SIA Social Impact Assessment
SoE State Owned Enterprise

DEFINITIONS AND TERMINOLOGY

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Cumulative impacts: Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

Do nothing alternative: The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Environment: the surroundings within which humans exist and that are made up of:

i. the land, water and atmosphere of the earth;
ii. micro-organisms, plant and animal life;
iii. any part or combination of (i) and (ii) and the interrelationships among and between them; and

iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental Impact: An action or series of actions that have an effect on the environment.

Environmental impact assessment: Environmental Impact Assessment (EIA), as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental management plan: An operational plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its ongoing maintenance after implementation.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000).

Indirect impacts: Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

Interested and Affected Party: Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare".

Red data species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Significant impact: An impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

INTRODUCTION CHAPTER 1

In order to reinforce the existing Transmission network in the Tshwane Region, Eskom Transmission is currently proposing the construction of a 400kV transmission power line between the existing Apollo and Pluto substations. In addition, increased demand for a reliable electricity supply in the Central Grid has necessitated that Eskom Transmission improves the reliability and capacity of the transmission network in the area. Further, upgrade of the 400/132kV Verwoerdburg substation and establishment of a new Phoebus substation is also being proposed in the area in order to improve the reliability and quality of supply problems in the Tshwane area. Eskom Transmission is therefore proposing the construction of the **Tshwane Strengthening Project Phase 1.** The Tshwane Strengthening Project Phase 1 comprises of the following:

» **The extension and upgrade of the existing Verwoerdburg** Substation.
» Construction of **2x 400kV loop in and out power lines from the existing Apollo–Pluto** transmission line which will feed into the Verwoerdburg Substation, a distance of approximately ~4 km.
» Construction of the **new Phoebus Substation** adjacent to Hangklip Substation.
» Construction of a **new 400kV transmission power line** between the Phoebus Substation and the Kwagga Substation, a distance of ~30 km.
» The proposed loop in/out of Apollo-Dinaledi power line **Associated (infrastructure) works** to integrate the new transmission power lines and substation into the Transmission grid (such as access roads, communication tower, etc) and accommodate the new lines at existing substations (such as the construction of new feeder bays within the existing substation sites).

In total, **approximately 36 km of new power line** is proposed as part of the entire Tshwane Strengthening project Phase 1. The purpose of this project is to:

» Improve the reliability of the existing Central Transmission network.
» Improve the voltage regulation on the Central Grid Distribution and City of Tshwane Metropolitan Municipality network.
» Create additional Transmission network capacity which will supply the increasing electricity demand in the Central Grid.

As separate applications were submitted to DEA, separate reports have been compiled by Savannah Environmental as follows:

» The **nature and extent of the proposed 400kV transmission power line between the Kwagga and Phoebus Substations, the upgrade of the**

Kwagga Substation and construction of the Phoebus Substation, as well as potential environmental impacts associated with the construction, operation and decommissioning of this infrastructure are **assessed in this Final EIA Report (Reference Number 12/12/20/1471 and 12/12/20/1524)**.

The **nature and extent of the proposed 2x 400kV loop-in lines from the existing Apollo–Pluto and the expansion and upgrade of the Verwoerdburg substation**, as well as potential environmental impacts associated with the construction, operation and decommissioning of this infrastructure are **assessed in a separate Final EIA Report (Reference Number 12/12/20/1470)**.

This draft Environmental Impact Assessment (EIA) Report consists of the following chapters:

» **Chapter 1** provides background to the proposed Tshwane Strengthening project Phase 1 and the environmental impact assessment process
» **Chapter 2** provides an overview of the proposed Tshwane Strengthening project Phase 1
» **Chapter 3** outlines the process which was followed during the EIA Phase of the EIA process
» **Chapter 4** provides a description of the environment which may be potentially affected by the proposed project (Kwagga-Phoebus substations and power lines)
» **Chapter 5** provides an assessment of the potential issues associated with the proposed upgrade and establishment of the Kwagga and Phoebus substations
» **Chapter 6** provides an assessment of the potential issues associated with the proposed 400kV power lines and comparatively assesses the identified alternative corridors
» **Chapter 7** presents the conclusions and recommendations of the EIA and an Impact Statement
» **Chapter 8** presents the list of references and information sources used for the compilation of this FEIR

1.1. Background and Overview of the Proposed Project

Eskom Holdings Ltd (Eskom) is responsible for the provision of reliable and affordable power to its consumers in South Africa. Electricity by its nature cannot be readily or inexpensively stored and, therefore, must be used as it is generated. Electricity must, therefore, be efficiently transmitted from the point of generation to the end-user.

In South Africa, thousands of kilometres of high voltage transmission lines (i.e. 765kV or 400kV transmission lines) transmit this power, which is mainly

generated at power stations in the Mpumalanga and Limpopo provinces, to Eskom's transmission substations. At these transmission substations, the voltage is reduced and distributed to smaller distribution substation throughout the country through distribution lines (i.e. 132kV, 88kV or 66kV Distribution lines). Here the voltage is reduced and distributed to local substations, which distribute the power via various small lines (i.e. 22kV and 11kV lines) to local users. The power generated by Eskom can only be utilised from points of supply which transform power into usable voltage. However, transmission power lines and substations play a vital role in ensuring the provision of Distribution substations with sufficient power to be reticulated to the consumer.

If Eskom is to meet its mandate and commitment to supply the increasing needs of end-users, the organisation is required to plan, establish and expand its infrastructure of generation capacity and transmission power lines on an on-going basis, in parallel to the expanding electricity generation process. It is vital that transmission capacity keeps up with both electricity generation capacity and electricity demand.

As part of its assessment of supply requirements, and as a result of the projected load growth of the Gauteng region, Eskom have determined that additional transmission capacity will be required in the Tshwane area by the year 2013. For this reason, Eskom Transmission is proposing the **Tshwane Strengthening Project**. Figure 1.2 provides an indication of the study area considered within the EIA process for this proposed project (TSP Phase 1). This report focuses on the following components:

» Construction/establishment of the **new Phoebus Substation** adjacent to the existing Hangklip Substation.
» Expansion of the existing Kwagga substation.
» Construction of a **new 400kV transmission power line** between the Phoebus Substation and the Kwagga Substation, a distance of ~30 km.
» Construction of a loop in/out Apollo-Dinaledi power line.
» **Associated (infrastructure) works** to integrate the new transmission power lines and substation into the Transmission grid (such as access roads, communication tower, turn-in lines, feeder bay etc) and accommodate the new lines at existing substations (such as the construction of new feeder bays within the existing substation sites).

In addition, it must be noted that the **Tshwane Strengthening Project Phase 2** consists of the proposed Dinaledi-Anderson 400 kV power line corridor and the refurbishment of the Lomond substation, while **Phase 3** includes the Hangklip/Dinaledi 132 kV corridor as well as the installation of a third transformer at the Verwoerdburg substation. Lastly, **Phase 4** includes the addition of a second transformer at the proposed Phoebus substation. The environmental

impact assessment by **Nemai Consulting** is currently underway for the Tshwane Strengthening Project Phase 2 including the establishment of the Anderson substation and the 400kV power line between Dinaledi and Anderson substations, (Reference Numbers **12/12/20/1567** and **12/12/20/1568**)[1].

[1] These are subject of a separate EIA altogether by a different EIA Consultant

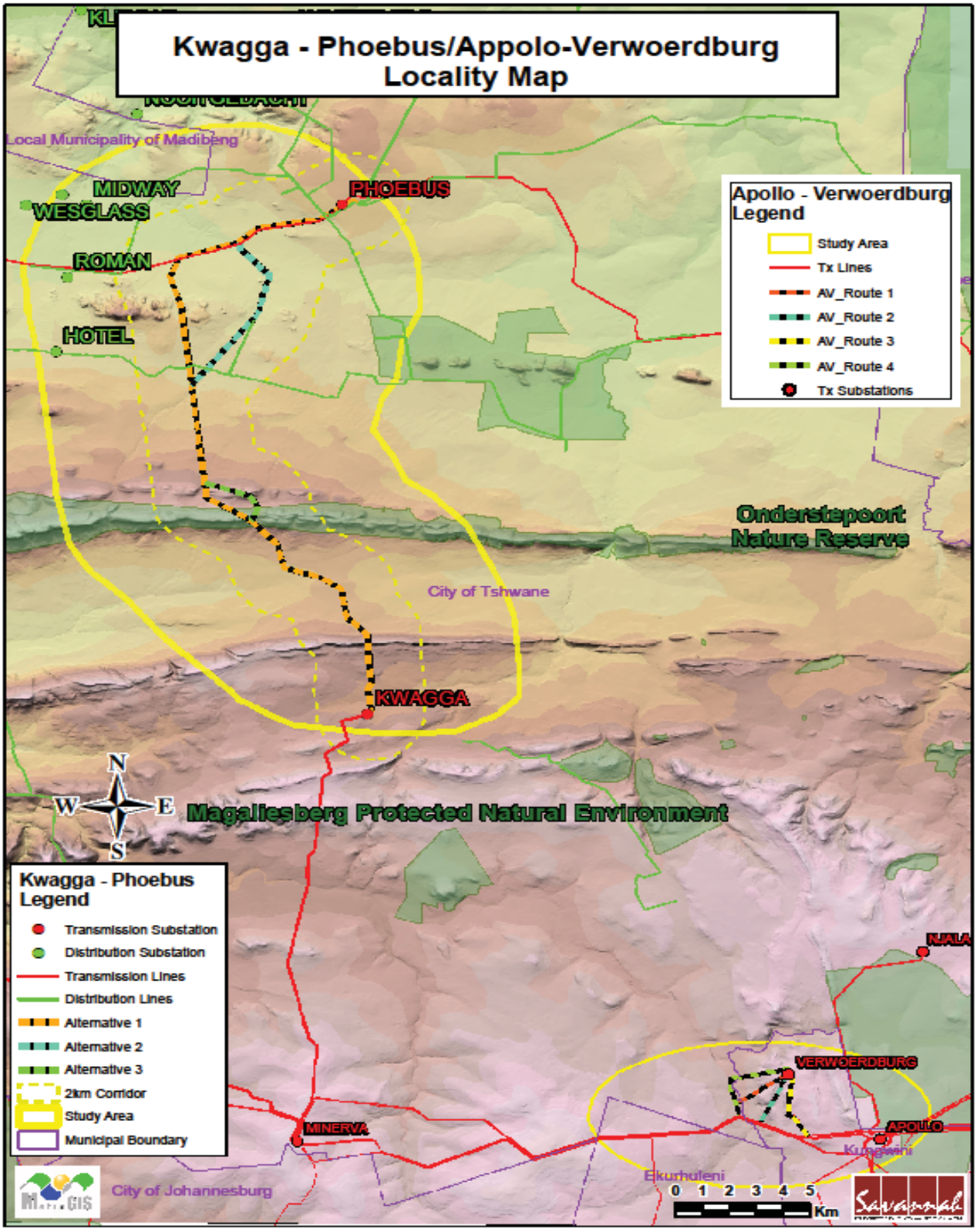

Figure 1.1: Locality Map showing the various components of the proposed Tshwane Strengthening Project Phase 1

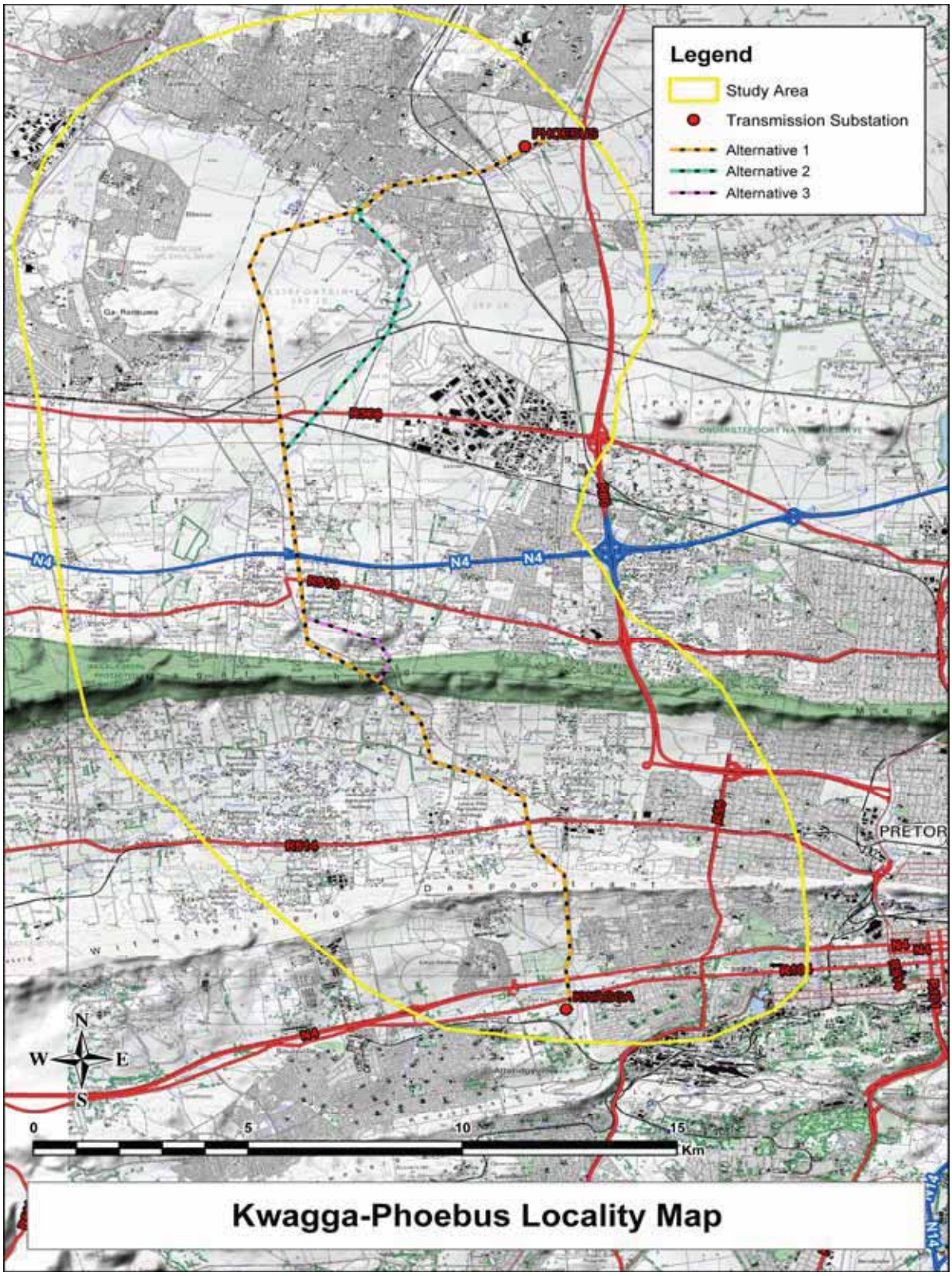

Figure 1.2: Locality map showing the study area for the proposed Kwagga-Phoebus transmission power line and, as well as alternatives identified for consideration in the EIA process

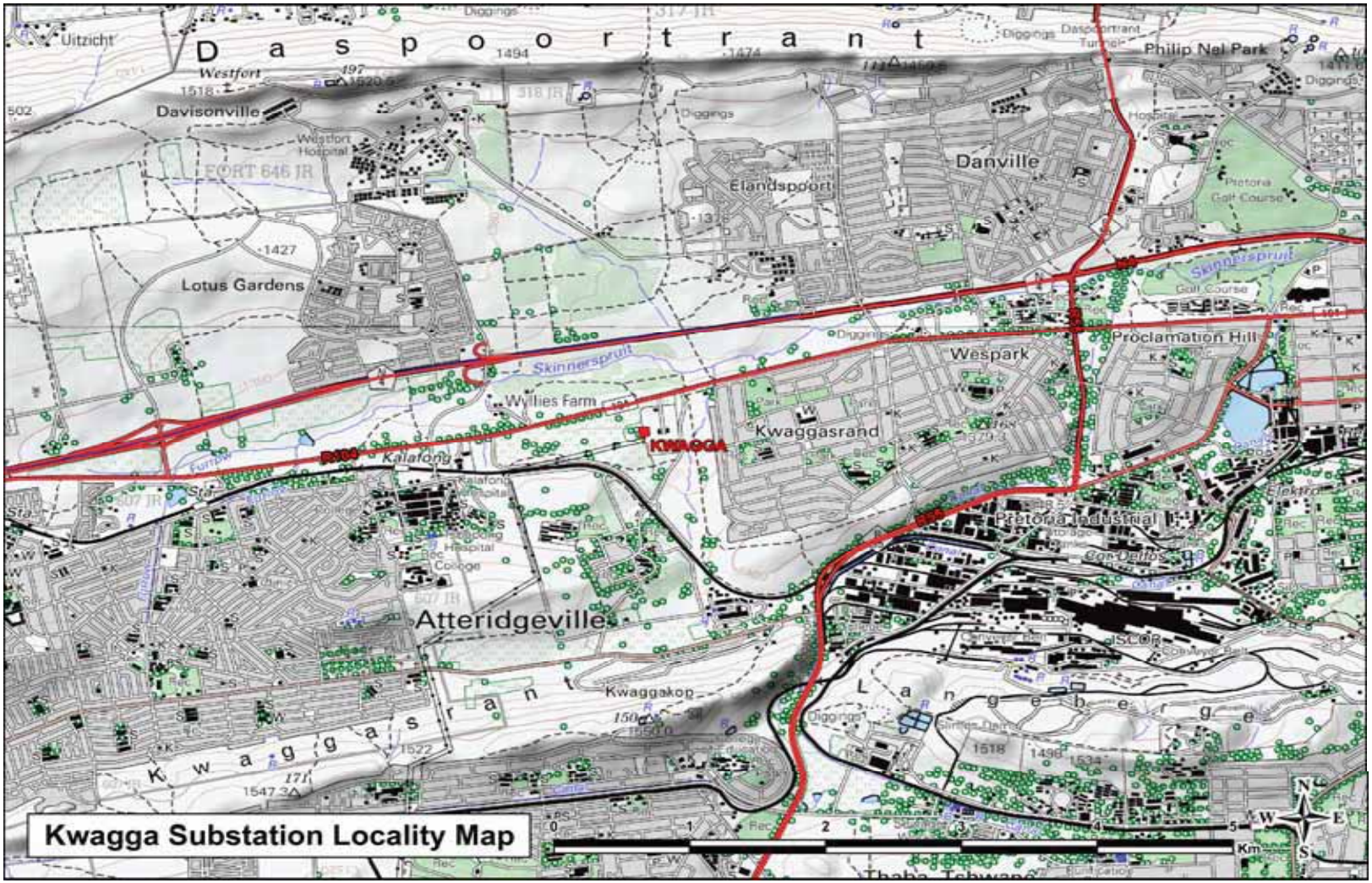

Figure 1.3: Locality map showing the locality of the Kwagga substation near Kwaggasrand in Pretoria, as well as the extension under investigation during the EIA process

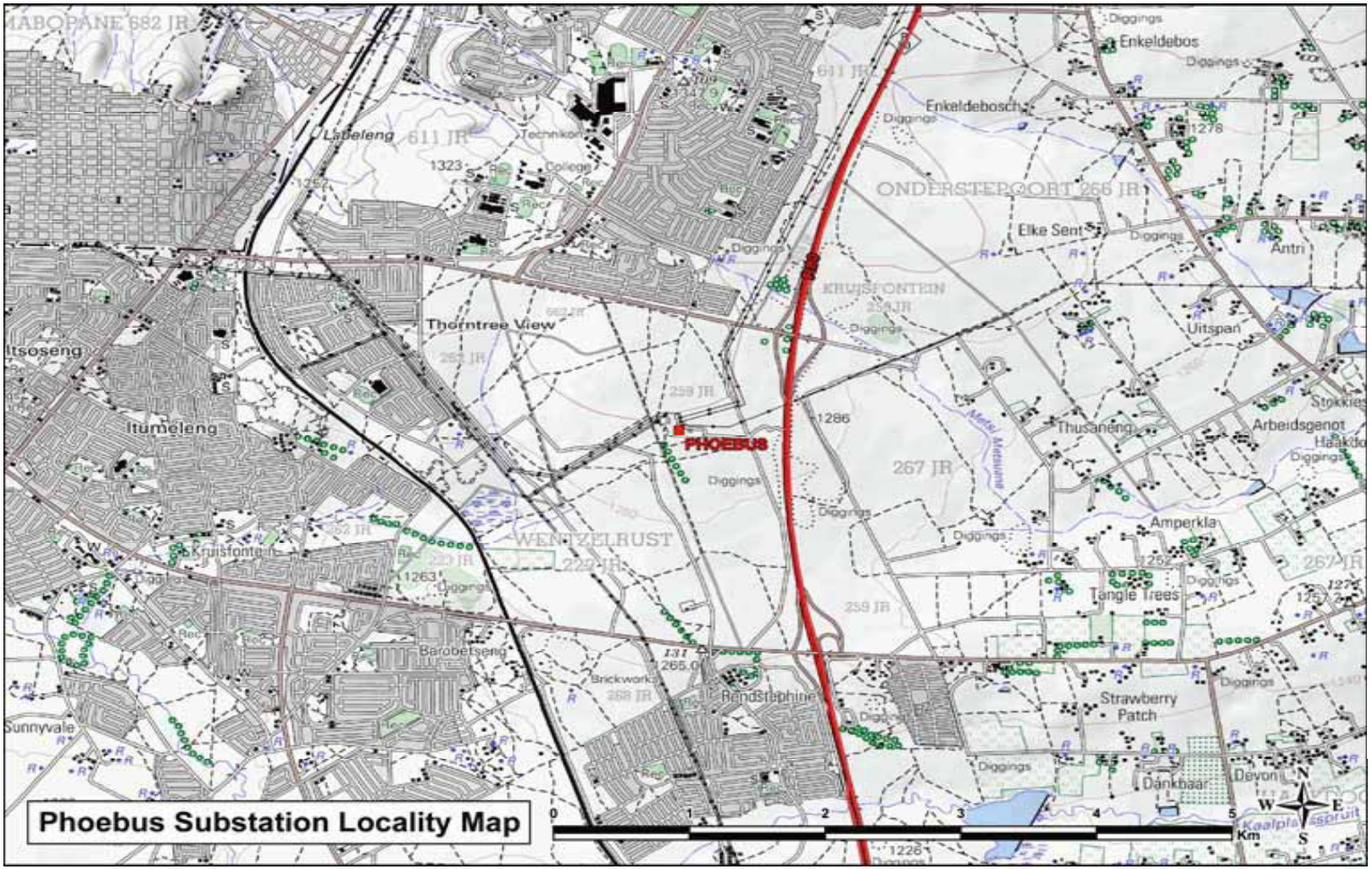

Figure 1.4: Locality map showing the locality of the proposed Phoebus substation in Soshanguve under investigation during the EIA process

1.2. The Purpose and Need for the Proposed Project

South Africa is an energy intensive country, largely as a result of an historic economic focus on energy intensive industries such as mining and primary metal processing. With current energy and electricity demands within the country projected to continue increasing, new investments in electricity generation and transmission capacity are required over the next few years.

The current Eskom transmission network supplies the City of Tshwane Metropolitan Municipality (CoT) via three substations, namely: Kwagga, Njala and Verwoerdburg. The contracted reserve capacity at each point is reviewed annually. CoT has applied for new supply points and a step load increase to Eskom Transmission and Distribution. The three parties (Distribution, Transmission and the City of Tshwane Metropolitan Municipality) agreed on the 20-year load forecast for the CoT and also concluded that the CoT and the Eskom transmission networks supplying Tshwane need to be strengthened. A number of options were analysed based on technical and economic benefits to all parties involved.

1.3. Requirement for an Environmental Impact Assessment Process

The proposed Tshwane Strengthening Project is subject to the requirements of the Environmental Impact Assessment Regulations (EIA Regulations) published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998). This section provides a brief overview of EIA Regulations and their application to this project.

NEMA is national legislation that provides for the authorisation of certain controlled activities known as "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. The National Department of Environmental Affairs (DEA) is the competent authority for this project. Applications for authorisation have been accepted by DEA (under Application Reference numbers **12/12/20/1471** (Kwagga – Phoebus 400kV power lines), **12/12/20/1524** (Kwagga-Phoebus substations) and **12/12/20/1470**[2] (Apolllo-Verwoerbdurg). Through the decision-making process, DEA will be supported by the Gauteng Department of Agriculture and Rural Development (GDARD).

[2] Although critical component of TSP Phase 1, this is subject of a separate EIA report

The need to comply with the requirements of the EIA Regulations ensures that decision-makers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimised or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the competent authority with sufficient information in order for an informed decision to be taken regarding the project.

In terms of sections 24 and 24D of NEMA, as read with Government Notices R385 (Regulations 27–36) and R387, a Scoping and EIA are required to be undertaken for this proposed project as it includes the following activities listed in terms of GN R386 and R387 (GG No 28753 of 21 April 2006):

Number & date of relevant notice	**Activity No/s (in terms of relevant Regulation or notice)**	**Description of listed activity**
Government Notice R387 (21 April 2006)	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 kV or more.
Government Notice R386 (21 April 2006)	12	The transformation or removal of indigenous vegetation of 3 ha 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).
Government Notice R386 (21 April 2006)	14	The construction of masts of any material of type and of any height, including those used for telecommunications broadcasting and radio transmission, but excluding: (a) masts of 15 m and lower exclusively used by (i) radio amateurs; or (ii) for lightening purposes (b) flagpoles; and (c) lightening conductor poles
Government Notice R386 (21 April 2006)	15	The construction of a road that is wider than 4 m or that has a reserve wider than 6 m, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 m long.

Government Notice R386 (21 April 2006)	1 (c)	The above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of 1000 cubic metres or more at any one location or site including the storage of one or more dangerous goods, in a tank farm
Government Notice R386 (21 April 2006)	1 (m)	The construction of facilities or infrastructure, including associated structures or infrastructure, for any purpose in the one and ten year flood line of a river or stream, or within 32 m from the bank 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
Government Notice R386 (21 April 2006)	20	he transformation of an area zoned for use as public open space or for a conservation purpose or another use

This report documents the assessment of the potential environmental impacts of the proposed construction, operation and decommissioning of the proposed Kwagga-Phoebus power lines, extension of the Kwagga substation as well as the proposed Phoebus substation. This EIA Phase followed the Scoping Phase, and was conducted in accordance with the requirements of the EIA Regulations in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

1.4. Eskom's Planning Process and the Role of the Environmental Impact Assessment Process

Eskom Transmission's planning process is required to be based on anticipated load requirements, rather than immediate load requirements in order to timeously supply the anticipated increased demand in the country. This is due to the time-consuming process of acquiring the necessary permissions to construct such infrastructure from DEA and the National Energy Regulator of South Africa (NERSA), servitude negotiations with landowners, as well as transmission power line design and construction.

Technically feasible and transmission power line alignment corridors have been identified for investigation within the EIA process. Through the EIA process, preferred alternative transmission power line alignments will be nominated. Should the project be authorised by the National Department of Environmental

Affairs (DEA), Eskom will then enter into a servitude negotiation process with each affected landowner. The process of negotiating a servitude is independent of the EIA process, and will be undertaken directly by Eskom Transmission.

While there should be reasonable confidence in the environmental acceptability of the preferred corridor nominated (generally a corridor of ~500 m in width), certain criteria identified during the land negotiation process and the final placement of towers may require minor alterations to the power line alignment within the corridor which receives environmental authorisation. These may include:

» Identification of a technical problem during the detailed design phase which will require excessive cost to resolve (e.g. unstable subsurface conditions identified by detailed geotechnical investigations).
» Request by a landowner during the course of the negotiation process that the alignment be shifted to avoid disruption of a particular activity on his property, but provide a feasible and reasonable new alignment.

Provided such potential deviations to the power line alignment are within the corridor authorised and are not unreasonable, it is fair for Eskom Transmission to investigate and negotiate local adjustments. This may be required at a number of points along the alignment.

1.5. Objectives of the Environmental Impact Assessment Process

The Scoping Phase of the EIA process identified potential issues associated with the proposed project, and defined the potentially feasible alternatives and extent of the studies required within the EIA Phase. This was achieved through a desk-top evaluation of the proposed project using existing information, involving the project proponent, specialists with experience in undertaking EIAs for similar projects, and a public consultation process with key stakeholders that included both government authorities and interested and affected parties (I&APs).

The EIA assesses those identified potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with all phases of the project including design, construction, operation and decommissioning, and recommends appropriate mitigation measures for potentially significant environmental impacts. The EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The Draft EIA Report includes a draft Environmental Management Plan (EMP), which details environmental specifications required to be implemented to reduce environmental impacts associated with the proposed project. Should the project

be authorised, this EMP will be finalised and will form part of the Contract documentation for construction and operation of the substation and power lines.

The release of a draft EIA Report (including the draft EMP) provides stakeholders with an opportunity to verify that the issues that they have raised through the EIA process have been captured and adequately considered. The final EIA Report will incorporate all issues and responses raised during the public review of the draft EIA report prior to submission to DEA.

1.6. Details of Environmental Assessment Practitioner and Expertise to conduct the Scoping and EIA

Savannah Environmental was contracted by Eskom Transmission as an independent environmental assessment practitioner to undertake an Environmental Impact Assessment (EIA) for the proposed project, as required by the NEMA EIA Regulations. Neither Savannah Environmental, nor any of its specialist sub-consultants on this project are subsidiaries of or affiliated to Eskom Holdings Limited. Furthermore, Savannah Environmental does not have any interests in secondary developments that may arise out of the authorisation of the proposed project.

Savannah Environmental is a specialist environmental consulting company providing a holistic environmental management service, including environmental assessment and planning to ensure compliance and evaluate the risk of development; and the development and implementation of environmental management tools.

The Savannah Environmental team has considerable experience in environmental assessment and environmental management, and has been actively involved in undertaking environmental studies for a wide variety of projects throughout South Africa. Strong competencies have been developed in project management of environmental EIA processes, as well as strategic environmental assessment and compliance advice, and the identification of environmental management solutions and mitigation/risk minimising measures.

Savannah Environmental has gained extensive knowledge and experience on potential environmental impacts associated with electricity generation and transmission projects through their involvement in related EIA processes. They have successfully managed and undertaken EIA processes for other power transmission projects for Eskom Holdings Limited throughout South Africa. Curricula vitae for the Savannah Environmental project team consultants are included in Appendix A.

In order to adequately identify and assess potential environmental impacts, Savannah Environmental has appointed several specialist consultants to conduct specialist studies, as required. Details of these specialist studies are included in Chapter 3. The curricula vitae for the EIA specialist consultants are also included in Appendix A.

Electricity cannot be stored and must therefore be generated and delivered over long distances at the very instant it is needed. In South Africa, thousands of kilometres of high voltage transmission power lines transmit power, mainly from the power stations located in the Mpumalanga coal fields to major substations, where the voltage is reduced for distribution to industry, businesses, homes and farms all over the country.

If Eskom Transmission is to honour its mandate and commitment to meet the increasing needs of end-users, it has to establish and expand its infrastructure of transmission power lines and substations on an ongoing basis. Due to substantial annual load growth, load shifts and step loads in the recent past, it has become necessary to reinforce the existing electrical infrastructure through the establishment of new electricity generation and transmission capacity.

Eskom is the primary supplier of electricity in South Africa and supplies power in bulk to most towns and cities, the municipalities of which sell it to households, industrialists and other end-users within their areas of jurisdiction. Eskom also sells bulk electricity directly to end-users in some parts of South Africa. Eskom has a mandate to satisfy potential customer needs, which implies certain responsibilities. One of the most significant of these is to find and maintain the balance between satisfying the needs of society and remaining within the capabilities of the environment. In order to achieve this Eskom must continually re-assess the projected demand for electricity[3] in relation to its present infrastructure, and take into account new developments to ensure that there is a continued supply of electricity, without significantly impacting on the environment.

As part of its capacity expansion and grid strengthening programme, Eskom Transmission is proposing the **Tshwane Strengthening Project Phase 1**. The Tshwane Strengthening Project Phase 1 is proposed to include the following:

» Extension of the existing Verwoerdburg (Rietvlei) Substation.
» Construction of 2x 400kV loop in and out power lines from Apollo – Pluto transmission lines to feed into the Verwoerdburg (Rietvlei) Substation, a distance of approximately 4 km.
» Construction of 400kV loop-in lines to feed into the Phoebus Substation from the existing Apollo-Dinaledi transmission power line, a distance of approximately 1 km.

[3] This is undertaken through the Integrated Strategic Electricity Planning (ISEP) process

» Construction of a new 400kV transmission power line between the proposed Phoebus Substation and the Kwagga Substation, a distance of ~30 km.
» Expansion and upgrade of the existing Kwagga Substation.
» Establishment of the new Phoebus substation adjacent to existing Hangklip substation

In total, approximately 36 km of new power line is proposed as part of the Tshwane Strengthening project Phase 1.

2.1. The Need and Justification for the Proposed Project

The following provides a brief description of the need and desirability of the project from the proponent's perspective.

2.1.1. The Need for Additional Transmission Capacity in the Tshwane Area

Hundreds of kilometres of transmission power lines feed electricity from power stations in the Mpumalanga and Limpopo Provinces to transmission substations across the country. The existing transmission power lines and substations within Gauteng are becoming heavily loaded and are predicted to reach their full capacity in the near future (approximately 15 years). Through technical investigations undertaken by Eskom, it has been concluded that the current transmission power line and substation infrastructure cannot supply the increased demand in the Gauteng North area. It is becoming increasingly difficult for Eskom Transmission to meet its mandate of supplying electricity to the area during a contingency condition which involves the loss of one power line, as the remaining power lines have to carry the entire load. This makes it difficult to carry out routine maintenance, resulting in the potential deterioration of operating lines and poor line performance (including faults, etc). This can be largely attributed to development growth in the area, hence an increased demand for power.

A twenty-year electricity demand forecast is produced by Eskom Transmission annually. In this forecast, inputs from customers and various governmental and commercial associations regarding load growth are taken into account. Due to economic growth and the government's policy, *"Accelerated and Shared Growth Initiative for South Africa"* (ASGISA), it was calculated that the load for the country will grow at an aggregated value of 4% per annum from the current load of 34 807 MW in 2007 to approximately 93 776 GW in 2030.

Studies undertaken by Eskom have shown a steady 3% per annum average load growth for the area fed from Verwoerdburg, Wildebeest and Apollo substations, the main bulk supply substations to the Tshwane Region. This is due to light

industrialisation, commercialisation, urban growth and electrification within this area. It is also a sign of good economic growth in this area. The load forecasters within Eskom predict that this load growth will continue into the future, which will result in the need for additional power by the year 2013. The load demand mentioned here is subject to change as the prevailing economic climate changes and as other Eskom initiatives to conserve energy are widely adopted. The various developments are being monitored, and their effect will be incorporated in future plans. The expected load in the Pretoria area is shown in Table 2.1 below.

Table 2.1: Projected/Expected electricity loads in the Pretoria area up to 2018 (source: Eskom Transmission Ten Year Plan, 2009-2018)[4]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Projected Load (MW)	2171	2264	2354	2443	2570	2655	2736	2815	2931	3004	3074

2.1.2. The Need to Optimise the Electrical Transmission System in the Tshwane Area

From Section 2.1.1 above it is clear that a fault on any of the power lines supplying the Tshwane Region could have a detrimental effect on supply to customers within this area once new customer/s are supplied from the existing network. Eskom Transmission has already implemented measures to optimise the existing Transmission system within the Tshwane Region such that the construction of new power lines to supply this area will occur only when needed. These measures include:

» Comprehensive checks on the existing lines to ensure that they are within the legal clearance for overhead lines. Lines sag when placed under heavy load conditions, due to heating of the conductors.
» Installation of line monitoring devices that measures the atmospheric conditions prevailing. This allows Eskom Transmission to determine whether the lines can cope with more loading (e.g. on a cold day the line can be loaded to more than usual levels since the lines cool down and they do not sag as much as on hot days).
» Installation of new infrastructure
» Demand side management

[4] This is extracted from the Eskom Transmission Ten Year Plan (2008)

» Selection of the most appropriate reinforcement options in order to ensure that an optimised mix of cost, technical benefit and environmental impact was achieved.
» Energy Efficiency initiatives

As all options for optimisation of the existing infrastructure in the Tshwane area have already been studied and implemented, new transmission power lines will be required to be constructed in order to meet the predicted load requirements. The new transmission lines will be required to be brought into operation at the time when the load growth and demand exceeds the supply, i.e. by 2012. It is therefore necessary to secure the required servitudes timeously, to ensure this will be possible.

A definite two-fold need for new transmission power lines has therefore been identified:

» To optimise the existing system; and
» To increase line capacity in the Transmission system.

By increasing the supply into the Transmission system, the forecasted load growth can be addressed in a suitable and economical way. Optimisation of the current system is currently underway, and would alleviate some problems in the system. The short- to medium-term load requirements can be addressed by the increased supply through the construction of new transmission power lines. In addition the extension and upgrade of the existing substations will improve the supply to the area.

2.2. Alternatives for Satisfying the Additional Electricity Supply Need within the Tshwane Area

Electrical supply constitutes a complex system of generation facilities, substations, and transmission and distribution power lines. The system operates on a demand-supply structure with the power being generated and transmitted at the moment it is needed.

The forecast growth in demand in the Tshwane region over the next few years (25-30 years), however, urgently requires Eskom Transmission to take timeous action to ensure supply reaches the end-users. It is therefore necessary to ensure extra supply capacity into the Tshwane area. There is a definite need to overcome the future overloading problems on the existing transmission lines and substations.

The ideal solution should be to:

» meet the projected demand
» optimise existing infrastructure
» minimise cost
» minimise any adverse environmental impacts.

The following alternatives for satisfying the two-fold need for additional electrical supply to the region and optimising the existing infrastructure were investigated by Eskom Transmission.

2.2.1. The "Do Nothing" Option

The 'do nothing' alternative is the option of not extending the existing Verwoerdburg substation as well as not constructing any new transmission power lines looping in from the Apollo-Pluto power lines. By not taking any action, Eskom Transmission may end with a situation of not being able to ensure firm supply into some parts of the country and the Tshwane area in particular, in the very near future (i.e. by 2012). This would eventually lead to load shedding which can cause major disruptions of power supply to different areas at different times. This will have a significant impact on the economy of the Tshwane region, as no real economic growth would be able to take place without additional electricity supply. Therefore, without the implementation of this proposed project, there will be significant impacts on the reliability and stability of electricity supply to the Tshwane region. This option is therefore discarded as a feasible alternative as it would neither supply the projected demand for electricity nor optimise the existing infrastructure.

2.2.2. Demand Side Management

Demand Side Management (DSM) can generally be defined as the activities performed by the electricity supply utility, which are designed to produce the desired changes in the load shape through influencing customer usage of electricity and to reduce overall demand by more efficient use. These efforts are intended to produce a flat load duration curve to ensure the most efficient use of installed generation capacity.

By reducing peak demand and shifting load from high load to low load periods, reductions in capital expenditure (for network capacity expansion) and operating costs can be achieved. Some of the basic tools are the price signals (such as time of use tariffs) given by the utility and direct load management. This option is practised to a certain extent, but is currently not considered feasible for expansion in this particular region. This is so because there will be large step loads in the Tshwane area in the 20-25 years horizon. As part of a long-term plan, Eskom is planning to deload Apollo and Minerva substation as we as additional supply to Pelly. In addition, the second transformer will be installed in

the new Phoebus substation is 2022. As part of the strengthening of the Tshwane region, Eskom is also planning refurbishment of Lomond substation.

Eskom Transmission is currently investigating various means to achieve a flatter load profile in this area such as building new electricity infrastructure, expansion and upgrade of existing substation infrastructure. However, the large concentration of industrial and commercial users in this area makes this a very difficult option to pursue. This option is therefore not considered to be feasible to meet the long-term power demands associated with the expansions in the Pretoria area.

2.2.3. New Generation Systems

The option of a new coal-fired, gas, renewable or nuclear generation plant being commissioned near to the load centre could be considered. This may have a more negative overall impact on the environment due to the land requirements, fuel resources, etc., and would take at least five years to implement and would not address the foreseen supply demand in the short-term. In addition, the cost of such an option will be extremely high compared to the cost of transmission power lines and could prove to be non-feasible from an economic perspective. Transmitting power via overhead transmission power lines is currently considered to be the most economical and environmentally acceptable way to supply bulk electricity.

The use of other types of generation such as wind and solar energy were suggested by some I&APs within the public participation process. However, the high cost and low output of such systems does not make these economically feasible for the supply of baseload electricity supply[5] to the Tshwane area.

Therefore, this option is not considered feasible to address the need in the Tshwane area and was not investigated further within this EIA process.

2.2.4. Upgrade Existing Transmission Power Lines by using Bigger Conductors

The upgrade of existing transmission lines in the area by using bigger conductors would require these existing power lines to be permanently off while being upgraded to thicker conductors. This would put the existing and future load at risk should the remaining lines in the area trip. The upgrade option would result in the physical load on the existing towers increasing substantially, resulting in sagging of the conductors. The existing towers would be inadequate to support

[5] "Base load electricity generating capacity" refers to power station technology designed specifically to generate electricity continuously for all hours of the day and night. Wind and solar power does not provide base load energy.

this physical load. Therefore, to mitigate against sagging, additional towers would be required to be constructed within the existing servitudes being upgraded. Furthermore, it would not be possible to remove one transmission power line from service to perform the upgrading work, as the remaining supply lines would not be able to supply the electrical loads in the Transmission system. The power transmission from the Apollo substation would not be able to be evacuated to the load centres without causing dynamic instability in the Eskom network which could result in black-outs. This option would not improve the reliability of the Transmission system nor be sustainable and is therefore not considered to be a feasible alternative.

2.2.5. Upgrade of the Kwagga Substation, establishment of Phoebus Substation and construction of a 400kV Transmission power line between Kwagga and Phoebus Substations

The alternative is part of the new generation and transmission capacity alternatives. The need for increased capacity and the need for optimising existing infrastructure would be met through the implementation of this option.

Due to current land use and development in the country, very limited open corridors remain that could be utilised to install major transmission power lines. New routes must, however be secured to ensure servitudes for the expansion of the network and to be able to meet the forecast increase in demand. Therefore, Eskom Transmission is proposing the upgrade of the Kwagga 400/132kV substation, establishment of the Phoebus substation and 400kV transmission power lines between Kwagga and Phoebus Substations to strengthen the existing transmission network.

In addition, Eskom Transmission is proposing the extension of the Verwoerdburg 400/132kV substation and Verwoerdburg-Apollo, 2X 400kV loop-in and out of the existing Apollo-Pluto 400kV transmission power lines at Verwoerdburg Substation[6].

The advantages associated with this option include:

» It overcomes the line overloading problems.
» It will create a more flexible network, since it forms an interconnection between the loads fed from Apollo substation and the proposed new Phoebus substation. This will improve the overall reliability of the Transmission system, which will be of benefit to both Eskom and to all electricity users within the area.

[6] This proposed development is a subject of separate report assessing the Apollo-Verwoerdburg substation extension and loop-in power lines (EIA Reference Number 12/12/20/1470)

» It will improve the angular stability of the Tshwane generation pool.
» Compared to the other options considered, this option proves to be more economical.

It improves the reliability of supply to the Tshwane Customer Load network. This network presently feeds the City of Tshwane customers, affecting the livelihoods of the people and the economy of the area (refer to Figure 2.1).

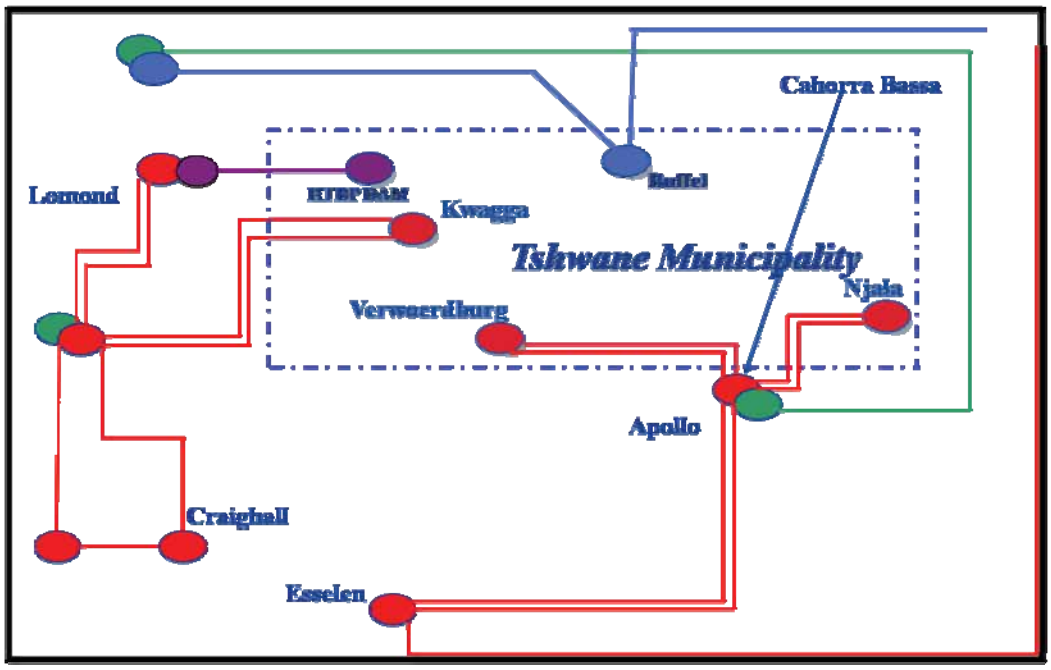

Figure 2.1: Current Tshwane Electricity Supply network (Eskom Grid Planning, 2009)

Due to the current land use and developments in the Soshanguve, Pretoria, and small holdings area (Fundus), very little open space remains that could be utilised to install major transmission power lines with a servitude of 55 m. New routes must however be secured to ensure servitudes for the expansion of the network and to be able to meet the forecast increase in demand.

This option is most favoured by Eskom Transmission as well as the City of Tshwane Electricity Department as it is considered to be the most feasible from a technical and economic perspective, and will meet the required need for increased capacity and the need for optimising existing infrastructure in the short- and long-term. This option is therefore nominated as the preferred option by Eskom Transmission to supplement the power supply to the Pretoria North area.

2.3. Proposed Strategy for Satisfying the Additional Electricity Supply Need within the City of Tshwane Metropolitan Municipal Area

From the analysis of the various alternatives to satisfy the need for additional power transmission capacity, Eskom Transmission determined that the upgrade and establishment of the new Phoebus substation adjacent to Hangklip substation and construction of 400kV loop-in transmission power lines as part of the Tshwane Strengthening Project Phase 1 was the most feasible and cost-effective solution in order to meet the CoT electricity requirement (refer to 2.1.2 above and figure 2.2 below)[7]. This solution will also de-load the heavily loaded Minerva- and Apollo substations. The proposed project involves the following:

» Construction of a **new 400kV transmission power line** between the proposed Phoebus Substation and the existing Kwagga Substation.
» **Expansion and upgrade** of the **existing Kwagga Substation**.
» **Establishment** of the **new Phoebus substation** adjacent to existing **Hangklip substation**.
» **Construction of the loop in/out Apollo-Dinaledi power** line in Phoebus substation.
» **Associated Infrastructure works** to integrate the new transmission lines into the Transmission grid (such as access roads, bus bar, transformer, feeder bay etc).

The installation of the new 400kV transmission power line would offer the following benefits to Eskom Transmission and its customers in the Pretoria North area in the medium- to long-term:

» Increased electricity supply to the region.
» The proposed power lines and substation expansion will improve the electrical system performance in the region.
» The proposed substation expansion and power lines will ensure the capacity of Eskom Transmission to supply the forecasted increase in electricity demand in the region.
» It will alleviate the current supply constraints in the Eskom and City of Tshwane Power network.

[7] Subject of separate report investigating the other components of the Tshwane Strengthening project Phase 1 (Savannah Environmental, 2010)

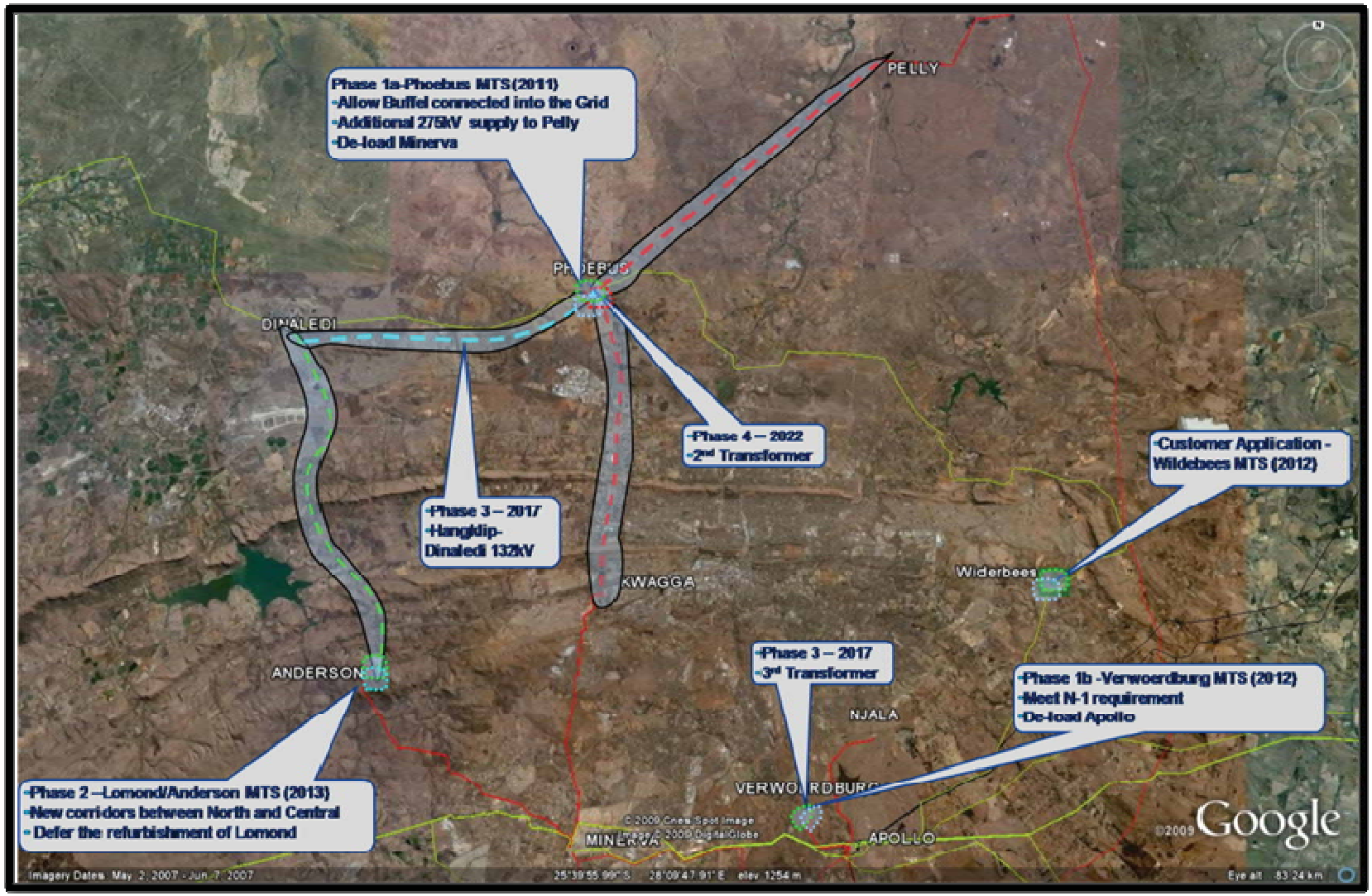

Figure 2.2: Image indicating the entire Tshwane Strengthening Project

Eskom Transmission is aware that it is of paramount importance that the required servitudes be obtained, to ensure an acceptable quality of electrical supply to the region. Overhead lines have been proposed over underground cables as the disadvantages of underground cables outweigh that of overhead lines.

» Underground cabling is more expensive, since the cost of burying cables at transmission voltages is several times greater than overhead power lines.
» Whereas finding and repairing overhead wire breaks can be accomplished in hours, underground repairs can take days or weeks, and for this reason redundant lines are run.
» Operations are more difficult since the high reactive power of underground cables produces large charging currents and so makes voltage control more difficult.
» Cables could take up a larger land footprint as compared to overhead lines. This is a due to cables being required to be in trenches from the source of supply to the load. As a result, the land above the cable cannot be utilised for private purposes. The land footprint of overhead power lines is much less due to the land only being required to construct the towers approximately every 200 m.
» The environmental impacts associated with underground cabling are considered to be significantly higher than that associated with overhead lines as trenches are required to be excavated for long distances resulting in severe damage to habitats and surrounding areas.

2.4. Kwagga and Phoebus Substation Sites

2.4.1. Identification of Substation Site

The Kwagga Substation already exists in Kwaggasrand area, south-east of Danville suburb, Pretoria, hence the proposed the extension of the substation was proposed southwards in order to allow for the upgrade of the capacity of this substation (refer to Figure 2.3). The proposed Phoebus substation was identified by Eskom for investigation within a broader study area (refer to Figure 2.4) based on technical criteria. Land adjacent to the existing Hangklip substation was considered to be suitable from a technical perspective and was provided to the EIA team for further investigation through the EIA process. The criteria used in selecting these substation sites include, amongst others:

» the proximity to the load centre to achieve shorter power line lengths,
» access during construction and operation, and
» avoidance of environmentally sensitive features/areas
» Land is already owned by Eskom (Phoebus substation) and CoT Electricity Department (Kwagga substation).

The advantages associated with this option are as follows:

» It overcomes overloading problems.
» It creates a more flexible network, since it forms an interconnection between the loads fed from Apollo substation and the proposed new Phoebus substation. This will improve the overall reliability of the Transmission system, which will be of benefit to both Eskom and to all electricity users within the area.
» It will improve the angular stability of the Tshwane generation pool.

The area under investigation is already characterised by infrastructure of a similar nature, i.e. the existing Hangklip and Kwagga substations and a number of high voltage transmission power lines. It is therefore, at this stage, not foreseen that additions to the Kwagga substation or the construction and operation of the new Phoebus substation adjacent to the Hangklip substation would yield significant negative impacts to the surrounding environment. Potential impacts of the proposed development are assessed in more detail in Chapter 6 of this report.

2.4.2. Construction Process for the Substation

The proposed new substation and upgrade is proposed to be constructed in the following simplified sequence, and will take approximately 24 months to complete:

Step 1: Survey of the substation site (including a final survey by environmental specialists and the compilation of a site-specific Environmental Management Plan (EMP)
Step 2: Site clearing and levelling and construction of access road to substation site (if required)
Step 3: Construction of terrace and substation foundation, including the installation of stormwater drainage on the surface to dispose of such stormwater on the terrace
Step 4: Assembly, erection and installation of equipment (including transformers and control building)
Step 5: Connection of conductors to substation infrastructure
Step 6: Rehabilitation of any disturbed areas and protection of erosion sensitive areas.

Extension of the existing fences will be installed to secure the substation and the substation site. These fences include a 2.4 m high security fence to enclose all assets, a 1.8 m high fence around the yards, and a 1.2 m high boundary fence on the property-line.

Construction crews for construction of the substation will constitute mainly skilled and semi-skilled workers. No construction workers will reside on site. It is most likely that construction workers will be accommodated within formal housing within towns surrounding the study area.