance of the *Contractor's* design

The design drawings shall show the following data and information for each tower type, including all extensions. Two types of towers shall not be combined on a single drawing.

a) A large scale drawing showing tower outline, hardware attachment points, conductor locations and electrical clearances.

b) An outline (single line diagram) of each tower type, drawn accurately to scale and showing all basic design dimensions and design group members.

c) The compression and uplift reactions with corresponding horizontal base shears due to the governing loading conditions for the self-supporting tower, identifying tower height and differential leg extensions used. The compression reactions with corresponding horizontal base shears and guy strand tensions due to the governing loading conditions for the shortest and the tallest guyed structure.

d) A tabulation showing the member size, the member forces, and the governing load cases.

e) All loading and their manner of application, including determination of the wind load on the structure. Wind load on the tower shall be applied at each panel point along the height of the tower.

7.1.14.2 After acceptance of the Contractor's design

Two sets of drawings, together with detailed design calculations, computer analyses, etc., as may be required by *The Employer* for each type of tower and foundation, shall be submitted for acceptance. This shall include a tabulation of the calculations showing the design of each member, i.e. magnitude of compression/tension forces, governing load case, section size, gross and nett cross-sectional areas, unbraced lengths, radius of gyration, slenderness ratios, yield stress or reduced yield stress, compression/tension capacities of member, connection capacity of member in respect to bolt shear and bolt bearing, indication of number of holes deducted from gross cross-sectional area of tension members, bolt size and number of bolts required. After successful tower testing, an acceptable transparency of each drawing, suitable for microfilming, and two prints of each calculation shall be supplied. These shall be provided in all cases, irrespective of copyright agreements.

a) The following drawings are required:

i) Completely dimensioned general arrangement drawing of each tower superstructure and foundation, and of each body and leg extension.

ii) An electrical clearance drawing, indicating clearances from conductors to tower steelwork and conductors to earth conductors, and the cover angle from earth conductors to phase conductors.

iii) If not detailed on the above drawings, the following shall also be provided:

- Erection drawing showing the erection mark of each member, and indicating number and type of bolts and nuts required at each point where members are connected.
- General arrangement and erection drawing of stub-setting templates.
- Drawing showing dimensions of excavations for all foundations.
- General arrangement of earth conductor and phase conductor attachment shackles, chain links, extensions links or other ancillary hardware.
- General arrangement of anti-climbing device.

c) For each tower type, a separate drawing is required showing an unbroken transverse elevation, preferably to a scale of 1:100, to be accommodated on A3 size showing leading dimensions, clearances, main foundation dimensions, etc.

d) To facilitate checking, the *Contractor* shall provide a material list for each type of tower, detailing all items required to complete the tower. The material lists shall be included on the detail drawings.

e) Where the *Employer* obtains the tower copyright, drawings shall be drawn on the *Employer's* titled sheets.

7.1.15 Shop detailing

7.1.15.1 General

a) All tower types and all tower and leg extensions shall be detailed, even though some of the components may not be required.

b) The *Contractor* shall be responsible for the correctness of dimensions and details on the working drawings. The acceptance of the detail drawings shall not relieve the *Contractor* of this responsibility. All bent angles and plates shall be detailed to finished dimensions.

c) Connections shall be detailed in a manner to avoid eccentricity as much as possible. Assembly bolts shall be located as near the centre of gravity of angles as is practicable.

7.1.15.2 Intersection of members

a) All diagonal-bracing members shall be connected at their point of intersection by at least one bolt.

b) Cutting of flanges to interpose members will only be allowed with the *Project Manager's* acceptance.

c) Assembly bolts shall not connect more than three (3) thicknesses of material.

7.1.15.3 Double-angle members

All double-members shall be connected at intervals between end connections by stitch bolts as follows:

i) Tension/compression members: spaced so that the L/r ratio of one angle between stitch bolts is equal to, or less than the L/r ratio of the member as a whole, with a maximum length between stitch bolts of 600mm. A minimum of two stitch bolts shall be used between panel points.

ii) Angles with connected legs greater than 100mm shall be stitched at each point with two bolts and a plate.

iii) Angles with connected legs 100mm or less shall be stitched at each point with one bolt and ring spacer.

7.1.15.4 Spacers

a) Spacers shall be provided, as necessary, for all gaps to prevent distortion of structural members.

b) Spacers between tower members, where more than one bolt is involved, shall be one plate of the required thickness. Where a single bolt is involved, the spacer may be made of up to three pieces. The thickness of individual spacers shall be limited to the following standard sizes: 5mm, 8mm and 12mm.

c) Bolts and nuts that bear on sloping faces shall be provided with bevelled washers.

7.1.15.5 Conductor attachment plates

a) All earth conductor attachment plates shall be provided with at least one extra maintenance hole of the same diameter as the attachment hole.

b) All phase conductor attachment plates shall be provided with a least two extra maintenance holes of the same diameter as the attached hole, symmetrically spaced from the attachment hole.

c) For the purpose of determining shackle hole edge distance, these shall be as for "Flame cut edge" as specified in 7.1.12.8

7.2 Fabrication

7.2.1 General

a) All parts of structures shall be fabricated in accordance with the accepted shop drawings, and generally carried out in accordance with SABS 1200H. Workmanship and finish shall be equal to the best modern practice for transmission tower work. Pieces having the same mark shall be interchangeable. Members shall be straight.

b) All parts of the structure shall be neatly finished and free from kinks or twists. All holes, blocks and clips shall be made with sharp tools and shall be clean-cut without torn or ragged edges.

c) Shearing and cutting shall be neatly and accurately done. Cuts shall be clean without drawn or ragged edges. Particular care shall be taken in the edge finish of plates subjected to large bending moments or large bends in fabrication.

d) Redundant material on gusset plates shall be removed.

e) All holes in structural steel less than 18mm thick may be punched to full size unless otherwise noted on the accepted drawings. Holes shown on the drawings as drilled holes, and all holes in structural steel 18mm or more in thickness, shall be drilled or subpunched and reamed. All holes shall be clean cut and without torn or ragged edges. All burrs resulting from reaming or drilling shall be removed. All holes shall be cylindrical and perpendicular to the member. Where necessary, to avoid distortion of the holes, holes close to the points of bends shall be made after bending. The use of a torch for cutting holes shall not be permitted.

For punching holes to full size, the diameter of the punch shall not be more than 2mm larger than the nominal diameter of the bolt, and the diameter of the die shall not be more than 2mm larger than the diameter of the punch.

f) For subpunching, the diameter of the punch shall be 6mm smaller than the nominal diameter of the bolt, and the diameter of the die shall not be more than 3mm larger than the diameter of the punch. Subpunching for reamed work shall be such that after reaming, no punched surface shall appear in the periphery of the hole.

g) Where holes are reamed or drilled, the diameter of the finished hole shall not be greater than the nominal diameter of the bolt, plus 2mm.

h) All holes shall be spaced accurately in accordance with the drawings and shall be located on the gauge lines. The maximum allowable variation in hole spacing, from that indicated on the drawings for all bolt-holes, shall be 1mm. Misdrilled or mispunched holes may not be refilled by welding.

7.2.2 Bending

a) All forming or bending during fabrication, shall be only done according to methods accepted by the *Project Manager*, such that will prevent embrittlement or loss of strength in the material being worked. The technical requirements for hot and cold forming are as follows:

- **i)** Only the direct resistance heating method shall be used.
- **ii)** The length of the section to be heated shall be clearly marked on the section, and heating equipment set accordingly.
- **iii)** The required bending tool shall be ready on the bending press with checking jigs available at all times.
- **iv)** A dry run shall be made first to check that all systems are operational and that the proper tools are used.
- **v)** Material shall be uniformly heated over the required length, to a temperature of between 750°C to 900°C. Oxidation of the material shall be minimised.
- **vi)** Heated material shall be inserted into the bending press and formed while the temperature is still within the specified range.
- **vii)** Formed material shall be checked immediately to ensure that they have been formed correctly.
- **viii)** Formed material shall be left to cool naturally.
- **ix)** Re-checks shall be made with the appropriate jigs when material is cold.

b) If more than one bend is required on a section, the operation shall be repeated for each bend. Repeated heating of a bend position shall not be allowed.

c) New bends shall not deform the bend previously made.

d) For bending limitations on the flaring of flanges on angle sections, refer to the *Project Manager.* Any other bending of angle sections must be done hot.

e) Cold bending limitations on plates are as follows:

Plate thickness	Maximum deviation angle
Up to 12mm	14°
14 to 22mm	7°

A minimum bend radius of 8mm shall apply for above table. Cold bending is not allowed for plates in excess of 22mm thickness.

7.2.3 Marking

a) Marking shall be done by stamping the marks into the metal with numerals or letters of 10mm minimum height. The marking shall be consistently in the same relative location near the ends on all pieces. No other marking shall be used.

b) All steelwork shall carry a manufacturer's identification marking consisting of a minimum of three letters. This shall be of the same height as the number code. Acceptance of the marking shall be obtained prior to usage.

7.2.4 Galvanising

Galvanising shall be in accordance with SABS 763. All possible care shall be taken to avoid damaging the zinc coating in transit or on site. Any material found to be damaged is to be made good or replaced by the *Contractor*.

7.2.5 Welding

For components of sufficient complexity to require welding, permission must first be obtained from the *Project Manager*. If permission is granted, the *Contractor* shall submit his manufacturing procedure to the *Project Manager* for acceptance before manufacturing commences.

7.2.6 Testing and inspection

a) The *Project Manager* reserves the right to inspect the work, and witness tests at any stage during manufacture.

b) Witnessed tests to SABS 1431 may require samples of steel from the *Contractor*'s stockpile.

c) The *Project Manager* or the SA Bureau of Standards may make tests, to ensure satisfactory quality of the galvanising.

d) Certificates shall be obtained proving compliance with all aspects of material quality, manufacture and galvanising.

7.3 Tower acceptance tests

7.3.1 Prototype assembly and inspection

One tower of each type shall be assembled in the shop to the extent necessary to assure correct fit of all parts and proper field erection. The same procedure shall be followed when the *Employer* supplies copyright tower drawings to the *Contractor*. Two working days notice shall be given for the *Project Manager* to inspect the assembled prototype tower.

7.3.2 Tower

a) If specified, tests shall be made on complete towers at an accepted tower testing facility.

b) These tests shall be made in accordance with International Electromechanical Commission (IEC) Standards, Publication No. 652 and applying the specified test loads for a period of one minute.

c) Upon completion of testing for all specified design loads, the towers shall be tested to destruction, if so instructed by the *Project Manager*.

d) Tensile tests to SABS 1431 shall be carried out on samples of steel taken from members of the tested towers as selected by the *Project Manager*.

7.3.3 Test programme

Two copies of the proposed test programme, including drawings showing the method of testing and the loads to be applied, shall be submitted to the *Project Manager* for acceptance before testing commences.

7.3.4 Test witnesses

The *Project Manager* shall be notified, in writing, at least ten days in advance of the acceptance tests.

Unless the *Employer* specifically waives attendance, no test shall be valid unless witnessed by the *Project Manager*.

7.3.5 Test towers

a) The test towers shall be manufactured at the *Contractor*'s premises and the material and dimensions shall be strictly in accordance with the accepted tower drawings and prototype. When testing guyed towers, the guy strand and guy attachments shall be of the size and type proposed for use in construction. Guyed test towers shall be erected with a working tension in the guys of approximately 10% of the ultimate breaking strength of the guy.

b) No part of any tower tested to destruction may be used on the line.

7.3.6 Tower drawings

During testing, two complete sets of accepted tower drawings shall be kept at the test station on which all modifications made to the tower, before or during testing, shall be clearly marked in red. On completion of testing, the *Employer* shall retain this marked-up set of drawings.

7.3.7 Load application

a) Loads shall be applied at the conductor attachment points. The wind load on the tower shall be applied to at least four representative panel points below the crossarm.

b) Tests shall be made with the tower in a vertical position. Loads shall be applied in such a manner as to avoid impact on the tower. The tower shall be mounted on a rigid foundation and plumbed vertically with a tolerance of 2mm in 1m.

c) The self-supporting towers shall be tested at their maximum design heights. The guyed towers shall be tested at their maximum, and also at their minimum design height, if there are major differences in the member forces for the different height towers.

d) The tower test programme shall include all load cases that have controlled the sizing of main tower members as accepted by the *Project Manager*.

7.3.8 Load measurement

a) All loads shall be measured through a suitable system of strain devices, or the direct application of weights. All systems shall be such that pulley friction is minimised.

b) All strain devices shall be used in accordance with the manufacturer's recommendations. The *Contractor* prior to and following the tests shall provide certified calibration test reports of all load-measuring devices.

c) Tower deflections shall be measured by a procedure accepted by the *Project Manager*. Deflection readings at points specified shall be recorded prior to each load increment, during the period the load increment is on, and after the release of each load increment.

7.3.9 Acceptance

The tower shall be considered acceptable if none of the members or bolts show evidence of permanent deformation. If any member or bolt shows evidence of permanent deformation, the member or connection shall be redesigned and replaced. The test shall be repeated until the tower is capable of withstanding the loads without permanent deformation.

7.3.10 Test reports

a) Within 14 days after testing, the *Contractor* shall supply one copy of the test report covering each test.

b) Test reports shall include the following:

i) General test arrangement.

ii) Loads applied to test tower.

iii) Deflection readings of tower under each load increment.

iv) Photographs of the test tower under final load increment for each design loading, including destruction test.

v) Photographs of all members and connections that fail during the testing sequence, including the destruction test.

vi) Certified mill test reports for main members used in the test towers.

vii) SABS 1431 tensile test reports.

7.4 Tower erection

7.4.1 Tower material handling and storage

a) Tower steel in storage shall be blocked off the ground with a sufficient number of blocks to prevent bending or warping of individual members.

b) Tower steel shall be handled with the use of nylon or fabric slings. The use of unprotected wire rope slings is not permitted.

c) Material shall not be dumped or dropped from trucks, but shall be carefully unloaded and stacked.

d) Material shall not be dragged on the ground.

7.4.2 Assembly and erection of towers

a) The applicable type of tower shall be erected on the completed foundation. In the case of self-supporting tower concrete foundations, towers shall not be erected until the concrete has had at least 14 days in which to cure. In the case of guyed tower concrete foundations and/or anchors, towers shall not be erected until the concrete has had as least 21 days in which to cure.

b) All towers shall be vertical within 2mm in 1 metre in both the transverse and longitudinal directions when erection of the tower is completed, unless a different tolerance is specified.

c) Steel towers shall be assembled and erected so as not to overstress structural members, bolts or foundations. The assemblies shall be erected with the members supported in their proper relative position. Structural assemblies that are not sufficiently rigid to be raised in one piece shall be stiffened by means of temporary bracing.

d) All towers shall be assembled in strict accordance with the drawings. The size and length of all bolts, washers, nuts, ring fills and plate fills shall be as specified on the erection drawings.

e) Contact surfaces of plates at the joints shall be cleaned of foreign materials and dirt before assembly. Wherever possible, bolts shall be installed with threads and nuts to the outside, and bolt heads to the inside of columns and trusses. Surfaces that are horizontal after erection shall have bolt heads down and nuts up.

f) A reasonable amount of drifting will be allowed in the assembly of members, but driving of bolts to correct mismatched holes will not be allowed.

g) If blind or partially blind holes, missed clips, or other minor mis-fabricated steel members are discovered in the field, the *Contractor* shall notify the *Supervisor* and receive his acceptance prior to effecting field repairs.

h) Where drilling, punching or clipping is done in the field, all exposed steel surfaces shall be coated with a heavy layer of zinc-rich paint or an accepted equivalent.

i) Suitable ladders shall be used wherever necessary during erection of towers. Such ladders, and any temporary step bolts shall be removed when erection work is not in progress.

j) After final tightening of all nuts, they shall be fixed in position by punching four indentations symmetrically around the threads with a round pointed centre punch. The nuts and exposed bolt thread shall be painted with an accepted calcium plumbate based galvanised iron primer.

k) After erection, all towers shall be cleaned of all foreign matter or surplus paint.

7.4.3 Erection of guyed towers

a) Provision shall be made for the erection of guyed towers on terrain with various ground slopes.

b) Adjustable guy grips are to be installed to the anchor ends of each guy strand. The total adjustment of the guy grips shall be 450mm, and the guy strands shall be cut to allow a minimum of 300mm tightening adjustment after the tower is erected and the guy strands tensioned.

c) The guy grips shall be installed in strict accordance with the manufacturer's recommendations, to ensure complete holding power of the guy grips.

d) Guy grips of the adjustable U-bolt design shall be carefully tightened to ensure equal loading of the two legs of the U-bolt. Neither nut shall be tightened more than 6mm differentially without equalising the load on the nuts, nor when the desired tension is achieved, the nuts shall be even before locking.

e) The guy strand will be cut to a length that will allow projection to just beyond the bottom of the U-bolt, and tied to obviate opening of the strands, effectively closing the open area of the U-bolt.

f) At the time of tower erection, all guys shall be tensioned to 10% (±2%) of the minimum breaking strength of the guy strand. This shall be the tension in the guy after all fittings have been attached and all rigging used for tensioning the guy has been removed. The *Contractor* shall be responsible for establishing a suitable method of determining installed tensions in the guy strands.

g) Guys shall be tensioned to hold the towers plumb and perpendicular to the line as soon as the towers are erected. Towers shall not be more than 2mm in 1m from vertical in both the transverse and longitudinal direction, and the crossarms shall be perpendicular to the line within 0,3° of arc.

h) The guys shall remain properly tensioned so that the tower remains plumb during, and after conductor stringing and clamping. Conductor stringing operations shall be halted if any guy in a sag section becomes slack during the operation.

i) During erection, if it becomes necessary to leave the guys at reduced tension for longer than twenty-four hours, the *Supervisor* shall be informed immediately.

j) The *Project Manager* shall accept the method of locking the guy grip and guy guard at the anchor end of the guy wire. The guy guard shall not be locked over the guy grip until the *Supervisor* has inspected, and accepted the guy grip installation and the presence of adequate locking.

7.4.4 Tower labels

Tower labels are to be manufactured and installed as in "TRMSCABC9 – Design, manufacturing and installation specification for transmission line labels".

7.4.5 Step bolts and anti-climbing devices

The *Contractor* shall install all step bolts and anti-climbing devices.

8. Stringing

8.1 Material supply

8.1.1 By the *Employer*

a) The *Contractor* is to provide off-loading and secure storage facilities and shall be held responsible for the proper protection and safekeeping of all material until the *completion date*. The *Contractor* shall be held responsible for any loss or damage to material after delivery.

b) The *Contractor* is to verify and confirm the quantities of material supplied by the *Employer.* Conductor use is to be optimised to obviate excessive waste. A nominal amount (dependant on the terrain - max. 3%) of phase and earth conductor will be allowed for sags and jumpers. Off-cuts and waste shall be returned to the *Employer* upon Completion as scrap.

c) All other surplus material shall be returned to the *Employer* upon Completion.

8.1.2 By the *Contractor*

a) The *Contractor* is to estabish the correct quantities of all stringing materials required to Provide the Works.

b) A nominal amount (dependant on the terrain - max. 3%) of phase and earth conductor will be allowed for sags and jumpers. Off-cuts and waste shall be returned to the *Employer* upon Completion as scrap.

8.2 Installation of phase and earth conductors

8.2.1 Crossings, notices and permits

a) Substantial temporary conductor supports shall be used, or equally effective measures taken, to prevent encroachment of statutory clearances, or other clearance requirements stated in the permits, between the conductor being strung and other power or communication lines, roads or railways being crossed.

b) Suitable structures under each phase will be erected to protect all fences from conductor damage during stringing.

c) Temporary changes in poles, fixtures or conductors of lines being crossed will only be carried out if accepted by the *Supervisor.* The *Contractor* shall indicate any changes considered necessary and the *Supervisor* will co-ordinate any changes with the owner of the service.

d) The *Contractor* shall notify the *Supervisor*, at least 30 days in advance, of the time he intends to make crossings of power lines, communication lines, major roads or railways. This notification shall state the location of the crossing to be made, the approximate time of the permit, the length of time that will be required to effect the crossing, and the duration of permit requested.

e) The *Employer* will endeavour to arrange that all crossings be made with the crossed line de-energised. The time of line outages shall be kept to the absolute minimum. All preparatory work shall be done prior to the work permit coming into effect. Upon completion of the work, the *Contractor* shall immediately notify the *Supervisor* that lines are clear and release his working permit.

f) Special scaffolding may be required at certain crossings. If so, the *Supervisor* will instruct the *Contractor* to provide suitable scaffolding and nets

8.2.2 Handling and stringing of conductors

a) All phase and earth conductors shall be tension strung.

b) The equipment and methods used for stringing the conductors shall be such that the conductors will not be damaged. Particular care shall be taken at all times to ensure that the conductors do not become kinked, twisted or abraded in any manner.

c) Stringing shall be done in daylight hours only.

d) The *Contractor* shall make suitable arrangements for temporary staying of towers, and anchoring of conductors when necessary. Conductors may not be anchored to any portion of any tower, except strain towers, and then only at the points designed for conductor attachment. Temporary anchoring to footings and guy anchors will not be permitted. Where temporary anchoring is required, suitable temporary anchors shall be provided. Installation and removal of temporary anchors will be the *Contractor*'s responsibility.

e) Matched conductor drums, marked with the same number followed by the suffix A, B, C etc., shall be used for each pull of multiple conductors per phase to ensure even sag characteristics and a minimum number of joints. The *Contractor* shall select the most suitable sets of matched conductor drums for each stringing position to minimise wastage of conductor. The *Contractor* shall keep an accurate record of the phase and earth conductor drum numbers and their position in the line. On Completion a copy of these records shall be supplied to the *Project Manager*.

f) Where multiple conductors per phase are used, these shall be attached to a single running board and strung simultaneously to ensure matched sags. The individual conductors shall be attached to the running board by auxiliary clamps that will not allow relative movement of strands or layers of wire, and shall not over tension or deform individual wires.

g) Running boards shall pass through blocks smoothly without hanging, catching or causing wide variations in pulling tensions, damage to the blocks or over stressing of towers. The pulling line shall be a non-rotating type, which will not impart twist or torque to the running board or conductors. Swivels shall be used to attach the pulling line and conductors to the running board. Swivels shall be small enough to pass through the blocks without damage to either, and shall have ball bearings and be free turning under load.

h) All conductors shall be strung by the controlled-tension method by means of rubber faced, double-bullwheel-type tension stringing equipment. This equipment must be so designed that there shall be no conduction of the heat generated by the braking action, to the bullwheels. There shall be appropriate mechanical braking on the reels to prevent loose conductor between the reels and the bullwheels, but sufficient tension to pull the conductor in between layers remaining on the reel. Brake controls shall be positive and fail-safe in order to minimise the danger of brake failure.

i) The tension shall be controlled individually on each conductor, and when the desired tension is obtained, the same constant tension shall be held so long as the brakes are left at this setting. Tensions, while pulling, must be sufficient to clear all obstacles safely without damage to the conductor. At no time shall the pulling tension exceed the tension shown on the sag charts.

Pulling of more than one drum length of conductor shall be subject to the *Supervisor's* acceptance.

j) Adequate protection shall be provided where there is danger of conductors being damaged by vehicles or other equipment and objects. Conductors shall not be left in contact with the ground, vegetable matter or any conducting or semi-conducting material. Wood lagging or similar material shall be used to protect the conductor when working at ground level.

k) Radio communications shall be used to relay information and instructions between the conductor tensioning station, intermediate check points, mobile stations and the pulling station at all times during a stringing-tensioning operation. An outage of radio communications at any station will require immediate cessation of conductor pulling operations.

l) The placement of tensioning and pulling equipment shall be such that the vertical angle of pull on a crossarm during stringing operations shall not be more than 20°. Conductors shall not be pulled around angles that exceed 20°. With tandem-mounted blocks, the pulling angle shall not exceed 40°.

m) The sheaves shall conform to the conductor manufacturer's recommendation as to diameter, and to size and shape of groove for the size of conductor used. Sheaves shall have a minimum diameter of fifteen times the conductor diameter at the base of the groove. Block surfaces that will be in contact with the conductor shall be coated with neoprene or rubber. This covering shall be kept clean and free of materials that might damage the conductor surface. The conductor sheaves shall have a separate groove for the pulling line. The pulling line shall not run on the rubber covered conductor grooves. The sheaves shall be inspected for damage or contamination before each usage. The *Contractor* shall not use any sheaves rejected by the *Supervisor* due to damage or excessive wear. The Contractor shall immediately remove such sheaves from the site.

n) During stringing operations and before regulating, if it becomes necessary to leave the conductor in the blocks for longer than eighteen hours, the conductor shall be left at reduced tension, and the *Supervisor* immediately notified. The percentage of sag, spans involved, time interval, and correction for creep shall be noted, and records forwarded to the *Supervisor*. In no case shall conductors be left with less than the following clearances:

- cultivated or open country : 6 metres,
- roads and trails: 8 metres,
- railroad tracks: 9 metres.

8.2.3 Joints

a) Before stringing commences, the *Contractor* will be required to compress sample phase and earth conductor mid span joints, as well as phase conductor dead/end assemblies on site in the presence of the *Supervisor*, using the matched and numbered dies and compressors intended to be used on the line during stringing. The length of conductor between any two fittings on the sample shall be not less than 100 times the overall diameter of the conductor.

At an acceptable testing authority a tensile load of about 50% of the breaking load of the conductor shall be applied and the conductor shall be marked in such a way that movement relative to the fitting can easily be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95% of the breaking load and then reduced to 90% of the breaking load and maintained for 1 min. There shall be no movement of the conductor relative to the fitting due to slip during this period of 1 min and no failure of the fitting. The conductor shall then be loaded to failure, and shall again withstand a minimum load of 95% of the minimum breaking strength of the conductor for it to be deemed acceptable. If the sample fails this test, a further three (3) samples shall be tested and will all be required to pass the above. If any one or more of these samples fail, no stringing shall commence until the *Project Manager* is satisfied that the equipment is acceptable. A copy of the test report shall be forwarded to the *Project Manager,* prior to stringing.

b) As far as possible, complete drum lengths of conductor and earth conductor shall be used to reduce the number of joints. Joints shall not be closer than 15 metres to the nearest suspension tower or 30 metres from the nearest strain tower. Joints shall not be installed in spans crossings railways, proclaimed roads, power or important communication lines. In no case shall more than one joint be installed in a given span, nor shall a joint be installed in a span dead-ended at both ends. The minimum distance between joints shall be 300 metres.

c) Whenever joints or dead-ends are made, auxiliary erection clamps and hauling devices shall not be placed closer than 8m to the point of joint or dead-end. The auxiliary erection clamps shall not allow relative movement of strands or layers of wire, and shall not birdcage, over tension or deform individual wires.

d) The conductor shall be cut with a ratchet or guillotine cutter to produce a clean cut, retaining the normal strand lay and producing minimum burrs. The aluminium strands shall then be stripped from the steel core by using an acceptable stripper. Under no circumstances shall high tensile hacksaw blades be used to cut conductor.

e) The conductor shall be laid out for a distance of 15 metres and straightened at the ends before preparation for installation of joints or dead-ends. Compression jointing shall be carried out on a clean tarpaulin or jointing trailer. The lay of wires shall be tightened before the first compression is made. The conductor strands shall be cleaned by wire brushing and an accepted non-oxidising paste applied. Compression shall be carefully made so that the completed joint or dead-end is as straight as possible. To minimise distortion, the joint should be rotated 180° between each compression operation, the joint and conductor being fully supported in the same plane as the compression jaws. If, in the opinion of the *Supervisor*, the completed joint or dead-end requires straightening, it shall be straightened on a wooden block by use of a sledgehammer and shaper or wooden mallet.

If, in the opinion of the *Supervisor*, the joint or dead-end has not been satisfactorily straightened or has been damaged in the process, the *Contractor* shall replace it.

f) After compression has been completed, all corners, sharp projections and indentations resulting from compression shall be carefully rounded. All other edges and corners of the fitting that have been damaged shall be carefully rounded to their original radius. Nicked or abraded surfaces shall be carefully smoothed. Tape, tape residue and filler paste shall be removed from fittings and conductors.

g) Sufficient notification must be given to *Supervisor* prior to the installation of compression fittings. Unless previously agreed all joints and dead-ends shall be installed in the presence of the *Supervisor*.

h) Under no circumstances shall compression joint be allowed to pass the travellers.

i) During the progress of the stringing, the *Contractor* shall keep an accurate record of the spans in which conductor and earth conductor joints are made, the date of assembly onto the conductor. A copy of these records shall be supplied to the *Project Manager*.

8.2.4 Preparation of metal to metal contact surfaces

All current carrying connections, contact surfaces, clamps, conductor and terminals shall be prepared as follows:

- wipe the mating surfaces free from grease and dirt (except the bores of compression sleeves);
- apply 1mm thick coating of approved jointing compound to the surfaces using a non-metallic spatula or similar tool;
- scrub all the coated surfaces thoroughly with a wire brush which is new or which has been used solely for this purpose;
- wipe off the jointing compound;
- apply a fresh 1mm thick coating of compound; and

- after a period of not more than one minute make the connection in the normal manner and remove excess extruded compound.

NOTE: No compound squeezed out by clamping pressure shall be used in making further joints. The *Contractor* shall apply such compound as necessary for making the connections by the method outlined above. On bolted connections care shall be taken during the tightening to avoid overstressing the bolts or components of the clamps. A torque wrench shall be used for tightening each bolt to the required torque.

- Tighten all bolts and U-bolts to their specified torque.
- Leave clamps for 24 hours to allow aluminium conductor to expand and contract.
- Check all bolts to ensure that they are still at the required torque.

8.2.5 Conductor repairs

a) Damage caused by the *Contractor* shall be repaired in a manner determined by the *Supervisor.* Damage is any deformity on the surface of the conductor that can be detected by eye or by feel. Damage includes, but is not limited to nicks, scratches, abrasions, kinks, birdcaging, and popped out and broken strands.

b) Depending upon the severity of the damage and the length of damaged section, the repair shall be made by careful smoothing with extra fine sandpaper, covering with preformed repair rods, installing a compression-type repair sleeve, or by cutting and splicing.

c) Kinked, birdcaged or severely damaged sections of conductor shall be cut out. When there is repeated damage in the same span, or in consecutive spans, the entire conductor in such spans shall be replaced.

d) All damage caused by auxiliary erection clamps or other gripping devices shall be repaired or cut out, as instructed by the *Supervisor*, before the conductor is sagged.

e) Preformed repair rods shall be installed if no more than one strand is broken, or nicked deeper than one third of the strand diameter, or when a number of strands are reduced in area not exceeding the area of one strand. Not more than two sets of preformed repair rods shall be installed on any one conductor in any given span.

f) A compression-type repair sleeve shall be installed, if not more than one third of the outer strands of the conductor are damaged over a length of not more than 100mm, or not more than two strands are broken in the outer layer of conductor and the area of any other damaged strands is not reduced by more than 25%.

g) Compression-type repair sleeves shall not be installed on one conductor in a given span if it already contains a conductor splice, conductor dead-end or another compression-type repair sleeve.

h) Damage to the steel strands or aluminium strands, exceeding the stated limits for repair sleeves, shall be cut out and spliced by means of a compression type mid-span joint.

i) Any foreign matter such as pitch, paint and grease placed on the conductor and fittings by the *Contractor* shall be removed by methods approved by the *Supervisor* prior to regulating.

8.2.6 Regulating

a) The *Contractor* shall string all conductors and earth conductors to the appropriate sags and tensions as determined from the conditions specified in the Works Information. The calculation of sag corrections for creep and clamping offsets shall be the responsibility of the *Contractor*, based on charts supplied by the *Project Manager*. Such calculations shall be submitted to, and accepted by the *Project Manager* prior to regulating.

b) Conductors and earth conductors shall be strung to the appropriate sag determined for the actual span length, and the equivalent span of the strain section involved.

c) The ruling/equivalent span of a strain section is given by the formula

$$Le = \sqrt{\frac{\Sigma L_i 3}{\Sigma L_i}}$$

where L_i is the length of the individual spans in the strain section. The sag S_e for the equivalent span L_e, is the sag determined from the conditions specified, i.e. appropriate conductor temperature. The correct sag S for any actual span length L in a strain section of equivalent span L_e is then given by:

$$S = (\frac{L}{Le})^2 \times Se$$

The appropriate conductor temperature to be used for sagging shall be determined by means of a Celsius thermometer inserted in the end of a suitable length of conductor or earth conductor from which a 150mm length has been removed from the centre strand, or other accepted method. The wire with the thermometer inserted shall be hung at crossarm level for at least two hours before the temperature is read.

d) The length of a section of phase and earth conductors to be regulated at any one time shall be limited to that length that will assure attainment of correct sag based upon terrain and obstructions.

e) Where there are a large number of suspension towers between strain towers, regulating of phase and earth conductors shall be done at intervals of 3 to 5 spans. In hilly country the conductors may require to be temporarily anchored one span away from the spans being regulated. The sag spans chosen shall be near each end of the section pulled for single conductor lengths, and near each end and at the middle for double conductor lengths. In addition, the sags shall be checked in all spans over 500 metres. In unusual situations, the *Supervisor* may require additional checks.

f) The *Contractor* shall provide, and maintain in good condition, suitable dynamometers, sag boards or other accepted apparatus for the proper checking of the work. Dynamometers shall read in Newtons and shall be tested and recalibrated at regular intervals. The *Contractor* shall keep dynamometer calibration certificates at the site office.

g) The *Contractor* shall notify the *Supervisor* at least twenty-four hours prior to any planned regulating operation. No regulating shall be done except in his presence, unless otherwise authorised. The *Contractor* shall furnish labour and equipment, for signalling and climbing purposes as requested by the *Supervisor*, to facilitate his inspection of the sag.

h) In pulling up the conductor, caution shall be used to avoid pulling the conductor above sag.

i) The maximum elapsed time from the beginning of the pulling operation to the completion of the regulating operation, shall not exceed seventy two hours, nor shall the maximum elapsed time between the completion of the regulating operation, and the completion of the clamping operation exceed seventy two hours. Conductor remaining in the blocks longer than the established limits shall be subject to inspection and, if damaged, replaced. The *Contractor* shall furnish labour and equipment as requested by the *Supervisor* for this purpose, as well as for inspection in the event of sudden windstorms.

j) No minus regulating tolerance will be allowed. A plus regulating tolerance of 0,01 times the theoretical sag, but not exceeding 150mm will be allowed, provided all conductors in the regulating span assume the same relative position to true sag. Sags of conductors in the same bundle shall not vary more than 35mm relative to one another. Sag variances between phases shall not be apparent to the naked eye.

k) When finally adjusting the sags of conductors and earth conductors, the sag shall be checked with sag boards, or other accepted methods in spans where the levels of the two towers are approximately the same, and the span length is approximately equal to the equivalent span length of the strain section. Upon completion of this regulating operation, as many successive spans as can be observed from the sag board position shall be checked for uniformity of sag.

l) All conductors, except for conductors in sag sections over flat terrain, shall be plumb-marked at each structure for the complete section regulated, before clamping-in or dead-ending of the conductor is begun. Conductors shall be marked with paint crayon or wax pencil - not with metal objects.

m) Insulator strings on three suspension towers adjacent to a new section to be regulated must be clamped to the conductor before temporary anchors are removed and regulating of the new section begins. These insulators shall remain in the plumb position upon completion of regulating of the new section and during plumb-marking.

n) Regulating operations shall be conducted during daylight hours only. Regulating operations shall be suspended at any time, when in the opinion of the *Supervisor,* wind or other adverse weather conditions would prevent satisfactory regulating.

o) Records of temperature, sag and tension for each section regulated shall be kept by the *Contractor*, and a copy supplied to the *Project Manager*.

p) On completion of regulating of a section of the line, the *Contractor* shall measure and record all clearances over roads, powerlines, communication lines, railways etc. along the route. A copy of these records is to be submitted to the *Project Manager*. The *Supervisor* is to be notified immediately of any discrepancy found between the actual clearance and that shown on the profiles.

8.2.7 Clamping of conductors

a) The conductors and earth conductors shall be clamped-in by the *Contractor* after the *Supervisor* has accepted the regulating operation as being in full compliance with the specifications and stringing data. Where offsets are required, the conductors shall be accurately adjusted in accordance with the offset clamping information developed by the *Contractor*.

b) All conductors in a sag section shall normally be clamped-in, beginning at the second structure from the forward end of the pull, and shall progress structure by structure, until the conductors at all structures are clamped-in.

c) The *Contractor* shall exercise extreme care in moving the phase and earth conductor from the stringing blocks to the suspension clamps.

d) Where armour rods or conductor clamps incorporating armour rods are called for, they shall be installed in strict accordance with the manufacturer's recommendations. Armour rods shall be centred in each suspension clamp in such a manner that the clamp is not more than 50mm from the centre of the rods. Variations between the ends of the individual rods shall not exceed 12mm. Aluminium rods shall be handled with the same care as the conductor.

e) Properly calibrated torque wrenches shall be used to tighten suspension clamp and dead-end bolts to the manufacturer's specified torque values. U-bolts shall be drawn up evenly to torque values. Bolts shall not be tightened excessively. Proof of calibration must be submitted to the *Supervisor.*

f) All conductor support assemblies shall be installed such that the insulator string will hang in a vertical plane through points of insulator string attachment to structure, with the structure properly aligned.

8.2.8 Vibration dampers

a) Where vibration dampers are specified, these shall be installed at each suspension and strain point.

b) The number of dampers to be installed per span shall be as recommended by the manufacturer. The spacing from the mouth of the strain clamp or the centre of the suspension clamp shall be in accordance with the manufacturer's recommendations.

c) If the use of armour rods makes it impossible to meet this spacing, the first damper shall be positioned at the end of the armour rods, and any additional dampers shall then be spaced from the first damper. Dampers shall be located within 25mm of their correct position.

d) Vibration dampers shall be installed when clamping the conductor, but only after the conductor has been securely fastened in the conductor support assembly.

e) Stockbridge type vibration dampers shall be installed so that they hang directly under the conductor.

f) The installation of vibration dampers shall be in accordance with the manufacturer's recommendations.

8.2.9 Multi-conductor spacers and spacer dampers

a) On lines employing more than one conductor per phase, spacers or spacer-dampers, shall be installed to separate the individual conductors of each phase.

b) Conductor spacers or spacer dampers shall be installed immediately after clamping the conductors, but in no instance shall conductors be allowed to remain without spacers installed for longer than seventy-two hours after clamping.

c) Notwithstanding the allowed times between stringing, regulating, clamping and fitting of vibration dampers, spacers or spacer dampers, the overall time for these operations shall not exceed six days (144 hours).

d) Conductor spacers or spacer dampers shall be installed within 1 000mm of the positions as specified by the manufacturer.

e) Conductor spacer carts used by the *Contractor* to move his men along the conductor shall be furnished with neoprene or rubber lined wheels to support the carts on the conductors. The carts shall be equipped with an odometer, which shall run on one sub-conductor and indicate distances in metres. The odometer shall be set in such a manner, as to give the distance from the suspension clamp to all cart positions along the span on the centre phase from which all the hardware on the three phases will be aligned perpendicular to the centre line of each span. Spacer-dampers will also be installed perpendicular to the sub-conductors of a phase along the catenary.

8.2.10 Jumpers

a) The jumpers shall be formed to provide the maximum amount of clearance from earthed hardware, and tower steelwork. Their positioning shall comply with the clearances stated under the specified displacements.

b) The *Contractor* shall supply labour and equipment to assist the *Supervisor* in measuring clearances from jumpers to earthed hardware if requested.

c) Jumpers not meeting the required clearances shall be removed and replaced.

8.3 Stringing of OPGW

Refer to “TRMASACB2 – Standard for the installation of overhead ground wire with optical fibre (OPGW)”.

Annex A

Revision information

DATE	REV. NO.	NOTES
9/88	0	• Document originally issued as NWS 1512.
7/92	1	• Text changes.
12/94	2	• Number and format of document changed to comply with requirements of the Eskom Documentation System. (See Eskom Directive ESKADAAA0 and Eskom Procedure ESKPVAAA0). • Text changes made.
12/00	3	• Text changes made.

APPENDIX F

ESKOM'S PROCEDURE FOR ACCESS TO FARMS (TRMPVACV2 REV 1)

Eskom Transmission

PROCEDURE

REFERENCE	REV
TRMPVACV2	**01**

TITLE: **ACCESS TO FARMS**

DATE: **OCTOBER 2002**

PAGE **1** OF **5**

REVISION DATE: **OCTOBER 2005**

COMPILED BY	FUNCTIONAL RESP.	AUTHORIZED BY
H.F.Vosloo	E Shunmagum	G. Bruce
Transmission Servitude Specialist	Primary Plant support Manager	Transmission Technology Manager
DATE: 1/10/03	DATE: 10/11/03	DATE: 6/11/03

This document has been seen and accepted by:

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B Vockerodt	Regional Line and Servitude Manager
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R Bekker	Regional Line and Servitude Manager
E Grunewald	Lands and Rights Manager

Revision Information

Rev	Notes	Date
1st draft	Broaden scope of document to include notice to Line and Servitude Manager, inclusion of gate log and references to the Fencing act.	October 2002

Note: Concerns queries and comments on this document should be referred to the compiler **Classification category:**

CONTENTS

Page

1. Purpose

The access to land on which Eskom holds servitudes is a matter that is of concern to both the maintenance personnel as well as landowners. Security on farms is important to landowners, who want to control access to their farms. Although Eskom has a right to enter farms in order to maintain plant, it must always be remembered that we are visitors and should pay the appropriate respect to the landowner.
Claims against Eskom arise from inappropriate behaviour during visits and these in turn lead to difficulty in obtaining new servitudes.
This document proposes to regulate the visits to properties over which Eskom holds servitudes.
This document details Transmission's requirements for any Transmission employee or contractor (visitor) that enters land on which Eskom Transmission holds a servitude.

2. Applicability

This document shall apply to all Transmission Servitudes

3. Normative References

Fencing Act (Act 63 of 1963)

4. Definitions

3.2. **Land owner:** A land owner is defined for the purposes of this document as the owner of the land, registered as such in the Deeds Office, his/her assignee, representative or the legal occupier, manager or lessee of the land.
3.3. **Contractor**. Any company or person that performs work for or on behalf of Eskom Transmission on the servitude or line.
3.4. **Visitor**: An Eskom employee or contractor

5. Abbreviations

none

6. Requirements for access to land

6.1. Notification of intended visit

No Eskom employee or contractor shall enter land over which Eskom Transmission holds a servitude without prior notification of the **Line and Servitude Manager**.

Any visits should preferably be carried out in the company of a member of Line and Servitude Manager's staff.
Landowners shall as far as possible be notified prior to the intended visit. The Line and Servitude manager or Lands and Rights will assist in the notification of landowners. Where landowners cannot be reached, notification should be given via other appropriate security or community structures that exist in the

area. The Line and Servitude Manager or his staff will be familiar with such structures. The notification should include description of vehicles, the number of people and the time and intention of the visit.

Where an unplanned visit takes place, every effort should be made to inform landowners or their personnel of the visitor's presence.

6.2. Identification of visitors

Eskom personnel visiting farms shall carry Eskom Identity cards displaying a photograph, unique number and National I.D, number. These visitors shall also have the Line and Servitude Managers details available upon request so that a landowner may verify their presence telephonically.

6.3. Identification of vehicles

In addition to announcing the presence to land owners, vehicles should also display the Eskom Logo and markings where applicable. Where vehicles are not permanently marked, use must be made of magnetic logos.
Rotating magnetic roof lights may also be used in addition to displaying the Eskom logo.

6.4. Gates and Fences

Gates are intended to either permit or restrict the movement of animals on farms. Reference to gates is made in section 21 and 22 of the Fencing act (Act 31 of 1963). Although section 22 (b) of this act states that:
"Any person who-

(a) opens and leaves open or unfastened: or

(b) finding open on passing through, neglects to shut and fasten,

a gate in any fence shall be guilty of an offence and liable on conviction to a fine not exceeding fifty rand or, in default of payment……

Gates should be left in the state the landowner intended. In order to assist with any possible claims, any visitor will keep a log of each gate that is used stating

- the position of the gate with reference to towers
- the state in which it was found (open or closed)
- the time
- Any other appropriate information (locks, etc.)

This list should be forwarded to the Line and Servitude Manager at the earliest date.
The climbing or crawling over or through fences without permission of the landowner is prohibited in terms of section 23 of the Act and visitors should take note of this section.

6.5. Use of helicopters

Where use is made of helicopters, care should be taken in conjunction with the Line and Servitude Manager and the landowner not to cause any disturbance or harm to livestock such as ostriches or game.

6.6. Damage caused during a visit

Any damage caused to any gate, fence crop or grazing shall be reported to the Line and Servitude Manager who will then refer it to the appropriate

Eskom official for processing. Extreme care shall be taken with fires and the use of fires will only be permitted with the express approval of the landowner.

6.7. Removal of fauna or flora.

No fauna or flora will be collected or removed from any farm by any visitor without written permission of the landowner, in which case cognizance will be taken of appropriate provincial legislation pertaining to fauna and flora. Under such cases Eskom's ethical policies and guidelines will be strictly applied.

6.8. Waste and Refuse.

Any visitor will at all times refrain from littering and remove any refuse when leaving.

6.9. Complaints register.

Each Line and Servitude manager shall keep a register of all complaints received from landowners regarding Transmission servitudes.

6.10. The use of roads

Visitors shall as far as possible use only the servitude roads. Where this is not possible the landowner's permission shall be obtained for the use of any other roads. In all cases care shall be taken not to cause any damage in the process and driving through the veld must be avoided as far as possible.

6.11. High Voltage regulations.

Any visitor who intends to access any Transmission tower above the anti-climb, shall have the appropriate authorization issued by the region's GMR2.1

6.12. Access to Nature reserves

Access to any type of nature reserve requires specific permission, which should be arranged with the appropriate authority or landowners. Because these reserves have both dangerous as well as very expensive game, a designated guide should always accompany visitors. This will ensure the safety of the visitor as well as prevent any claims against Eskom in the case of death of expensive game.

APPENDIX G

ESKOM'S VEGETATION MANAGEMENT GUIDELINE

Eskom Transmission

GUIDELINE

TITLE: **TRANSMISSION VEGETATION MANAGEMENT GUIDELINE**

REFERENCE **TRMAGAAZ7** REV **0**
DATE: **MAY 2003**
PAGE **1** OF **28**
REVISION DATE: **MAY 2006**

COMPILED BY	FUNCTIONAL RESP.	AUTHORIZED BY
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Revision Information

Rev	Notes	Date

Note: Concerns queries and comments on this document should be referred to the compiler :

TABLE OF CONTENTS:

1. Purpose

The reaction of plants to made-made or natural impacts are complex. Plants account for a high percentage of line faults.
The aspect of line faults originating from fires have not previousely been documented and quantified.

The purpose of this document is to provide generic guidelines for the management of vegetation in Transmission's servitude in a sustainable manner that will also reduce risk of line faults resulting from plants.

In now way can this document attempt to be specific, but rather provides general guidelines that should be applied according to specific circumstances and each case should be managed by way of an Environmental Management Plan (EMP)

2. Applicability

This document will apply to all Tranmission servitudes.

3. Normative references

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4. Definitions

Servitude "the right to use someone else's land, for a specified purpose". In the case of an overhead line servitude, is the right to erect, operate and maintain an electric line as well as enter that land for the execution of those activities. It does not constitute full ownership and access and activities should always be carried out with due respect for the landowner. A servitude is registred in the Deeds office and forms part of the title deed of a property.

5. Abbreviations

EMP- Environmental Management Plan
ROW- Right of way, also meaning servitude in Transmission.
IVM- Integrated Vegetation Management
FDI-Fire Danger Index

6. HISTORICAL OVERVIEW AND INTRODUCTION TO VEGETATION MANAGEMENT

The development of vegetation management is related in “The history of Utility Right-of-Way Management in the New York State”. According to Jackson [2](p111) the first transmission line in New York State was built between Niagara Falls and Buffalo, covering a distance of 26 miles or 42km.

Finch and Shupe [4] state that during 1951 ammate herbicides (soluble crystals for foliar application) were first introduced.

The publishing of Rachel Carson’s book “The Silent Spring” in 1962 is credited with spawning the global environmental movement.

During 1972 legislation was introduced in the U.S.A. requiring environmental assessments.

A number of aspects such as the type, diversity and quantity of vegetation, burning regimes, the soils, hydrology, the rainfall, the impact on wildlife and land use practices influence the vegetation management plan for a particular stretch of power line. These aspects will vary from one area to the other and a successful management plan will have to take these aspects into account. Because of highly variable local conditions, this document can only indicate broad principles and experts will have to be employed to compile site-specific Environmental Management Plans (E.M.P.) applicable to a particular stretch of line.

7. PURPOSE OF THE ENVIRONMENTAL MANAGEMENT PLAN. (EMP)

The purpose of an EMP is to facilitate the management of servitudes in a sustainable manner, in keeping with legislation, Eskom policies and sound business practices to ensure the safe, sustainable and optimal operation of the transmission grid. This programme should enhance access for emergency and routine maintenance of the power line. The management of vegetation should be a key factor in the EMP and should consider the aspects highlighted below.

8. PROBLEMS TO POWER LINES CAUSED BY VEGETATION

8.1 SAFE CLEARANCES.

The first problem associated with vegetation in the R.O.W. is that of plants growing into the safe clearance distance and causing flashovers [3].

In South Africa the Occupational Health and Safety Act (Act 85 of 1993) stipulates the minimum clearances to be adhered to for a range of voltages.

8.2 FALLING TREES

The second problem associated with vegetation is that large trees that might fall on power lines and cause short a short-circuit [3]. This type of problem only occurs on transmission lines that run close to large trees associated with plantations.

8.3 FIRES

According to some utilities in Europe and America, they do not experience fire as a major high frequency cause of line faults, as is the case in South Africa.

Forest fires of a disastrous magnitude are sometimes reported in America, Australia and in South Africa. These fires cause enormous damage and but occur infrequently. As a result they are not normally considered a major threat to power quality.

Figure 1 Extensive forest fires in Colorado U.S.A. during 2002 (photo Tony Martinez)

Some utilities in South America also experience problems with fires resulting from agricultural activities such as the harvesting of sugar cane, the burning of fire breaks or veld management practices using fire.

In South Africa, veld fires are a normal sight during winter and the causes of them include low fire management skills, negligence and arson.

Three main factors influence the occurrence and severity of these fires. They are:
The cause of ignition.
The type, quantity and condition of the available fuel.
Atmospheric conditions.

Some of the causes of ignition can be addressed by training and awareness programmes. Others, such as arson cannot. Preventing ignition and managing fires when they do occur can be addressed by measures proposed by the Veld and Forest Fire Act (Act 101 of 1998)

Vegetation management is aimed not only at managing the growth of plants that compromise safe clearances, but also at managing the fuel for fires.

Aspects relating to atmospheric conditions are discussed later in the document.

9. INTEGRATED VEGETATION MANAGEMENT (I.V.M.)

I.V.M. is a methodology that found its roots in Integrated Pest Management (I.P.M) and Integrated Weed Management (I.W.M). I.P.M was associated mainly with insects whilst I.W.M. dealt with weeds [3] (p.128).

I.V.M. is a structured approach to the management of vegetation that combines manual activities, mechanical tools, and chemical applications with cultural and biological methods to develop a vegetation community that requires minimal maintenance and benefits wildlife and its habitat. [3] It is a method that is highly recommended to the reader.

9.1 KEY ELEMENTS OF I.V.M.

- **Prevention of problem development.** This refers to the alteration or use of R.O.W. conditions (land use and vegetation types) that are not considered a threat to power quality. Examples are certain types of agricultural and recreational uses. [5] (p119-120).
- **Assessment of the problem, current and potential.** A clear understanding of the problems that must be addressed (fire hazard or trees invading the air gap) is important for a successful plan. Environmental aspects that require consideration in R.O.W. management include aesthetics, wildlife interaction, rare and endangered plants, wetlands and water bodies [2](p105-106). The consequences of the management interventions, such as plant density and species composition must also be considered [2](p107-108). Because the management of nature is complex and no management intervention is without flaw, the plan should also include thresholds of acceptable damage resulting from remaining vegetation.[7]
- **Evaluation of alternative approaches.** The alternative methods available for vegetation management are listed below. The risks and consequences of each method must be considered. Methods such as allelopathy [5] (p120) and greenstripping [8] may also be considered.
- **Monitoring of effectiveness and adverse impacts.** The effectiveness of I.V.M. on the reduction of outages as well as the effects on plant composition and densities must be monitored on an ongoing basis in terms of the goals set. Negative impacts such as vigorous re-sprouting of trees after mechanical cutting alone [5](p119) or the change in species composition and density [2] (p107) are examples that can be observed through a monitoring programme.
- **Adaptive management.** The management of vegetation is neither static nor ever finished [5](p124). Constant observation of results and adaptation of management measures is required.

9.2 The Tools of I.V.M.

- Manual methods. These methods are labour intensive but have the advantage of being selective.
- Mechanical methods. These methods include the use of large machinery for the cutting and mulching of plant material. Whilst these machines are effective, especially in mono cultures of invasive aliens access to certain parts of the R.O.W. may prove problematic.

Figure 2. An example of a mechanical mulching machine.

- Biological methods. One of the principal goals of R.O.W. vegetation management is to establish plant communities that meet the management objectives. These may be to establish low growing, stable plant communities or the natural inhibition of growth. [5](p.120). Where fire suppression is the objective, certain plants may be selected for their fire retardant properties in a greenstripping strategy. [8]. Other biological methods used with undesirable plants include the introduction of insects [2](p 107) or plants, pathogens or micro-organisms that have an allelopathic effect on the target vegetation [3](p 128)
- Chemical Methods. These methods use herbicides of growth inhibitors and may be applied in a number of ways, ranging from hand application and selective foliar and cut-stump applications to aerial spraying. [4](p 71).
- Fire. Whilst European and American vegetation management rarely uses fire as a form of vegetation management, its use under South African conditions is well known and it is considered a natural and regular phenomenon in all parts of South Africa except for the arid regions. [8](p 421). When use is made of fire as a vegetation management tool in electrical R.O.W., care must be taken against the dangers of runaway fires as well as the inherent danger to personnel working under the lines as a result of possible flashovers occurring during the burn. The common practice has been to execute these prescribed burns at night, when a low F.D.I. exists. In addition to the use of prescribed burns in vegetation management, fire breaks under power lines remain the most certain way of reducing the fire risk to these lines. Care must however be taken in considering the possible effects of fire on vegetation in the particular biome under consideration. This aspect will be discussed later in the document.

Figure 3 Burning prescribed burns at night with a low F.D.I. reduces the risk of runaway fires as well as the occurrence of flashovers.

10. BIOMES, PLANT SPECIES AND R.O.W. MANAGEMENT

Plant structure, moisture content and the quantity of material available as fuel, dictate the flammability and fire hazard of plants. [9](423)

Different plant species pose different threats and require different treatment. For the purpose of this document, plants have been grouped into the following groups and management recommendations are made for each group:

1. Alien invasive plants.
2. Densifiers
3. Reeds
4. Grasses
5. Commercial forests
6. Sugar Cane
7. Fynbos
8. Karroo
9. Indigenous forests

Bush encroachment is defined as the “expansion of woody plants into vegetation previously dominated by non-woody plants or where woody and non-woody plants were co-dominant, resulting in reduced carrying capacity for domestic livestock (grazers). The phenomenon is widespread in southern Africa and is generally attributed to the removal of megaherbivores, the alteration of fire regimes, the reduced use of trees, overgrazing or a combination of these factors.”[10](p591). An example of this is the densification of sekelbos (*Dichrostachys*

cinerea) in the savanna biome. The management of plants that pose a fire risk will be referred to as fuel management.

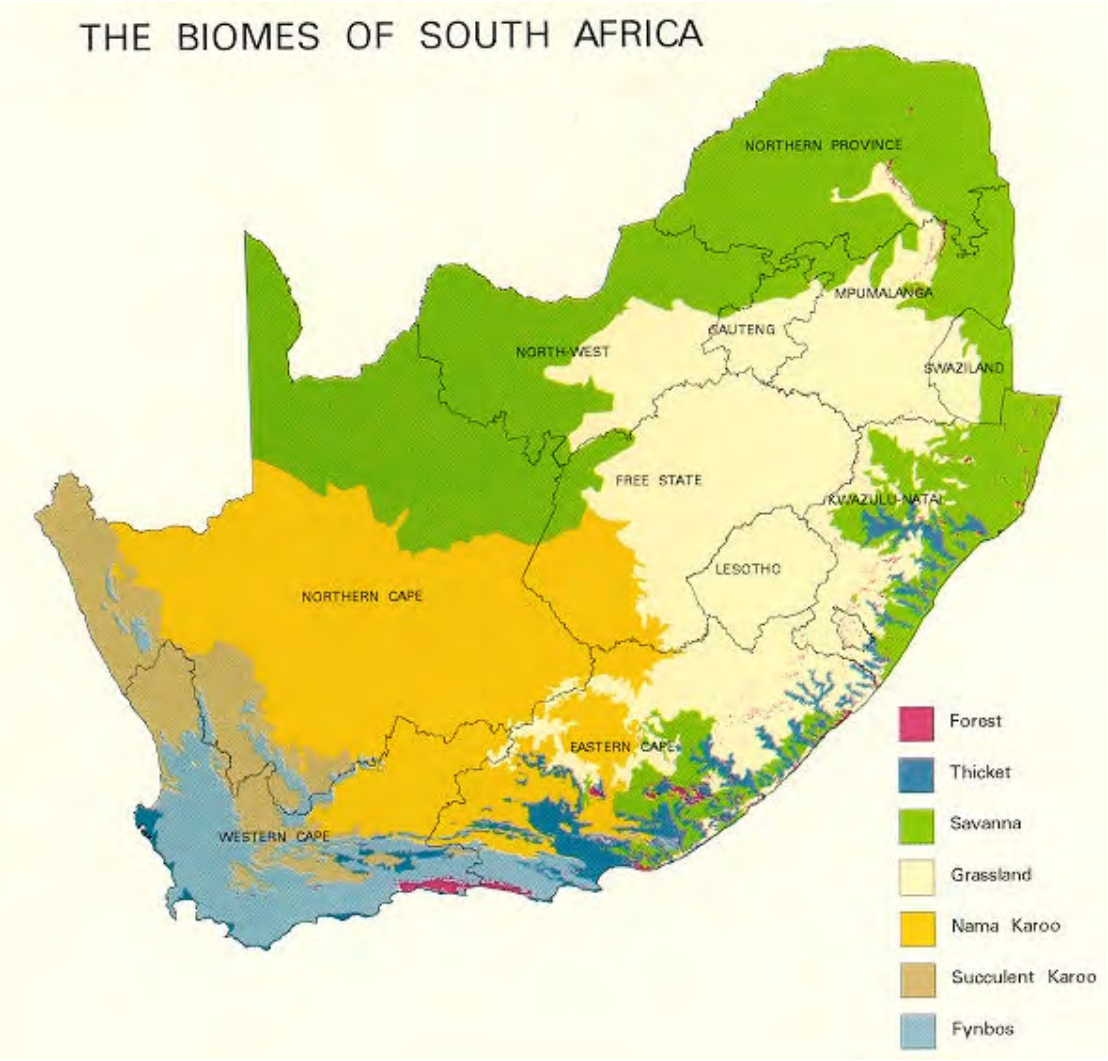


Figure 4. A map of the biomes of South Africa (Courtesy of the Dept. of Environment and Tourism)

10.1 Soils and topography

Plant species correlate closely with soils. Whilst plants pose a fire risk, they also stabilize soils and any plant management strategy should consider the effect on soils. Topographical features such as slopes not only add to the erosion risk, but have also been shown to add to the fire risk through the improved ventilation of the fire on sloped areas.

11. ATMOSPHERIC AND CLIMATIC CONDITIONS AND VEGETATION MANAGEMENT

11.1 CLIMATE AND VEGETATION

Plant production is clearly influenced by weather. Plant production is high, especially if good rains are followed by enough sunshine to promote photosynthesis. The occurrence of fires is influenced by the availability of sufficient fuel and they rarely occur in the arid regions of the west and the interior of South Africa or in the palatable grasslands or the arid savanna when the off-take by herbivores leaves nothing to burn [9](p421).

Medium term weather forecasts can be used in the general prediction of plant production and the strategies to manage it. As is the case with many aspects of vegetation management, the reader is advised to consult a weather expert on this subject.

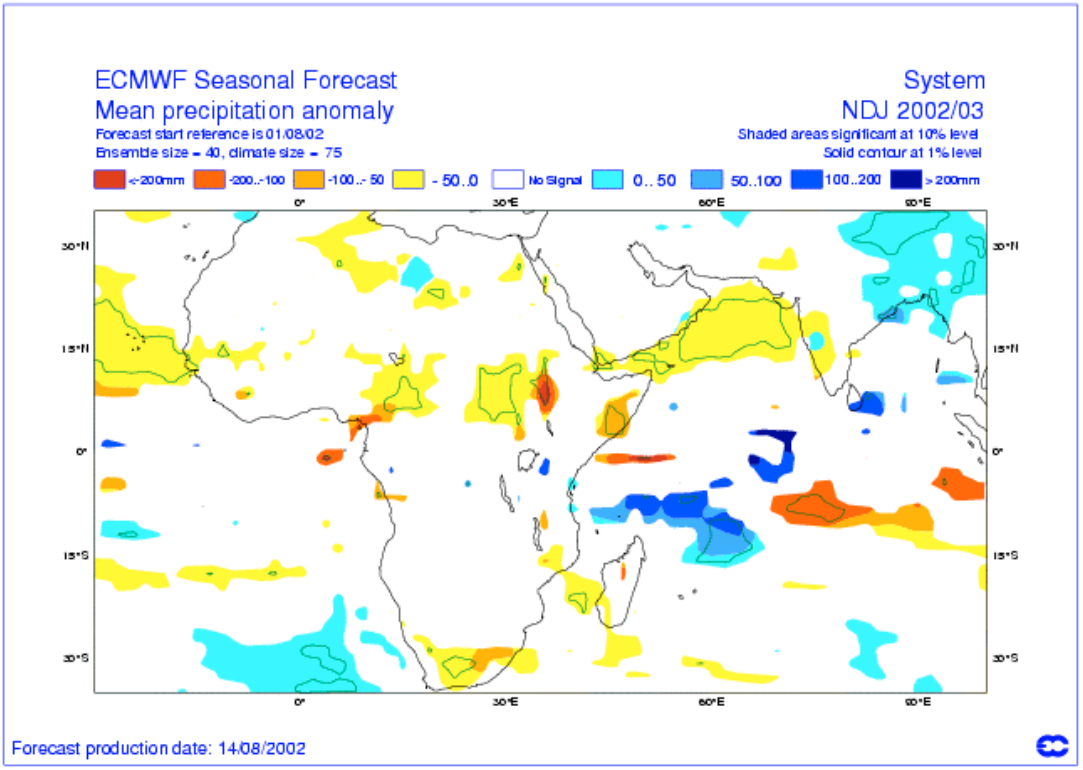


Figure 5. Example of a rainfall anomaly chart indicating predicted rainfall (Map courtesy of Sakkie Nigrini NETFORCAST)

11.2 WEATHER SYSTEMS AND FIRE DANGER.

The ignition of fires, fire behaviour and flame lengths are influenced in a major way by weather. In terms of the Mc-Arthur fire danger model used in South Africa, relative humidity, air temperature and wind speed are the main factors that are used to calculate the Fire Danger Index (F.D.I.) for a specific day (refer to the FDI page in Appendix F). Corrections are also applied for fuel moisture.

South Africa has both summer and winter rainfall areas. The Western Cape has a Mediterranean climate with winter rainfall and experiences dry windy conditions with a high fire danger [14] during the Austral summer months of December to March. The northern interior experiences fire weather during the winter months of April to September [15]. During these winter months, the subcontinent experiences frontal weather systems associated with pre-frontal Berg wind conditions. [1](p 202).

During these hot, dry and windy conditions, plant material becomes very dry and ignition of fuel is aided. Fanned by the high winds, fires spread rapidly and are extremely difficult to control. The windy conditions also ventilate fires and with the high availability of oxygen, hot fires with long flame lengths occur. These conditions coupled with fire whirls lead to flashovers of transmission lines. Even power lines with large clearances such as the 765kV lines suffer flashovers under these extreme conditions. [11,12,13]

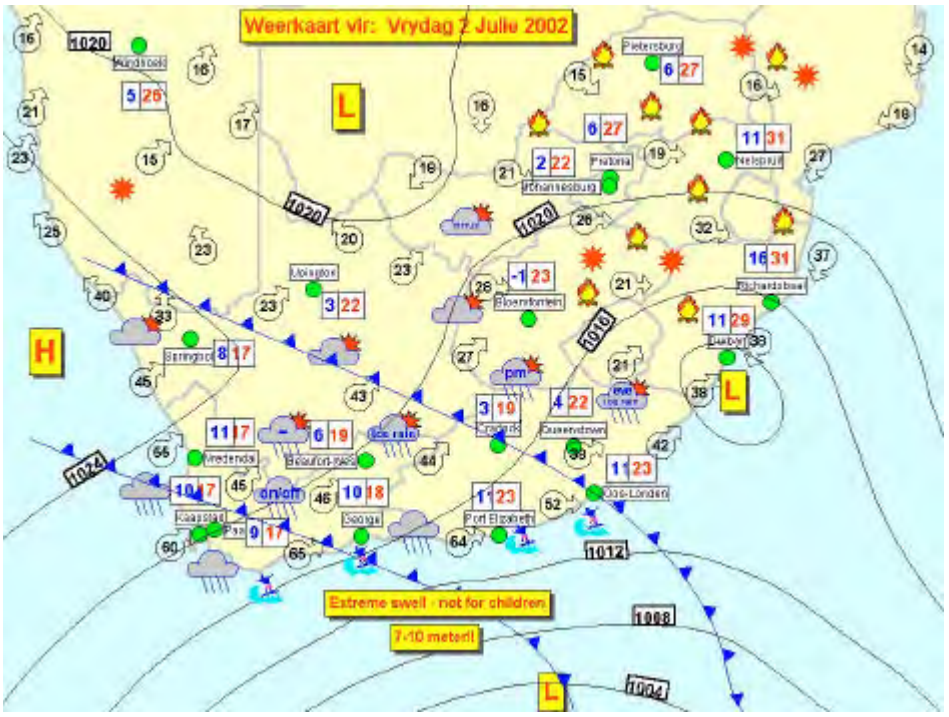


Figure 6 Example of a weather chart showing cold fronts with the associated inland hot conditions under the influence of a high pressure system, with Northerly to Westerly winds and associated fire risk. (Map courtesy of Sakkie Nigrini NETFORCAST)

Whilst it is not possible to control the weather aspect of fire risk, the use of fire breaks on the windward (NW to W) side of servitudes will reduce the intensity and heat of a fire in close proximity to conductors. In the case of the Cape Peninsula, the south-eastern side of the servitude must be protected. Experience has shown that when high winds are present, a distance of 100 m outside the servitude must be clear, especially of alien invaders such as *A cyclops and A saligna*.

Diligent lookout during times of high fire danger is also an important way in which this aspect of fire management can be addressed. This is further discussed later in this document.

12. VELD MANAGEMENT PRACTICES

The recommended veld management activities must be carried out, and should fit within a wide range of land use practices and the habits of the landowner or occupiers.

On one side of the spectrum, areas are managed as conservation areas. Under these conditions comprehensive veld management practices are employed that include burning programmes as well as control of the herbivores and their effect on the vegetation. Under these conditions Eskom's management of the servitude will have to integrate with that of the landowner. In certain cases, the servitude might be used by the landowner as a firebreak as part of the fire prevention measures.

Figure 7. Example of a power line servitude used as a fire break at Thaba Tholo near Thabazimbi.

At the other side of the spectrum, areas exist that are overgrazed and suffer from extensive erosion. Here fire risk would be low but risks associated with erosion will be high and management strategies should attempt to stimulate plant growth if possible.

The introduction of appropriate grass species may not only contribute towards reducing the risk of erosion, but will also compete with any resprouting shrubs. Cognisance will however have to be taken of the landowners' grazing practices as domestic animals will favour the cleared areas and over grazing and consequential erosion may be experienced.

Figure 8. Example of the dangers of erosion to power lines (photo Jorge Correia)

The Government has also committed itself to the eradication of alien invasive plant species in terms of the Conservation of Agricultural Resources Act (Act 43 of 1983). The well-known Work-for-Water programme bears testament to the commitment of the government towards eradicating these plants.

The use of fires as a veld management tool by landowners and the appropriate skills in this regard, varies across the country. Eskom has in the past, and must in the future, engage landowners in the safe use of fires, especially in close proximity to power lines.

13. LAWS AND POLICIES

A number of laws govern Eskom's actions with specific regard to servitude management practices. These range from the imperative of the protection of certain rare and endangered plant species to the removal of alien invasive species. Issues such as the sustained use of resources, measuring Eskom's impact, soil erosion, the use of chemical substances, are all in one way or another controlled by legislation or policy.

Safety clearances for power lines are stipulated by the OHS Act and these dimensions are considerably less than those required to safeguard against fire threats.

The newly promulgated Veld and Fire Act proposes to regulate fire related matters between landowners and will supersede previous fire legislation (refer to http://www.dwaf.gov.za/Forestry/Fireawareness/eng.pdf).

More information on the Veld and Fire Act can be obtained from an interpretative document issued by the Department of Water Affairs and Forestry. It can be viewed at http://intranet.eskom.co.za/enviroweb/

The use of an EMP for the management of a servitude is prescribed and controlled in terms of legislation, Eskom Policies as well as Eskom's commitment to becoming SABS ISO 14001 compliant.

For a comprehensive list of laws refer to http://appserv/enviroleg/acts.asp

14. SUGGESTED VEGETATION MANAGEMENT PRACTICES

All vegetation management activities should be carried out in terms of an EMP as prescribed by 4.2 of ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWERLINE SERVITUDES) and ESKPVAAZ1 (ENVIRONMENTAL MANAGEMENT PROGRAMME (EMP) PROCEDURE) These documents can be viewed at http://intranet.eskom.co.za/enviroweb/

All protected species shall be treated in terms of applicable legislation (refer to the above Enviroweb website).

The use of herbicides is prescribed by policies that can be viewed at http://teknowrep.eskom.co.za/EM_Herbicides/MM/main.htm

The following titles can be found there:

The Need for Herbicide usage in Eskom , Eskom Herbicide Policy and Strategy , Herbicide Use in Eskom , Herbicide Research in Eskom , Eskom Herbicide Guidelines , Safety Considerations and Responsible use of Herbicides, Recommendations on Herbicide Strategy in Eskom

14.1 Clearing of Reeds

These plants should be cleared for the total width of the servitude and an appropriate herbicide plan instituted (refer to http://teknowrep.eskom.co.za/EM_Herbicides/MM/main.htm for the Reed and Bulrush Management Plan). In areas of high winds such as the Western Cape, reeds should be cleared for 100 m outside the servitude or as local conditions may indicate. This should be done in full consultation with landowners and with an appropriate EMP as prescribed by ESKPVAAZ1 (ENVIRONMENTAL MANAGEMENT PROGRAMME (EMP) PROCEDURE) and ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES). See the Enviroweb website. Because the plants are associated with wetlands, care should be taken to minimize any impact by the management activities on the wetland.

14.2 Clearing Alien invasive vegetation

In terms of the Conservation of Agricultural Resources Act (Act 43 of 1983), all alien invasive species in the R.O.W. should be cleared and chemically treated for the total width of the servitude. Refer to "Problem Plants in Transmission and Distribution" on the Enviroweb website (refer to ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES)).

In areas of high wind (e.g. Western Cape) alien vegetation should be cleared to a distance of 100 m outside the servitude or as local conditions may indicate, as a precaution against fire.

Adjacent landowners should be included in the removal of alien plants as the Conservation of Agricultural Resources Act (Act 43 of 1983) also applies to them. Particular attention should be paid to alien plant infested rivers.

14.3 Management of savannas.

Savannas are described in broad terms by Scholes [16](p258) as consisting of a two layered structure (tree and grass layer) with an intermediate layer of shrubs that is sometimes present. These groups of plants are inter-linked and activity in the tree and bush layers will have an effect on the grass layer.

Fire in savannas is limited by the availability of grass fuels and the sparse grass production in arid savannas usually does not support fire [9](p 440, 439). Rainfall, soils and grass production should therefore form an important part of the vegetation management strategy.

A phenomenon known as bush densification occurs when the natural balance between the grass, shrub and tree layers is disturbed through change in interaction with grazers, browsers and the exclusion of fire [16](p 271) [9](p 439). Bush densification, as defined above, represents a problem in the savanna biome as it produces an abundance of fine fuels for fire and many fire-induced flashovers of transmission lines are experienced under these conditions.

Figure 9 An example of bush densification in the savanna biome and the amount of cut material that is generated during bush clearing (photo Theuns de Bruin, Pottie Potgieter)

The clearing of this biome generates a high volume of cut material, which poses a fire risk of its own. The clearing activities should therefore be done in a way that reduces the fire risk in the vicinity of the power line but without creating a new risk. These activities should also be done in a way that will not have a negative effect on the remaining plants and soils. Methods of disposing of this unwanted material will differ from one farm to the other as farming methods and owner preferences differ while suitable methods of disposal exist under certain farming practices

14.3.1 Fire critical zones in savanna

From observations of burn sites in the savanna biome, during the 2001 fire season, it was concluded that the fire-critical zone for flashovers resulting from fires in densifiers happens

within 5 m from the vertical below the conductor, predominantly in the mid span area. These values are highly influenced by the atmospheric conditions at the time of the fire.

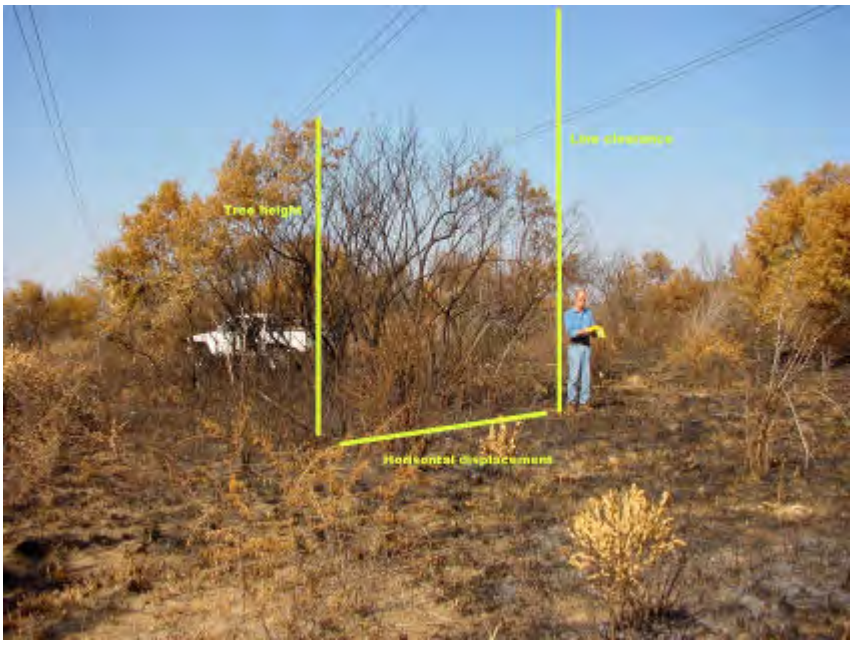


Figure 10 Measurements taken at a flash site after a fire.

Based on these results, the area of the servitude within 5 m from the outside conductors should be considered as critical for clearing any densifiers or any other plants that pose a fire risk. The areas closer to the towers carry a lower fire risk than the mid-span area. Local conditions have a marked effect on the fire risk and may indicate the removal of fire risk in a curved fashion as indicated in the sketches at the end of the document. See appendices A, B and C.

The secondary zone of the servitude refers to the remainder of the servitude. Local plant and other fire risk conditions will determine the action with regard to determining the fire risk of the plants in this area.

14.3.2 Fuel management in the servitude

Not all plants in the servitude pose a fire risk. The excessive removal of plants not only leads to a risk of erosion in certain soils and generates large quantities of unwanted plant material, but will also have an impact on the species of grass that will grow in the servitude in this newly modified habitat. It can be expected that that higher than normal growth of grasses will follow the removal of shrubs. The removal of large amounts of vegetation will also have an effect on the aesthetics, in particular on farms where eco-tourism is practised.

Atmospheric conditions such as wind speed, relative humidity and air temperature will greatly influence fire behaviour and this must be borne in mind with the clearing of the servitude.(see annexures A-D) As densifiers do not carry any legal protection and as they signify abnormal situation, they may normally be removed especially where they restrict access or pose

further fire risks. Protected species, slow growing plants that, due to their structure, do not pose a fire risk should be identified during the compilation of the management plan and left intact in the interest of preventing soil erosion.

In the compilation of the vegetation management plan consideration should also be given to plants with agricultural value. An example of such a plant that is found in the savanna biome is *Grewia flava* (Rosyntjiebos, Maretwa). This plant is highly favoured by both domestic animals as well as game and is often associated with grass, thereby adding to its fire risk. In cases where large plant specimens grow in the fire critical zone, these may be removed. In the rest of the servitude others should be left.

The removal of plants in the servitude should be preceded by a vegetation assessment where that actual condition of the veld is assessed and protected and other beneficial species are identified. The amount of densification should also be determined coupled with the associated local farming practices and vegetation removal strategy should be based on these facts and included in the EMP.

Where access to a botanists and a comprehensive vegetation survey is totally not possible, the following method may be applied: It is proposed that all shrubs, acacias and compound fine-leafed trees with a stem diameter smaller than 100 mm are cut. This should be revised after the first 10 spans have been cut to determine an appropriate standing stem count for the area. The remaining trees should then be assessed individually for their own risk in terms of fires or clearance.[Butch Rossouw, SURICATA, pers comm.)

Plants in valleys as depicted in appendix E can also be left without posing any fire risk.

In cases where a rigorous fire management plan exists on the land in question, this should also be taken into account in the determination of the fire risks. In cases where no control over fires exists, as is sometimes the case with Government-owned land, more extensive clearing would be called for than in the case where strict fire control measures are in force.

Care must however be taken with the extensive removal of plants not to destabilize soils. The appropriate EMP with a herbicide plan will ensure that this aspect as well as any other consequential reaction of plants (such as the growth of weeds or aliens) will be managed. The introduction of grass species may be considered as a remedy in these cases. The spreading of the cut material on areas of sparse plant growth may also contribute to the establishment of a micro-cosmos that will encourage the establishment of grass. The close contact between the cut material and the soil will also aid the decomposition of the cut material.

As mentioned above, the existing land use practices (livestock or game farming) will also have to be taken into account during this process. The landowner should at all times be consulted and be made part of the process.

Where eco-tourism is practised, effective use can be made of plants as a visual screen next to roads and tracts to screen towers and cleared areas. The management plan should identify and use plants with a low fire risk for this purpose.

Protected species shall be treated as prescribed by the law and only be cut after obtaining an appropriate permit. “Hot spots” where protected species (or unwanted species such as weeds) are likely to occur, may be used as a screening method in the compilation of the EMP.

The chemical or biological follow-up treatment should be discussed with the landowner and should follow the guidelines in ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES).

14.3.3 DISPOSING OF CUT MATERIAL

The disposing of large quantities of cut material generates its own problems. The stacking of cut material in windrows at the edge of a servitude poses a further fire threat to the line. It also has the potential to sterilize the seedbed under hot burning conditions. Farmers also complain about the effect that these windrows have on the free movement of game and stock animals.

As a result the above selective cutting procedure is proposed. This should adequately reduce fire risk without generating an unnecessarily large quantity of cut material that has to be disposed of.

Local farming practices will indicate which disposal method is to be followed. The following methods are available:

- Cut material can be spread equally inside and outside the servitude to protect new grasses from grazing pressure. The fire risk of this method must be assessed for each case and cognisance should be taken of the fire- critical zones as well as local farming and burning practices. In some cases stock farmers do not like this method as they claim that it prevents their cattle from grazing there. Under these conditions a high risk of overgrazing exists and these servitudes must be monitored closely. The cut material should as far as possible, not be stacked, but placed in close contact with the soil to aid the decomposition of the cut material.
- Excessive plant material may in certain cases also be removed by mulching, provided that the mulched material is spread in such a way that it does not sterilize the soil. This method has, to date, not proved very successful as the densifiers consist of high-density woods and equipment failure has been experienced.
- In certain areas the cut wood may be utilized as firewood by the landowner or by third parties. Local conditions and landowner preference will indicate the appropriate course of action.
- A proposal worth exploring would be to determine the viability of establishing a BEE/SMME contractor to chip and process the removed shrubs for the manufacture of compost or game pellets.
- In cases where the removal of plant material is not feasible, prescribed burning of the servitude may take the place of vegetation removal. Prescribed burns can take place with the line switched out and can be carried out during the day or at night. In cases of high phytomass, night burns are preferable. Certain plant types such as khakibos, blackjacks and cosmos have been reported to be implicated as high-risk plants with regard to fire flashovers. These plants occur where the soil has been disturbed as a result of agricultural or other activities and require special attention during fire prevention planning.
- The F.D.I. must be obtained and burns must be carried out by people with the correct training and equipment appropriate for the task. Cognisance should be taken of the possibility of soil sterilisation and consequential plant succession during these burns. As a general rule, landowners must report all burns to Eskom so that the necessary arrangements can be made to safeguard the lines.

14.3.4 FURTHER MANAGEMENT OF THE VELD

The further management of the veld after the removal of plants should be established and contained in a site-specific E.M.P. The aim should be to establish a stable and low maintenance situation with a minimum fire risk. The use of fire should play an important role here. The involvement of landowners in this process is extremely important. A monitoring programme should indicate any corrective actions.

15. COMMERCIAL FORESTS

Refer to ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES) and the Commercial Timber Growers Guideline for Maintenance and Maintenance Agreement in Forest plantation areas and servitude areas.

16. SUGAR CANE

Sugar cane is harvested after excess plant material has been burnt off. Where this process takes place in the proximity of, or underneath, power lines, a flashover occurs.[17]

Cane-free servitudes have been used as a remedy but this reduces the landowners' production capability. Early notification of intended burns is reported to Eskom's Operation Fire Break. If possible, lines are switched out for the duration of the burn. During 2001 more than a thousand reports of intended burns were received which resulted in successful switch-outs and the prevention of fire faults. Unplanned burns still remain a problem.

Other methods such as green harvest or thrashing are used. Innovative work on the alternative harvesting of cane in the vicinity of power lines has been done.

17. KAROO BIOME.

This biome is not known for fire risk. It is however vulnerable to erosion and veld management activities must be addressed in the site-specific E.M.P.

18. FYNBOS

This is a highly diverse and prized floral kingdom that also poses a high fire risk to power lines, The fire risk to power lines from plants in this biome, is further compounded by the atmospheric conditions prevalent in the Western Cape during the Austral summer.

The management of this biome is highly specialized and has a complex response to variation in the fire regime. Changes in species composition are attributed to the interaction between fire and the regenerative properties of the plant. [9](p 433). Bond [9] states that because some proteoid shrubs only regenerate from seed stored in canopy seed banks, some fires may drastically alter species composition. Short fire frequency can eliminate certain non-sprouting proteas, whilst favouring serotinous species.

The management of servitudes in Fynbos areas is clearly a very complex matter. Fire must be used with great caution and veld management practices have to be developed in a site-specific E.M.P. for this biome by experts with the appropriate knowledge.

19. INDIGENOUS FORESTS.

Indigenous forests normally do not pose a fire risk as they seldom burn [9](p 423).

The plants are worthy of conservation and a site-specific veld management E.M.P. must be developed for each case.

20. COMMERCIAL FORESTS

Commercial forests normally do not pose a fire risk to power lines, except under severe conditions. Servitudes are normally maintained by or in conjunction with the forestry industry and are often used as fire breaks in the fire management plan for the plantation.

The forestry industry is well organized to prevent fires as well as the early spotting and fighting of fires. Fire fighting associations (FFA) exist in Mpumalanga, KwaZulu Natal and the Western Cape.

21. FIRE PROTECTION AND FIRE FIGHTING ASSOCIATIONS

In addition to commercially operated Fire Fighting Associations (F.F.A.), formed mainly by the forestry industry and mentioned above, the Veld and Forest Fire Act promotes the formation of Fire Protection Associations (F.P.A.). The F.F.A. may be employed to act as a fire watch on specified days (ORANGE and RED). These associations have spotter planes and fire fighting ground crews to enable the early extinguishing of fires that are reported. In extreme cases, air borne water bombers are also employed to extinguish large fires.

The formation of Fire Protection Associations (F.P.A.) in terms of the Veld and Forest Fire Act is an ongoing process where the community is organized to prevent and control fires. These associations will benefit Eskom once formed, as they will result in a more controlled situation with regard to fires. For more information refer to http://www.dwaf.gov.za/Forestry/Fireawareness/eng.pdf

22. CONCLUSION

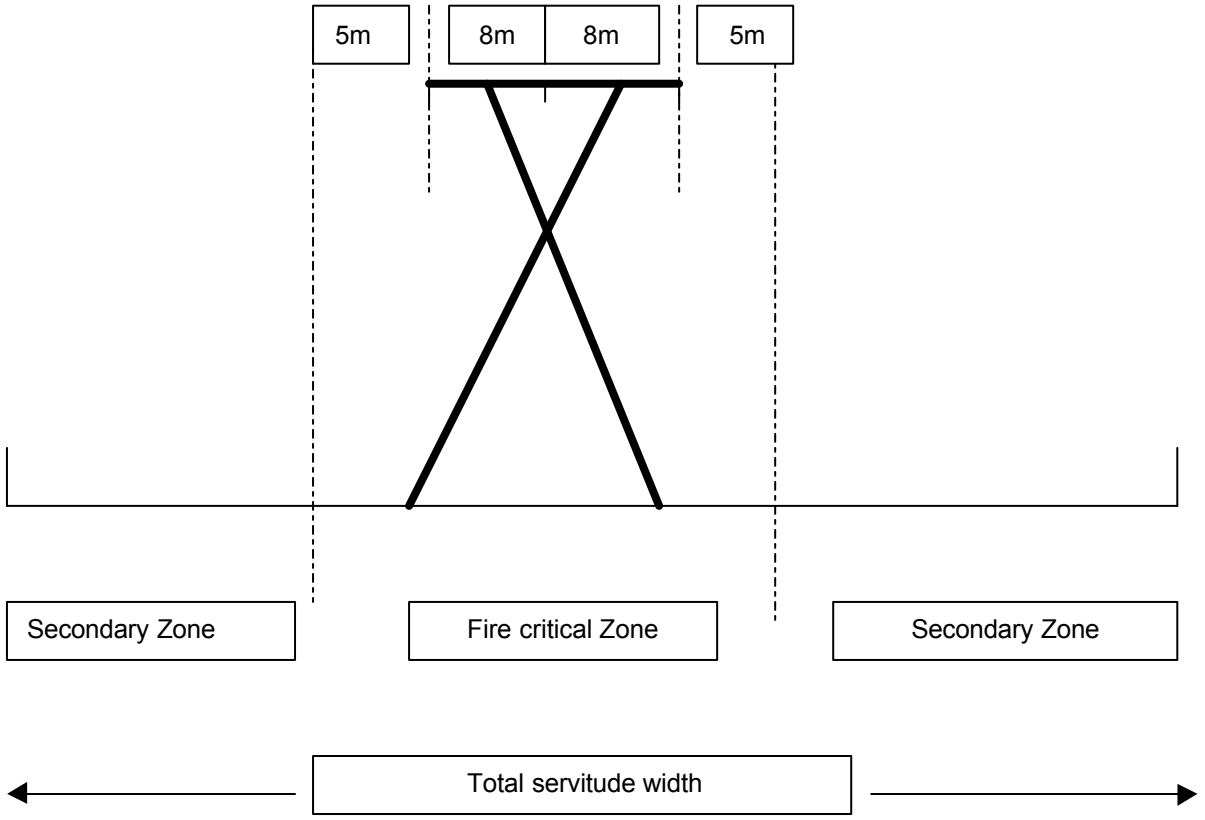
The management of plants in transmission servitudes is an important and complex matter as plants potentially have an important impact on the power quality. At the same time, activities throughout the life cycle of the transmission line, have a profound impact on flora and fauna. A comprehensive but practical management plan that takes care of both aspects appears to be the optimal way to manage servitudes.

23. Acknowledgements

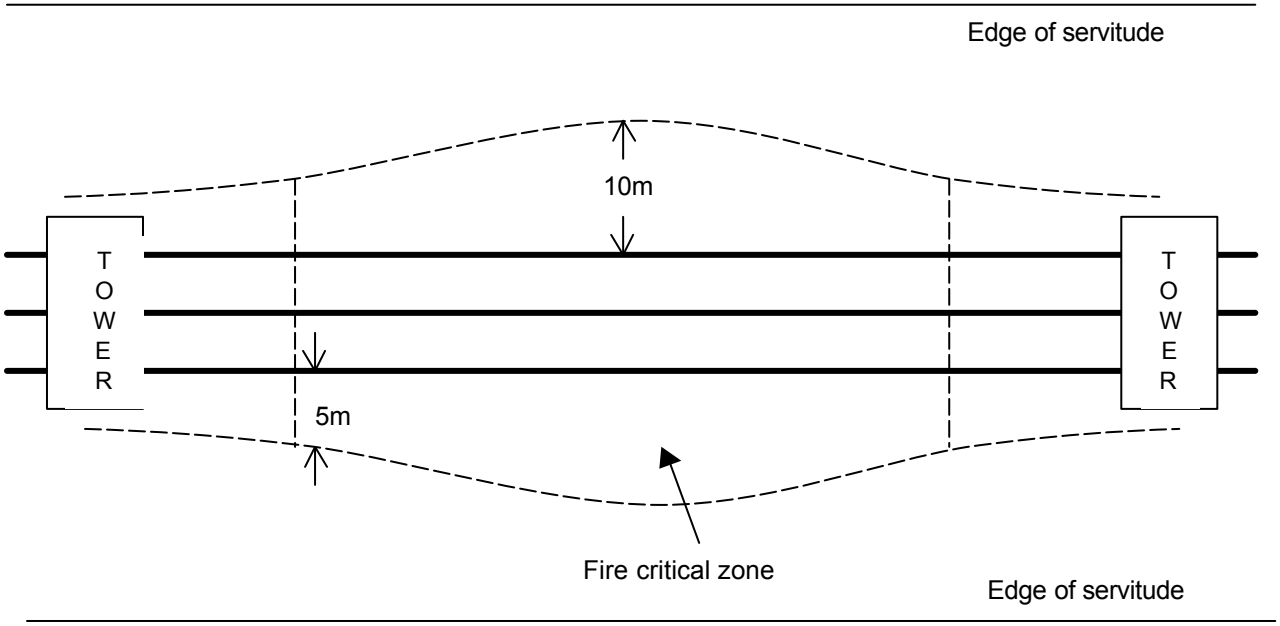
The autor wishes to acknowledge the contributions made by the Regional line and servitude managers and their staff as well as other Eskom colleagues in gathering information that was used in the compilation of this document..
The contribution ofPeter Nelson and dr. Eugene van Rensburr is also acknowledged.
The author wishes to thanks Butch Rossouw, Francois de Wet, Chris Austin and Joggie van Staden for their valuable input and shaping the ideas contained in this document.

24. Annex(es)

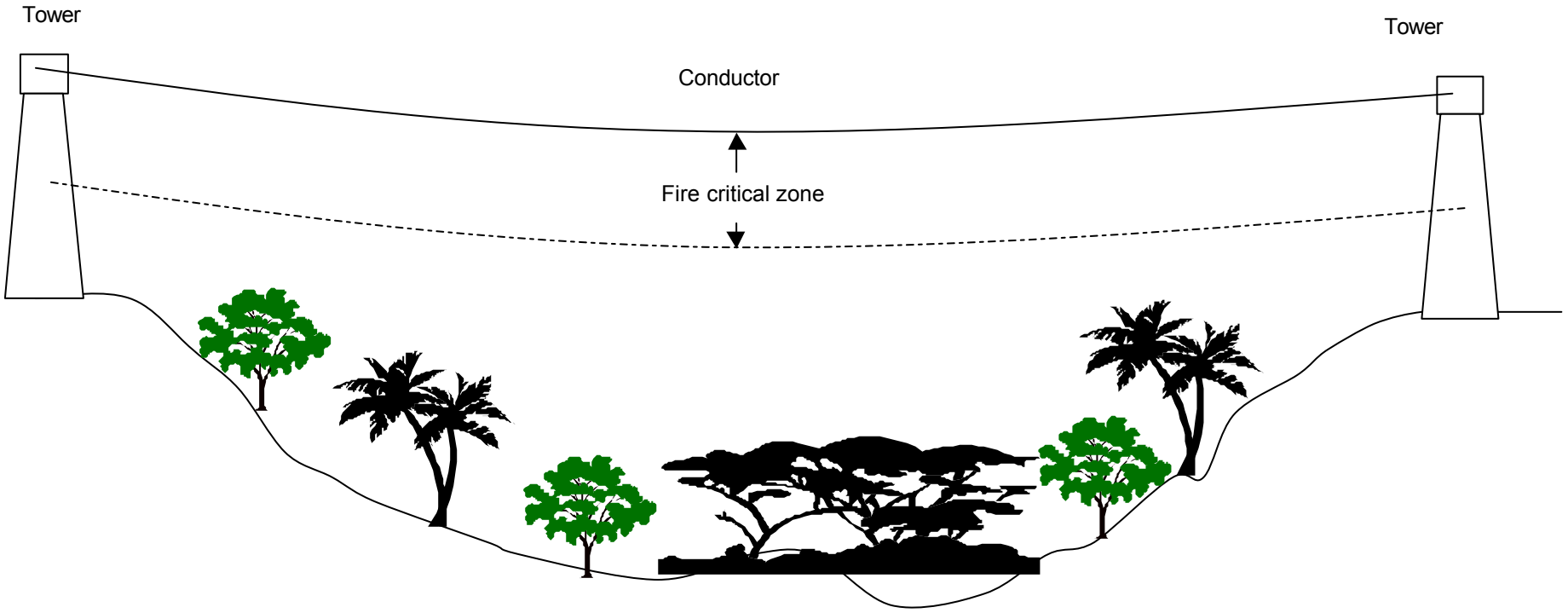
Appendix A: Typical cross section of power line



Appendix B: Typical plan view of power line



Appendix C: Typical long section of the servitude



Appendix D: A TYPICAL FIRE DANGER RATING SYSTEM

FIRE ALERT STAGES	BLUE	GREEN	YELLOW	ORANGE	RED
FIRE DANGER INDEX	0 – 20	21 – 45	46 – 60	61 – 75	78-100
FIRE BEHAVIOUR FLAME LENGTHS (m)	SAFE 0-1m	MODERATE 1 –1,2m	DANGEROUS 1,2 – 1,8m	VERY DANGEROUS 1,8 – 2,4m	EXTREMELY DANGEROUS 2,4m +
FIRE CONTROL GUIDE	Fires are not likely to start. If started, they spread very slowly or may go out without aid from suppression forces. There is little flaming combustion and intensity is low under all conditions. Control is readily achieved and little or no mopping up is required.	Ignition may take place near prolonged heat sources (camp fires, etc.), spread is slow in forests, moderate in open areas. These are light surface fires , with low flames. Control is readily achieved by direct manual attack and with minimum forces, difficulty may be experienced on exposed dry slopes and some light mopping up will be necessary.	Extreme caution should be taken when controlled burning is carried out. Aircraft should be called in at the early stages of a fire.	Ignition can occur readily, spread may be fast in the forests though not for sustained periods. Grass fires could outstrip forces with a spread of approximately 7km/h. Fires may be very hot with local crowning and “short to medium range” spotting. Control will be very difficult, requiring indirect attack methods with major assistance necessary. Mopping up may require and extended effort.	Ignition can occur from sparks. Rate of spread will be extremely fast for extended periods. Fires will be extremely hot with a dangerous heat effect on people within 10m of the fire and there may be extensive crowning, fire whirls and “long range” spotting. Control may not be possible by frontal attack during the day and fire fighters should limit their actions to containing lateral spread, until the weather changes. Damage potential total and mopping up operations mat be very extensive and difficult. Full assistance necessary

APPENDIX H

LANDOWNER SPECIAL CONDITIONS

ANNEXURE "B"

CONSTRUCTION PERIOD

1. The following special conditions are valid for the period from date of Option to completion date of the construction of the proposed project. This annexure will not form part of the Deed of Servitude.

2. The owner hereby confirms that none of the activities as mentioned in paragraphs *(2.1), (2.2), (2.3), (2.4), (2.5), (2.6) and (2.7) below, will affect Eskom's rights as granted in terms of the Option to Acquire a Servitude:

   2.1 Aircraft landing strips.
   2.2 Quarries of any kind.
   2.3 Dams.
   2.4 Pivot point irrigation systems.
   2.5 Dwellings.
   2.6 Keeping Giraffes
   2.7 Other (specify) .....

3. Eskom undertakes to adhere to the following conditions as requested by the owner for the period mentioned in paragraph (1) above

Inside game fence Eskom to provide 2m game fence 2.4m high normal game fence consist of 22 wires.
Four electric wires inside fence is required
No workers inside the game fence

Signed at Montana on this 9th day of March 20 12 in the presence of the undersigned witnesses:

AS WITNESSES:

1. .....

2. .....

.....
REGISTERED OWNER

(* Delete if not applicable)

ANNEXURE "B"

CONSTRUCTION PERIOD

1. The following special conditions are valid for the period from date of Option to completion date of the construction of the proposed project. This annexure will not form part of the Deed of Servitude.

2. The owner hereby confirms that none of the activities as mentioned in paragraphs *(2.1), (2.2), (2.3), (2.4), (2.5), (2.6) and (2.7) below, will affect Eskom's rights as granted in terms of the Option to Acquire a Servitude:

   2.1 Aircraft landing strips.
   2.2 Quarries of any kind.
   2.3 Dams.
   2.4 Pivot point irrigation systems.
   2.5 Dwellings.
   2.6 Keeping Giraffes
   2.7 Other (specify) .....

3. Eskom undertakes to adhere to the following conditions as requested by the owner for the period mentioned in paragraph (1) above

1) MAKE SURE LINE MISSES PIVOT.

Signed at MARKE HALL on this 18th day of FEBRUARY 20 11 in the presence of the undersigned witnesses:

AS WITNESSES:

1. .....

2. .....

(* Delete if not applicable)

.....
REGISTERED OWNER

ANNEXURE "B"

CONSTRUCTION PERIOD

1. The following special conditions are valid for the period from date of Option to completion date of the construction of the proposed project. This annexure will not form part of the Deed of Servitude.

2. The owner hereby confirms that none of the activities as mentioned in paragraphs *(2.1), (2.2), (2.3), (2.4), (2.5), (2.6) and (2.7) below, will affect Eskom's rights as granted in terms of the Option to Acquire a Servitude:

   2.1 Aircraft landing strips.
   2.2 Quarries of any kind.
   2.3 Dams.
   2.4 Pivot point irrigation systems.
   2.5 Dwellings.
   2.6 Keeping Giraffes
   2.7 Other (specify) .....

3. Eskom undertakes to adhere to the following conditions as requested by the owner for the period mentioned in paragraph (1) above

1) DO NOT CROSS PIVOT + LINE !!

Signed at MARBLE HALL on this 18th day of FEBRUARY 2011 in the presence of the undersigned witnesses:

AS WITNESSES:

1. .....

2. .....

x Botha
.....
REGISTERED OWNER

(* Delete if not applicable)

Rev 13.10.2009

ANNEXURE "B"

CONSTRUCTION PERIOD

1. The following special conditions are valid for the period from date of Option to completion date of the construction of the proposed project. This annexure will not form part of the Deed of Servitude.

2. The owner hereby confirms that none of the activities as mentioned in paragraphs *(2.1), (2.2), (2.3), (2.4), (2.5), (2.6) and (2.7) below, will affect Eskom's rights as granted in terms of the Option to Acquire a Servitude:

   2.1 Aircraft landing strips.
   2.2 Quarries of any kind.
   2.3 Dams.
   2.4 Pivot point irrigation systems.
   2.5 Dwellings.
   2.6 Keeping Giraffes
   2.7 Other (specify) .....

3. Eskom undertakes to adhere to the following conditions as requested by the owner for the period mentioned in paragraph (1) above

1. Beste binne 5 maande mag kap.
2. Geen vuur nie.
3. Geen Jag.
4. Volgende Jyr oral, die plaas gekoop moet word.

Signed at Ainst on this 18 day of February 20 11 in the presence of the undersigned witnesses:

AS WITNESSES:

1. .....

2. .....

.....
REGISTERED OWNER

(* Delete if not applicable)

APPENDIX I

MARBLEHALL-TUBATSE 400 KV POWERLINE ROUTE PROFILES