ENVIRONMENTAL IMPACT ASSESSMENT PROCESS
DRAFT ENVIRONMENTAL IMPACT REPORT

PROPOSED KAROO RENEWABLE ENERGY FACILITY

NORTHERN AND WESTERN CAPE PROVINCE
(DEA Ref No: 12/12/20/1993)

DRAFT EIA REPORT
1 APRIL 2011 – 5 MAY 2011

Prepared for:

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PROJECT DETAILS

DEA Reference No.	:	12/12/20/1993
Title	:	Environmental Impact Assessment Process Draft Environmental Impact Assessment Report: Proposed Karoo Renewable Energy Facility on a Site south of Victoria West, Northern and Western Cape Province
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Client	:	SARGE (Pty) Ltd
Report Status	:	Draft Environmental Impact Assessment Report for public review
Review Period	:	1 April 2011 – 5 May 2011

When used as a reference this report should be cited as: Savannah Environmental (2011) Draft Environmental Impact Assessment Report: Proposed Karoo Renewable Energy Facility on a Site South of Victoria West, Northern and Western Cape Province, for SARGE (Pty) Ltd.

INVITATION TO COMMENT ON THE DRAFT EIA REPORT

The Draft Environmental Impact Assessment Report is available for review and comment by Interested and Affected Parties (I&APs) and stakeholders at the following public places within the project area from 1 April 2011 – 5 May 2011:

» Victoria West Library
» Beaufort West Library
» Karoo Vleisboere Coorperation
» www.savannahSA.com

Please submit your comments to
Ingrid Snyman or Diana Verster of Batho Earth PO Box 35130, Menlo Park, 0102 Tel: 082 779 2750/ 012 361 1623 Fax: 087 807 4536 E-mail: ingrid@bathoearth.co.za or diana@bathoearth.co.za
The due date for comments on the Draft EIA Report is **5 May 2011**

Comments can be made as written submission via fax, post, or e-mail.

EXECUTIVE SUMMARY

SARGE (Pty) Ltd proposes to establish a commercial renewable energy facility which will comprise a combination of a wind energy facility component and a photovoltaic (PV) solar facility component, as well as the associated infrastructure on a site near Victoria West within the Northern and Western Cape Province. A study area of approximately 202 km^2 is being considered as the broader study area for the construction of the proposed facility.

The wind energy facility component is proposed to ultimately accommodate up to **150 wind turbines**, appropriately spaced to make use of the wind resource on the site. A total generating capacity of up to **450 MW** is proposed for the wind energy component, while the photovoltaic (PV) solar component will have a generating capacity of up to **50 MW.** The project would be developed in a phased approach. The proposed renewable energy facility will be comprised of the following associated infrastructure:

» Up to 150 wind turbines with a generating capacity of up to 450MW;
» Each turbine will be a **steel tower** (between 80m and 125m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of between 90m and 100 m (i.e. each blade ranging from 45 to 55m in length);
» An array of **photovoltaic (PV) panels** occupying an area of approximately 97 ha (including access roads) with a generating capacity of up to 50MW;
» Two (2) **132 kV substations** with high-voltage (HV) yard footprints of approximately 100m x 100m;
» **Foundations** to support both the turbine towers as well as the PV panels;
» **Cabling** between the project components, to be lain underground where practical;
» Two (2) new **overhead 132 kV power lines -**
» ***From Substation 1:***
- Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1km length of power line) or alternatively
- Substation 1 Option 2: To connect to Eskom's existing Biesiespoort Substation (up to 2.5 km length of power line).

» ***From Substation 2:***
- Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line) or alternatively
- Substation 2 Option 2: To connect to Eskom's existing Victoria Substation (up to 12 km length of power line).

» **Internal access roads** (5 m wide and ~82.15 km long) linking the wind turbines and PV component with the other

infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new internal access roads; and

» **Small office and/or workshop building** (40m x 20m) for maintenance and storage purposes.

The nature and extent of this facility, as well as potential environmental impacts associated with the construction and operation of a facility of this nature are explored in more detail in this Environmental Impact Assessment (EIA) Report which consists of the following chapters:

Chapter 1: Provides background to the proposed facility and the environmental impact assessment process.
Chapter 2: Provides an overview of the proposed project.
Chapter 3: Provides an overview of the Regulatory and Legal Context for electricity generation projects
Chapter 4: Outlines the process which was followed during the EIA Phase, including the consultation program that was undertaken and input received from interested parties and stakeholders.
Chapter 5: Describes the existing biophysical and socio-economic environment.
Chapter 6: Presents the assessment of environmental impacts associated with the facility, its associated infrastructure.
Chapter 7: Presents the conclusions of the EIA process, as well as an impact statement on the proposed project
Chapter 8: Provides a list of references and information sources used in undertaking the studies for this EIA Report.

The Scoping Phase of the EIA process identified potential issues associated with the proposed project, and defined the extent of the studies required within the EIA Phase. The Scoping Phase also identified potentially sensitive areas within the study site which served to inform the placement of the facility through a funnel-down approach.

The EIA Phase addressed those identified potential environmental impacts and benefits (direct, indirect, and cumulative impacts) associated with all phases of the project including design, construction, and operation. The EIA Phase recommends appropriate mitigation measures for potentially significant environmental impacts.

The EIA report aims to provide sufficient information regarding the potential impacts and the acceptability of these impacts in order for the Competent Authority (i.e. the National Department of Environmental Affairs (DEA)) to make an informed decision regarding the proposed project.

The release of a draft EIA Report provides stakeholders with an opportunity to verify that the issues 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 the DEA.

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

The most significant environmental impacts associated with the proposed project, as identified through the EIA, include visual, ecology and bird related impacts.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated resulting from the proposed project conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed renewable energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» From an environmental perspective, the preferred routes for the power lines for both **Substation 1 and 2**, is **Option 1**.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable** and the following recommendations are made:

» All mitigation measures detailed within this report and all practical mitigation measures detailed within the specialist reports contained within Appendices F - M must be implemented.
» The draft Environmental Management Plan (EMP) as contained within Appendix N of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed renewable energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMP for all life cycle phases of the proposed project is considered key in achieving the appropriate environmental management

standards as detailed for this project. This document should be considered as a dynamic document and must be updated as required throughout the life cycle of the facility.

» No facility components should be placed in demarcated high ecological, avifaunal and visual sensitivity areas (refer to Figure 7.1).

» All exclusion areas in terms of avifauna should be demarcated on-site, and no disturbance during the construction phase should be allowed in these demarcated areas. These include areas within:
  - 500 m of any cliff lines or elevated ridges within the development area to reduce collision risk, primarily for slope soaring raptors.
  - 1500 m of any known or suspected Verreaux's Eagle nest sites to reduce disturbance and collision risk for this species.
  - 2500 m of any known or suspected Martial Eagle nest sites to reduce disturbance and collision risk for this species.

» The above avifaunal exclusion areas could affect the location of Substation 2 in the south-east. Substation 2 should be repositioned so as to avoid a nesting site of a Verreaux's Eagle.

» The monitoring protocols for avifauna, as required by Appendix G of this report, should be implemented.

» During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.

» Internal access roads should be planned with due cognisance of the topography. Roads should be laid out along the contour wherever possible, and should never traverse slopes at 90 degrees. Construction of roads should be undertaken with adequate drainage structures in place to forego potential erosion problems.

» All construction areas, specifically trenches, road servitudes and cut and fill slopes should be appropriately rehabilitated after construction. This rehabilitation must also be monitored and maintained during operation.

» No development must take place within 100m of the rock shelters containing paintings, rocky outcrops with boulders containing rock engravings and stone-wall structures. If it is, however, inevitable that construction activities must take place within 100m of the heritage material, a perimeter fence must be erected to protect the sensitive area from any possible negative impact.

» Despite not been affected by the development, the exposed human remains must be reported to the South African Heritage Resources Agency (SAHRA) so that they may appoint the

relevant archaeologist/s to remove the exposed human remains.

» If at any stage during the construction phase any semblance of a fossil were to be observed, it would be vital to recover the fossil and report the occurrence to the relevant authority.

» The three turbines located in particularly elevated positions (i.e. on top of a landform more than 140m above the surrounding area) and the five turbines located on slopes in excess of 18 degrees should be repositioned through the final micro-siting to lower lying areas and more moderate slopes.

» A lighting engineer should be consulted to assist in the planning and placement of light fixtures for the turbines, the PV plant and the ancillary infrastructure in order to reduce visual impacts associated with glare and light trespass.

» Turbines located within 500 m of any inhabited settlement, homestead or public road should be relocated to beyond this distance in order to negate the potential impact of shadow flicker.

» When working near (within 500 m) to a potential sensitive receptor(s), the number of simultaneous construction activities must be limited to the minimum.

» Quarterly noise monitoring at the identified potential sensitive noise receptors is recommended to be conducted by an acoustic consultant or approved noise inspection authority for the first year of operation.

» Should the layout (or type of wind turbines used) change significantly during the final design, it is recommended that the revised layout be remodelled/reviewed in terms of:
  - the potential noise impact by an independent acoustics specialist;
  - the potential ecological impact, should areas within the defined high sensitivity areas be impacted, by an independent ecologist.

» In order to enhance the local employment and business opportunities, mitigation/enhancement measures listed in the Social Impact Assessment should be implemented.

» A comprehensive stormwater management plan should be compiled for those portions of the site which will be altered through the introduction of extensive hard/compressed surfaces.

» Applications for all other relevant and required permits required to be obtained by SARGE must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to

any riparian vegetation or wetlands.

» Following the final design phase of the facility, a final layout must be submitted to DEA for review and acceptance.

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APPENDICES

ABBREVIATIONS AND ACRONYMS

BID	Background Information Document
CBOs	Community Based Organisations
CDM	Clean Development Mechanism
CSIR	Council for Scientific and Industrial Research
CO_2	Carbon dioxide
D	Diameter of the rotor blades
DEADP	Department of Environmental Affairs and Development Planning
DEA	National Department of Environmental Affairs
DOE	Department of Energy
DOT	Department of Transport
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FIT	Feed-in Tariffs
GIS	Geographical Information Systems
GG	Government Gazette
GN	Government Notice
GWh	Giga Watt Hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
km^2	Square kilometres
km/hr	Kilometres per hour
kV	Kilovolt
m^2	Square meters
m/s	Meters per second
MW	Mega Watt
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
NGOs	Non-Governmental Organisations
NIRP	National Integrated Resource Planning
NWA	National Water Act (Act No. 36 of 1998)
PV	PhotoVoltaic
REFIT	Renewable Energy Feed-in Tariff
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework

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.

Ambient sound level: The reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

Betz limit: It is the flow of air over the blades and through the rotor area that makes a wind turbine function. The wind turbine extracts energy by slowing the wind down. The theoretical maximum amount of energy in the wind that can be collected by a wind turbines' rotor is approximately 59%. This value is known as the Betz Limit

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 and can include both direct and indirect impacts.

Cut-in speed: The minimum wind speed at which the wind turbine will generate usable power.

Cut-out speed: The wind speed at which shut down occurs.

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

Disturbing noise: A noise level that exceeds the ambient sound level measured continuously at the same measuring point by 7 dB or more.

'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.

Endemic: An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

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.

Generator: The generator is what converts the turning motion of wind turbines blades into electricity

Indigenous: All biological organisms that occurred naturally within the study area prior to 1800

Indirect impacts: Indirect or induced changes that may occur because 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 because 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.

Nacelle: The nacelle contains the generator, control equipment, gearbox, and anemometer for monitoring the wind speed and direction.

Photovoltaic cell: Semiconductors which absorb solar radiation to produce electricity

Photovoltaic effect: Electricity can be generated through the use of photovoltaic panels (semiconductors) which are comprised of individual photovoltaic cells that absorb solar energy to produce electricity. The absorbed solar radiation excites the electrons inside the cells and produces what is referred to as the Photovoltaic Effect.

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).

Renewable energy feed-in tariff (REFIT): REFITs are used to promote renewable energy and have been adopted in over 36 countries worldwide. The establishment of the REFIT in South Africa provides the opportunity for an increased contribution towards the sustained growth of the renewable energy sector, and to promote competitiveness between renewable and conventional energies in the medium and long-term. Under the National Energy Regulator Act (Act No. 40 of 2004), the Electricity Regulation Act (Act No. 4 of 2006), and all subsequent relevant amendment acts, the National Energy Regulator of South Africa (NERSA) has the mandate to determine the prices at and conditions under which electricity must be supplied by licence.

Rotor: The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades that rotate at a constant speed of about 15 to 28 revolutions per minute (rpm).

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.

Tower: The tower, which supports the rotor, is constructed from tubular steel. It is approximately 80 m tall. The nacelle and the rotor are attached to the top of the tower. The tower on which a wind turbine is mounted is not just a support structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. Larger wind turbines are usually mounted on towers ranging from 40 to 80 m tall. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

Wind power: A measure of the energy available in the wind.

Wind rose: The term given to the diagrammatic representation of joint wind speed and direction distribution at a particular location. The length of time that the wind comes from a particular sector is shown by the length of the spoke, and the speed is shown by the thickness of the spoke.

Wind speed: The rate at which air flows past a point above the earth's surface.

INTRODUCTION CHAPTER 1

South African Renewable Green Energy (SARGE), as an Independent Power Producer (IPP), is proposing the establishment of a commercial electricity generating facility which will comprise a combination of a wind energy facility component and a photovoltaic solar facility component, as well as the associated infrastructure. The purpose of the facility is to generate electricity from renewable energy resources (i.e. wind and solar) to provide power to the national electricity grid. The proposed facility is proposed to be established on an identified site located approximately 34 km south of Victoria West, falling within the Northern and Western Cape Provinces (and within the Ubuntu as well as the Beaufort West Local Municipalities) (refer to Figure 1.1). The facility is referred to in this report as the Karoo Renewable Energy Facility.

The facility is proposed to be located on the following Farms: remaining extent and Portion 3 of the Farm Nobelsfontein 227, remaining extent and Portion 1 of the Farm Annex Noblesfontein 234, Portions 2, 3 and 4 of the Farm Ezelsfontein 235, remaining extent of the Farm Modderfontein 228, Portion 1 of the Farm Rietkloofplaaten 239, and the Farm PhaisantKraal 1. The total area for consideration within which the proposed facility will be constructed ranges approximately 20 222 ha (202 km^2) in extent.

The proposed facility will have a generating capacity of up to **500MW** and will be undertaken in a phased approach. The facility will comprise the following infrastructure:

» Up to 150[1] wind turbines with a generating capacity of up to 450MW (i.e. turbine footprints are foreseen to cover a total area of approximately 3.37 ha);
» Each turbine will be a **steel tower** (between 80m and 125m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of between 90m and 100 m (i.e. each blade ranging from 45 to 55m in length);
» An array of **photovoltaic (PV) panels** occupying an area of approximately 97 ha (including access roads) with a generating capacity of up to 50MW;
» Two (2) **132 kV substations** with high-voltage (HV) yard footprints of approximately 100m x 100m;
» **Foundations** to support both the turbine towers as well as the PV panels;

[1] The current layout comprises 113 wind turbines as a result of the design process thus far which has taken environmental and technical constraints into consideration. The EIA application remains for a facility of up to 150 wind turbines.

» **Cabling** between the project components, to be lain underground where practical;
» Two (2) new **overhead 132 kV power lines -**

From Substation 1:

- Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1km length of power line) or alternatively
- Substation 1 Option 2: To connect to Eskom's existing Biesiespoort Substation (up to 2.5 km length of power line).

From Substation 2:

- Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line) or alternatively
- Substation 2 Option 2: To connect to Eskom's existing Victoria Substation (up to 12 km length of power line).

» **Internal access roads** (5 m wide and 82.15 km long) linking both the wind turbines and solar array with the other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new internal access roads; and
» **Small office and/or workshop building** (40 m x 20 m) for maintenance and storage purposes.

1.1 Requirement for an Environmental Impact Assessment Process

The proposed development is subject to the requirements of the Environmental Impact Assessment (EIA) Regulations, published in terms of Section 24(5) of the National Environmental Management Act (NEMA, Act No. 107 of 1998). NEMA is the 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. As this is a proposed electricity generation project, which is considered of national importance, the National Department of Environmental Affairs (DEA) is the competent authority for this project. An application for authorisation has been submitted in accordance with the EIA Regulations published in GN 28753 (21 April 2006), in terms of Section 24(5) of NEMA, and have been accepted by DEA under application reference number **12/12/20/1993.** Through the decision-making process, DEA will be supported by the Northern Cape Department of Environment and Nature Conservation (DENC) as well as the Western Cape Department of Environmental Affairs and

Development Planning (DEA&DP) as the provincial commenting authorities for the project.

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. SARGE appointed Savannah Environmental to conduct the independent EIA process for the proposed project.

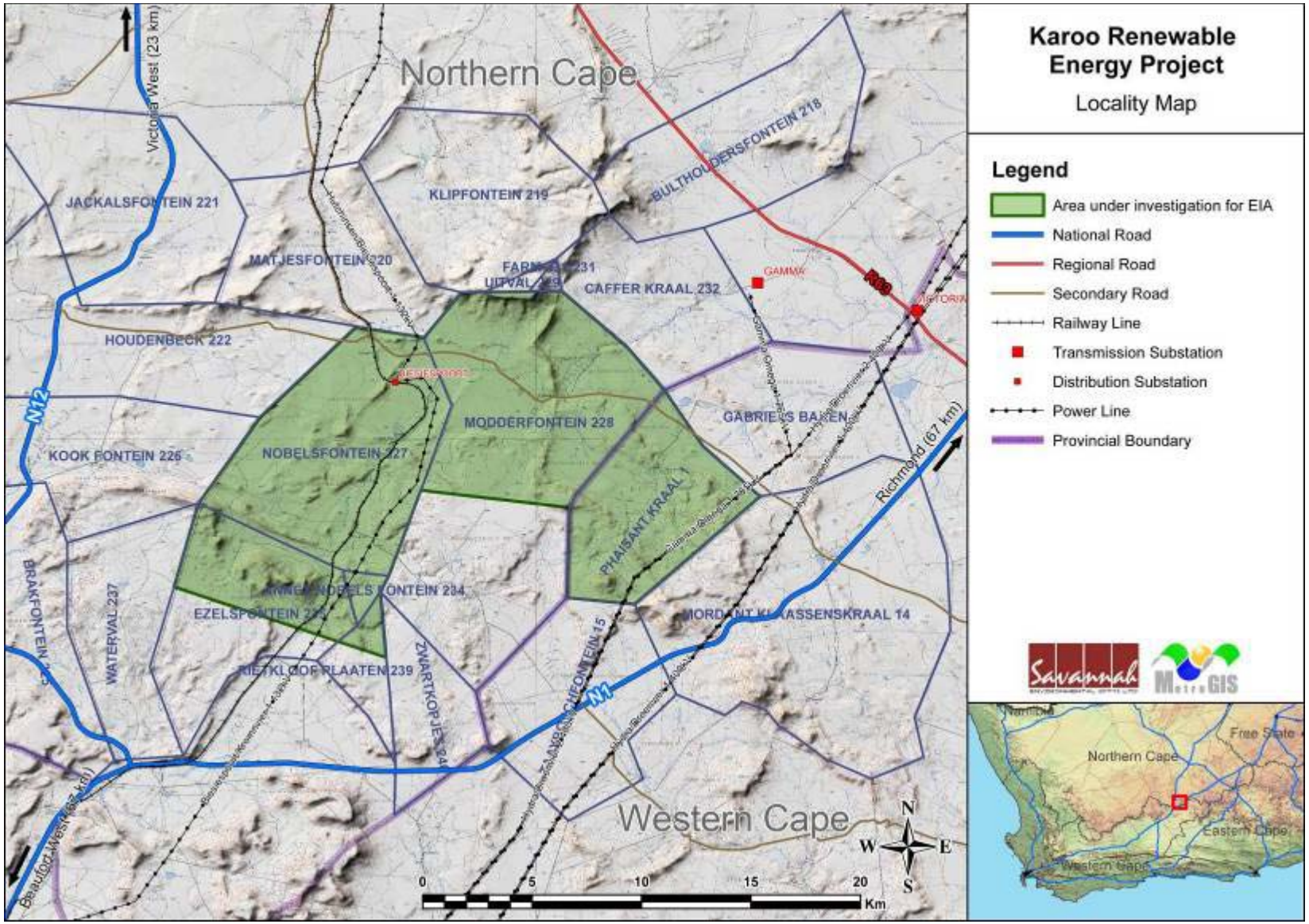

Figure 1.1: Locality map illustrating the location of the proposed development site for the Karoo Renewable Energy Facility

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):

Relevant Notice	Activity No	Description of listed activity
Government Notice R387 (21 April 2006)	1(a)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where (i) the electricity output is 20 megawatts or more; or (ii) the elements of the facility cover a combined area in excess of 1 hectare
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)	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 metres 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 R387 (21 April 2006)	2	Any development, activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be 20 ha or more.
Government Notice R386 (21 April 2006)	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 1 000 cubic metres at any one location or site.
Government Notice R386 (21 April 2006)	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).
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 15m and lower exclusively used by (i) radio amateurs; or (ii) for lightening purposes (b) flagpoles; and (c) lightening conductor poles
Government Notice R386 (21	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

Relevant Notice	Activity No	Description of listed activity
April 2006)		within the ambit of another listed activity or which are access roads of less than 30 m long.
Government Notice R386 (21 April 2006)	16(b)	The transformation of undeveloped, vacant or derelict land to residential mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare.
Government Notice R386 (21 April 2006)	17	Phased activities where any one phase of the activity may be below a threshold specified in this schedule but where a combination of the phases, including expansions and extensions, will exceed a specified threshold.

Note that this EIA is being conducted in accordance EIA Regulations that were current at the time of submitting the Application for Authorisation (i.e. the EIA Regulations of April 2006). No additional listed activities in terms of the EIA Regulations promulgated in August 2010 are triggered by the proposed renewable energy facility development. Therefore, no additional activities are required to be considered within this application.

1.2 Objectives of the Environmental Impact Assessment Process

The Scoping Phase of the EIA process, which preceded this current EIA Phase, **identified** a range of potential issues associated with the proposed project. The Scoping Phase also defined the extent of the studies required within this EIA Phase. This was achieved through an evaluation of the proposed project, involving the project proponent, specialists with experience in 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 Scoping Phase was concluded with the submission of the Final Scoping Report and Plan of Study for the EIA Phase to DEA for their review and acceptance on the 20th December 2010.

The EIA Phase **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 phase aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The release of a draft EIA Report for public review provides stakeholders with an opportunity to verify that the issues they have raised through the EIA process to date have been captured and adequately considered. This review period also provides a further opportunity for additional key issues for consideration to be raised. Following the 30 day review period, a final EIA Report will be submitted to DEA for review and acceptance. The final report will incorporate all issues and responses raised during the public review period as part of a Comments and Response Report.

1.3 Structure of this EIA Report

The EIA Report consists of eight chapters, which include:

Chapter 1: Provides background to the proposed facility and the Environmental Impact Assessment.
Chapter 2: Provides an overview of the proposed project.
Chapter 3: Provides an overview of the Regulatory and Legal Context for electricity generation projects and the EIA process.
Chapter 4: Outlines the process which was followed during the EIA Phase, including the consultation program that was undertaken and input received from interested parties.
Chapter 5: Describes the existing biophysical and socio-economic environment.
Chapter 6: Presents the assessment of environmental impacts associated with the proposed facility and associated power line alternatives.
Chapter 7: Presents the conclusions of as well as an impact statement on the proposed project.
Chapter 8: Provides a list of references and information sources used in undertaking the studies for this EIA Report.

1.4 The Environmental Assessment Practitioner

Savannah Environmental was contracted as the independent **Environmental Consultant** to undertake the EIA process for the proposed project. Neither Savannah Environmental nor any of its specialist sub-consultants on this project are subsidiaries of or are affiliated to SARGE (Pty) Ltd in any way. Furthermore, Savannah Environmental does not have any interests in secondary developments that could arise out of the authorisation of the proposed project.

Savannah Environmental is a specialist environmental consulting company providing holistic environmental management services, including environmental impact assessments and planning to ensure compliance and evaluate the risk of

development, and the development and implementation of environmental management tools.

The Savannah Environmental team have considerable experience in environmental impact assessments and environmental management, and have been actively involved in undertaking environmental studies, for a wide variety of projects throughout South Africa, including those associated with electricity generation. They have successfully managed and undertaken EIA processes for a number wind and solar energy facilities, throughout South Africa.

In order to adequately identify and assess potential environmental impacts associated with the proposed project, Savannah Environmental has appointed the following specialist sub-consultants to conduct specialist impact assessments. Appendix A contains the curricula vitae for the EAPs from Savannah Environmental as well as the specialist sub-consultants, as listed below.

» Ecology, flora and fauna – David Hoare Consulting
» Avifauna – Avisense Consulting
» Geology and erosion potential – Outeniqua Geotechnical Services cc
» Heritage resources – Albany Museum
» Palaeontology – Lloyd Rossouw
» Visual – MetroGIS
» Noise – M2 Environmental Connections
» Social – Batho Earth

OVERVIEW OF THE PROPOSED PROJECT CHAPTER 2

Chapter 1 introduced the proposed project, the legal requirements for the undertaking of an EIA process as per NEMA, and the environmental team assigned to the task. This chapter explores the following:

» The need and desirability of a project of this nature within the local, regional, and national context;
» A technical description of wind and solar energy as an option for power generation;
» A consideration of project alternatives including the "do nothing" option; site specific layout options; and alignments for the power line.
» The scope of works for the proposed Karoo Renewable Energy Facility during the construction, operation, and decommissioning phases.

2.1. The Need for the Proposed Project

The primary motivation behind the development of the proposed Karoo Renewable Energy Facility is the contribution of additional capacity to the national electricity grid and to assist in achieving the goal of a 30% share of all new power generation being derived from Independent Power Producers (IPPs), as targeted by the Department of Energy (DoE). South Africa's electricity supply remains heavily dominated by coal-based power generation. To date, South Africa has failed to exploit the various gains which the renewable energy industry offers, and the country's significant renewable energy potential remains largely untouched.

Targets for the promotion of renewable energy exist in more than 58 countries, of which 13 are developing countries. The South African government has recognised the country's high potential for developing its renewable energy sector and, coupled with the prevalent electricity shortages, the need to develop supplementary, environmentally friendly and sustainable sources of energy was identified. The development of renewable energy in South Africa is supported by a policy framework provided by the White Paper on Renewable Energy (November 2003), which has set a target of 10 000 GWh renewable energy contributions to the final energy consumption by 2013. This amounts to approximately 4% or 1 667 MW of the total estimated electricity demand which amounts to 41 539 MW by 2013 (NERSA, 2009). This target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro. The Department of Energy's macroeconomic study of renewable energy, developed under the now completed Capacity Building in Energy Efficiency and Renewable Energy Project,

has established that the achievement of this target would provide a number of economic benefits, including increased government revenue amounting to R299 million, increased GDP of up to R1 billion per year and the creation of an estimated 20 500 new jobs. Additionally, the development of renewable energy beyond the 10 000 GWh target holds further employment benefits and would maximise the number of jobs created per Terra Watt hour (TWh) (South Africa Renewable Energy Feed-in Tariff (REFIT) Regulatory Guideline published by NERSA (March 2009)).

To contribute towards these targets and towards socio-economic and environmentally sustainable growth, and stimulate the renewable energy industry in South Africa, the need to establish an appropriate market mechanism was identified, and Feed-in Tariffs (FIT) have been set. FITs are, in essence, guaranteed prices for electricity supply rather than conventional consumer tariffs. The basic economic principle underpinning the FITs is the establishment of a tariff that covers the cost of generation plus a "reasonable profit" to induce developers to invest. This is quite similar to the concept of cost recovery used in utility rate regulation based on the costs of capital. Feed-in tariffs to promote renewable energy have now been adopted in over 36 countries around the world. The establishment of the Renewable Energy Feed-In Tariff (REFIT) in South Africa provides the opportunity for an increased contribution towards the sustained growth of the renewable energy sector in the country, the region and internationally, and promote competitiveness for renewable energy with conventional energies in the medium- and long-term. Under the National Energy Regulator Act, 2004 (Act No 40 of 2004), the Electricity Regulation Act, 2006 (Act No 4 of 2006) and all subsequent relevant Acts of Amendment, the National Energy Regulator of South Africa (NERSA) has the mandate to determine the prices at and conditions under which electricity may be supplied by licence.

It is considered viable that long-term benefits for the community and/or society in general can be realised should the site identified prove to be acceptable from a technical and environmental perspective for the establishment of the proposed renewable energy facility. The Karoo Renewable Energy Facility has the potential to contribute to local electricity supply and to increase the security of supply to consumers. In addition, it may provide both economic stimulus to the local economy through the construction process and long term employment (i.e. management and maintenance) during the operation phase.

2.2. Description of the Proposed Renewable Energy Facility

The proposed site is located approximately 34 km south of Victoria West. The site lies within both the Northern and Western Cape Provinces, within the Ubuntu

as well as the Beaufort West Local Municipalities. The larger site covers an approximate area of 20 222 ha (200 km^2). The combined renewable energy facility, which will be appropriately placed within the larger site will have a generating capacity of up to **500 MW** and proposes the following infrastructure:

» Up to **150 wind turbines** with a generating capacity of up to 450MW;
» Each turbine will be a **steel tower** (between 80 and 125m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of between 90 and 100 m (i.e. each blade ranging from 45 to 55m in length);
» An array of **photovoltaic (PV) panels** with a generating capacity of up to 50MW;
» Two (2) **132 kV substations** with high-voltage (HV) yard footprints of approximately 100m x 100m each;
» **Foundations** to support both the turbine towers as well as the PV panels;
» **Cabling** between the project components, to be lain underground where practical;
» Two (2) new **overhead 132 kV power lines -**

From Substation 1:

- Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1 km length of power line); or alternatively
- Substation 1 Option 2: To connect to Eskom's existing Biesiespoort substation (up to 2.5 km length of power line).

From Substation 2:

- Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line); or alternatively
- Substation 2 Option 2: To connect to Eskom's existing Victoria Substation (up to 12 km length of power line).

» **Internal access roads** (5 m in wide and 82.15 km long) linking both the wind turbines and solar array with the other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new internal access roads; and
» **Small office and/or workshop building** (40 m x 20 m) for maintenance and storage purposes

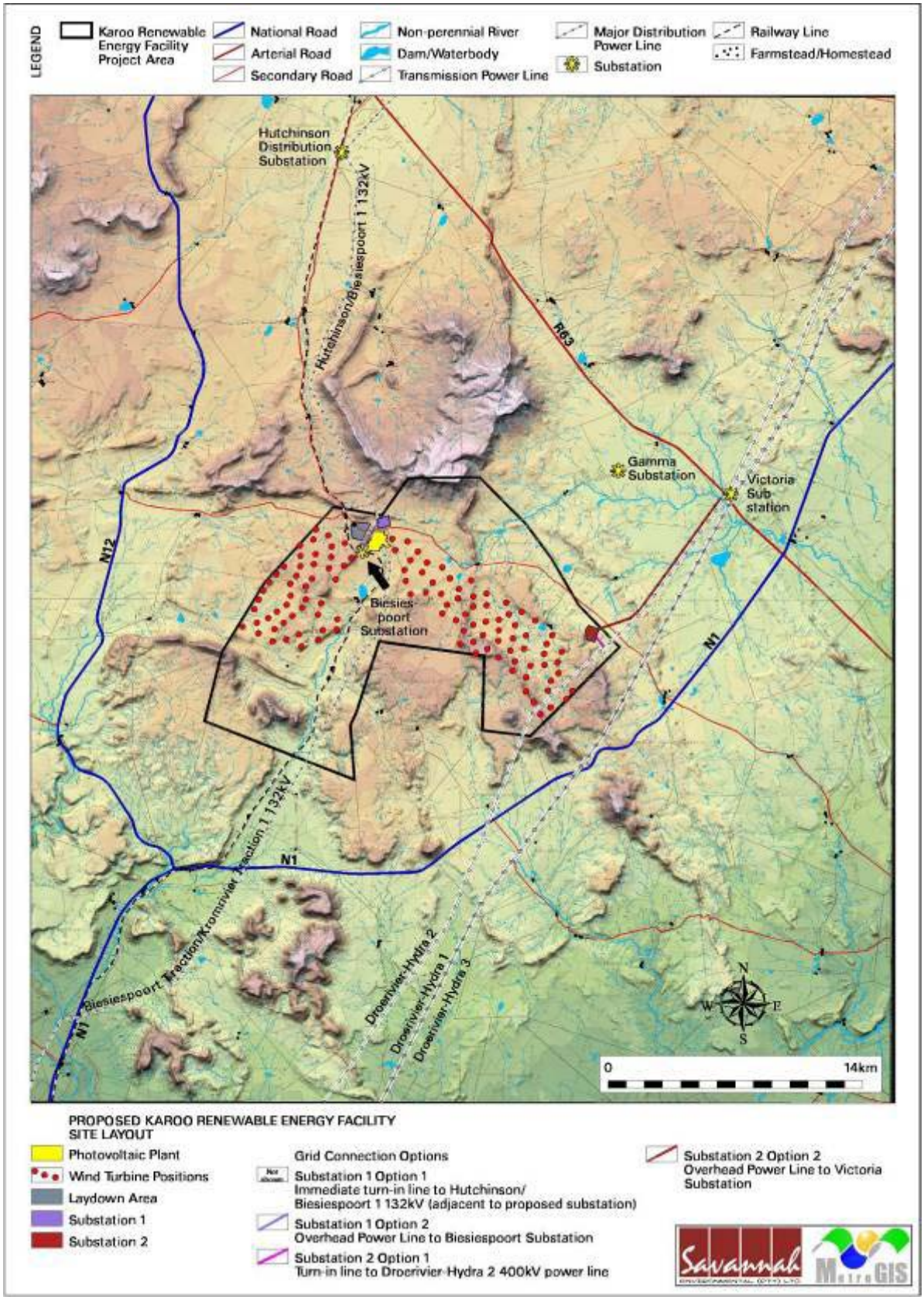

Figure 2.2: Map illustrating the preliminary layout for the proposed Karoo Renewable Energy Facility as well as associated linear infrastructure.

2.3 Project Alternatives

In accordance with the requirements of the EIA Regulations, project alternatives have been considered within the EIA process and are detailed below.

2.3.1 Site Alternatives

No site alternatives are proposed for this project as the location of the Karoo Renewable Energy Facility is strongly dependent on several factors including solar irradiation and wind resource, the extent of the site, the site topography, power transmission considerations, and site access. The site for the proposed facility is regarded by SARGE (Pty) Ltd as being highly desirable based on these characteristics. Based on these preferences, no further siting alternatives have been considered in this EIA process.

- **Topography:** the area proposed for the construction of the wind component is exposed to the wind resource as it is situated on elevated terrain. Areas that are associated with level/even topography are preferred for the installation of the photovoltaic solar facility component as the PV panels require a flat surface to be constructed upon.
- **Climatic conditions:** The economic viability of a renewable energy facility is directly dependent on the climatic conditions of the area. The site identified for the establishment of the facility receives sufficient average daily direct radiation as well as exposure to the wind resource to motivate for the establishment of such a combined facility.
- **Extent of site:** The proposed site which covers an area of approximately 200 km^2 will allow for the installation of both the wind energy facility component as well as the photovoltaic solar facility component, including associated infrastructure as the extent of the site is larger than the development footprint required for the facility.
- **Power transmission considerations:** The existing Hutchinson/Biesiespoort-1 132kV line and Droerivier/Hydra-2 400kV line both traverse the site and could allow for direct connection to the national electricity grid.
- **Site access**: on a regional scale the N1 as well as the N12 national roads provide decent access to the subject site. This will assist in the transportation of the facility components during the construction phase. A secondary road traverses the study site from east to west and also provides access to various parts of the study area. A number of less significant roads lead from this secondary road to various parts of the site.
- **Local labour and economic stimulus:** the site is located in close proximity to the towns of Hutchinson and Victoria West which will act as a ready source of local labour during construction of the proposed facility.

Based on these considerations, SARGE considers the identified site as highly preferred in terms of the development of the proposed renewable energy facility.

2.3.2 Layout Design Alternatives

The overall objective of the layout is to maximise electricity production through exposure to both the wind and solar resource, while minimising infrastructure, operation, and maintenance costs, and social and environmental impacts. Through the process of determining constraining factors, the layout of the facility components within the broader site was planned with a preliminary layout being produced. Alternatives for connecting each of the on-site substations to the electrical network have been provided and are being assessed through this EIA – Substation 1 Options 1 and 2, and Substation 2 Options 1 and 2 (refer to Figure 2.2). In both cases Option 1 is the preferred alternative from a technical perspective, due to the costs involved with the construction of power lines.

Feasible sites were provided for the on-site substations and the laydown area, however no alternatives have been assessed.

2.3.3. The 'Do-Nothing' Alternative

The 'do-nothing' alternative is the option of not constructing the Karoo Renewable Energy Facility. Should this alternative be selected there will be no potential environmental impacts on the identified site, and no positive benefits arising from the project would be realised.

However, the increasing electricity demand in South Africa is placing ever-increasing pressure on the existing power generation capacity. Therefore additional electricity generation options need to be developed throughout the country. Should the facility not be developed the benefits related to the generation of electricity from renewable energy resources will not be realised. These benefits are explored in further detail in the South Africa REFIT Regulatory Guideline published by NERSA (March 2009), and include:

» **Increased energy security:** The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of power supplementation. In addition, given that renewables can often be deployed in a decentralised manner close to consumers, they offer the opportunity for improving grid strength and supply quality, while reducing expensive transmission and distribution losses.
» **Resource saving:** Conventional coal fired plants are major consumers of water during their requisite cooling processes. It is estimated that the achievement of the targets in the Renewable Energy White Paper will result in

water savings of approximately 16.5 million kilolitres, when compared with wet cooled conventional power stations; this translates into revenue savings of R26.6 million. As an already water-stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly due to the detrimental effects of climate change on water availability.

» **Exploitation of our significant renewable energy resource:** At present, valuable national resources including biomass by-products, solar radiation and wind power remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio.

» **Pollution reduction:** The releases of by-products through the burning of fossil fuels for electricity generation have a particularly hazardous impact on human health and contribute to ecosystem degradation.

» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows South Africa to contribute towards mitigating climate change through the reduction of greenhouse gas emissions. South Africa is estimated to be responsible for 1% of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO_2 emissions.

» **Support for international agreements and enhanced status within the international community:** The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements under the Kyoto Protocol, and for cementing its status as a leading player within the international community.

» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities have significant potential for job creation in South Africa.

» **Acceptability to society:** Renewable energy offers a number of tangible benefits to society including reduced pollution concerns, improved human and ecosystem health and climate friendly development.

» **Support to a new industry sector:** The development of renewable energy offers the opportunity to establish a new industry within the South African economy.

» **Protecting the natural foundations of life:** The development of renewable energy projects can play an important role in the prevention of climate change through the reduction of our carbon footprint. In turn, this will secure the natural foundations of life for generations to come.

At present, South Africa is some way off from exploiting the diverse gains from renewable energy and from achieving a considerable market share in the renewable energy industry. South Africa's electricity supply remains heavily dominated by coal based power generation, with the country's significant renewable energy potential largely untapped to date.

Within a policy framework, the development of renewable energy in South Africa is supported by the White Paper on Renewable Energy (November 2003), which has set a target of 10 000 GWh renewable energy contributions to final energy consumption by 2013. The target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro. DoE's macroeconomic study of renewable energy, developed under the now completed Capacity Building in Energy Efficiency and Renewable Energy (CaBEERE) project, has established that the achievement of this target would provide a number of economic benefits, including increased government revenue amounting to R299 million, increased GDP of up to R1 billion per year and the creation of an estimated 20 500 new jobs. In addition, the development of renewable energy beyond the 10 000 GWh target holds further employment benefits and would maximise the number of jobs created per TWh (South Africa Renewable Energy Feed-in Tariff (REFIT) Regulatory Guideline published by NERSA (March 2009)).

Two monitoring masts of 15m and 80m height have been recording wind data since May 2010 and September 2010 respectively. Annual average horizontal and inclined irradiance values were taken from the closest temperature station (141km away), and the closest global radiation station (176 km away). Through the above research, the viability of the Karoo Renewable Energy Facility has been established. The 'do nothing' alternative will not assist the South African government in reaching their set targets for renewable energy.

This is, therefore, not a preferred alternative and not assessed in further detail.

2.3.4 Technology Alternatives

Following the consideration of technology alternatives, which is largely determined by site characteristics and technical requirements, it was determined by SARGE that the site would be suitable for establishing a combined wind and solar energy facility in order to generate electricity, which will be fed into the National power grid. The current technology options to be utilised for the renewable energy facility include:

» Photovoltaic (PV) panels;
» Wind Turbine Generators (WTGs)

The turbines being considered for use will each have a generating capacity of 3 MW and will have a proposed hub height of up to 125 m, and a rotor diameter of up to 100 m (i.e. each blade up to 50 m in length). The layout provided at this stage is considered to be preliminary (i.e. approximately 80% accurate). Both wind turbines and solar photovoltaic (PV) panels are described in more detail below.

2.4 Wind Energy as a Power Generation Technology

A wind energy facility consists of multiple wind turbines which are used to capture the kinetic energy of the wind. The mechanical power generated by the rotation of the blades is transmitted to the generator within the nacelle via a gearbox and a drive train. The wind turns the blades, which in turn spin a shaft which connects to a generator and generates electrical power. The use of wind for electricity generation is a non-consumptive use of a natural resource and consumes no fuel for continuous operation. Wind power produces an insignificant amount of greenhouse gases during its entire lifecycle and the operational phase does not produce carbon dioxide, sulfur dioxide, mercury, particulates, or any other type of air pollution, compared to fossil fuel power generation technologies including coal fired power stations.

Wind energy has the attractive characteristic that the fuel used to generate electricity is free. The economics of a wind energy project significantly depend on the wind resource at the site. Detailed and reliable information about the speed, strength, direction, and frequency of the wind resource is vital when considering the installation of a wind energy facility.

A wind measurement and analysis programme is being conducted by SARGE as only measured data will provide a robust prediction of the expected energy production of the facility over its lifetime. The placement of a wind energy facility and the actual individual turbines must therefore consider the following technical factors:

» Predominant **wind direction and frequency**
» **Topographical features** or relief affecting the flow of the wind (e.g. causing shading effects and turbulence of air flow)
» **Effect of adjacent turbines** on wind flow and speed – specific spacing is required between turbines in order to reduce the effects of wake turbulence.

2.4.1 How do Wind Turbines Function?

Wind turbines are mounted on a tower to capture the kinetic energy of the wind which is used to turn a wind turbine to generate electricity. At 30 m or more above ground, turbines can take advantage of a typically faster and less turbulent wind resource. Turbines catch the wind's energy with their propeller-like blades (usually two or three blades are mounted on a shaft to form a rotor). The rotor and a nacelle are mounted at the tip of a tapered steel tower. The mechanical power generated by the rotation of the blades is transmitted to the generator within the nacelle via a gearbox and drive train.

Wind turbines typically need to be spaced approximately 2 to 3xD apart, and 5 to 7xD where a turbine is behind another (D = the diameter of the rotor blades). This is required to minimise the induced wake effect the turbines might have on each other. Considering a turbine whose rotor is 90 m in diameter, each turbine would need to be separated by approximately 180 m to 270 m. The erection of turbines in parallel rows one behind another would require a distance between rows of 450 m to 630 m to avoid wake effects from one turbine onto another. Once a viable footprint has been determined the micro-siting of the turbines will be determined using industry standard software systems which will automatically consider the spacing requirements.

2.4.2. Main Components of a Wind Turbine

The turbine consists of the following major components (refer to Figure 2.3):

» The rotor
» The nacelle
» The tower

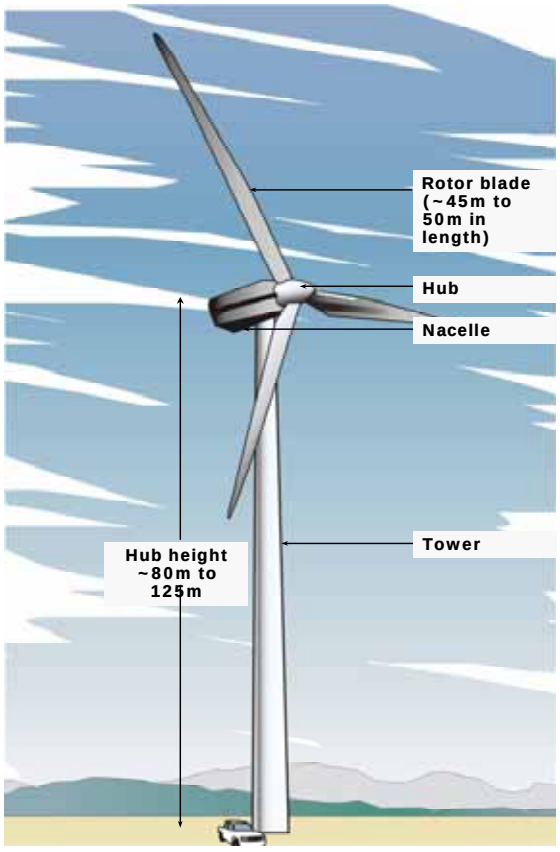

Figure 2.3: Illustration of the main components of a wind turbine.

The Rotor

The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the

generator. The rotor has three blades that rotate at a constant speed of about 15 to 28 revolutions per minute (rpm). The speed of rotation of the blades is controlled by the nacelle, which can turn the blades to face into the wind ('yaw control'), and change the angle of the blades ('pitch control') to make the most use of the available wind.

The rotor blades function in a similar way to the wing of an aircraft, utilising the principles of **lift** (Bernoulli). When air flows past the blade, a wind speed and pressure differential is created between the upper and lower blade surfaces. The pressure at the lower surface is greater and thus acts to "lift" the blade. When blades are attached to a central axis, like a wind turbine rotor, the lift is translated into rotational motion. Lift-powered wind turbines are well suited for electricity generation.

The rotation of the rotor blades produces a characteristic 'swishing' sound as the blades pass in front of the tower roughly once a second. The other moving parts, the gearbox and generator, cannot be heard unless the observer is physically inside the turbine tower. The tip-speed is the ratio of the rotational speed of the blade to the wind speed. The larger this ratio, the faster the rotation of the wind turbine rotor at a given wind speed. Electricity generation requires high rotational speeds. Lift-type wind turbines have optimum tip-speed ratios of around 4 to 5.

The Nacelle

The nacelle contains the generator; control equipment; gearbox and anemometer for monitoring the wind speed and direction.

The generator is what converts the turning motion of a wind turbine's blades into electricity. Inside this component, coils of wire are rotated in a magnetic field to produce electricity. The generator's rating, or size, is dependent on the length of the wind turbine's blades because more energy is captured by longer blades.

The Tower

The tower, which supports the rotor, is constructed from tubular steel and is proposed to be between 80 and 125m tall, depending on the turbine type chosen for the wind energy facility. The nacelle and the rotor are attached to the top of the tower.

The tower on which a wind turbine is mounted is not just a support structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

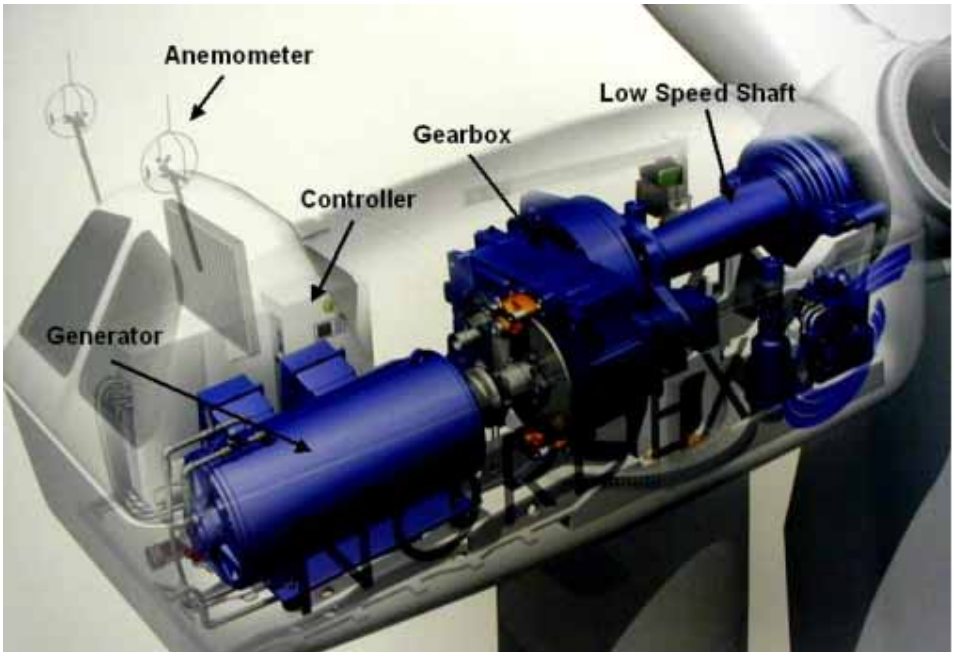

Figure 2.4: Detailed structure of a nacelle of a horizontal axis turbine

2.4.3. Operating Characteristics of a Wind Turbine

It is the flow of air over the blades and through the rotor area that makes a wind turbine function; the wind turbine extracts energy by slowing the wind down. The theoretical maximum amount of energy in the wind that can be collected by a wind turbine's rotor is approximately 59%. This value is known as the Betz Limit. If the blades were 100% efficient, a wind turbine would not work because the air, having given up all its energy would stop entirely. In practice, the collection efficiency of a rotor is not as high as 59%; the typical efficiency is 35% to 45%. A wind energy system, including rotor, generator etc, does not exhibit perfect efficiencies and will therefore deliver between 10 - 30% of the original energy available in the wind.

Turbines are able to operate at varying speeds; the amount of energy a turbine can harness depends on both the wind velocity and the length of the rotor blades. Wind turbines can start generating at wind speeds of between 10 km/hr to 15 km/hr (~3 m/s to 4 m/s), with nominal wind speeds required for full power operation varying between 45 km/hr and 60 km/hr (12.5 m/s and17 m/s).

The **cut-in speed** is the minimum wind speed at which the wind turbine will generate usable power. This wind speed is typically between 10 and 15 km/hr (~3 m/s and 4 m/s). At very high wind speeds, typically over 90 km/hr (25 m/s), the wind turbine will cease power generation and shut down. The wind speed at which shut down occurs is called the **cut-out speed**. Having a cut-out

speed is a safety feature which protects the wind turbine from damage. Normal wind turbine operation usually resumes when the wind drops back to a safe level.

Wind turbines can be used as stand-alone applications or they can be connected to a utility power grid. For utility-scale sources of wind energy, a large number of wind turbines are usually built close together to form a **wind energy facility**. A turbine is designed to operate continuously, unattended and with low maintenance for more than 20 years or **>120 000 hours of operation**. Once operating, a wind energy facility can be monitored and controlled remotely, with a mobile team for maintenance, when required.

2.5 Solar Energy as a Power Generation Technology

Photovoltaic (PV) facilities use semiconductors/PV cells which absorb solar energy to produce electricity through the "Photovoltaic Effect." This physical process was discovered in 1839 by Edmund Becquerel who found that certain materials (i.e. silicon) produce electric current when exposed to light. Sunlight is composed of photons or "packets" of energy and when these photons strike the PV cells, they may be reflected or absorbed, or they may pass right through. When a photon is absorbed, its energy is transferred to an electron in an atom of the semiconductor). Thereafter, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit.

Similar in nature to wind energy, solar energy also has the attractive attribute of a free fuel. Detailed and reliable information about the strength and direction of the incoming solar radiation (i.e. the solar resource) is vital when considering the installation of a solar energy facility, as the solar resource is a critical factor to the success of the installation. Solar energy facilities produce an insignificant quantity of greenhouse gases over its lifecycle as compared to conventional coal-fired power stations. The operational phase of a solar facility does not produce carbon dioxide, sulphur dioxide, mercury, particulates, or any other type of air pollution, as do fossil fuel power generation technologies.

2.5.1. How do Solar Photovoltaic Facilities function

Solar energy facilities, such as those using PV technology use the energy from the sun to generate electricity through a process known as the Photovoltaic Effect. This effect refers to photons of light colliding with electrons, and therefore placing the electrons into a higher state of energy to create electricity. This is achieved through the use of the certain components.

2.5.2. Main Components of a Solar Photovoltaic (PV) Facility

The PV component of the proposed facility is based on polycrystalline type modules which are assembled on fixed structures directly on the ground and arranged in "strings". The "strings" are electrically connected to a group of inverters. The PV plant will be divided into 25 sub-fields of about 2.02 MW each. Every sub-field is made up of 8,400 modules, divided into 420 strings (of 20 modules each). "Strings" consist of PV modules which are connected in series, so that the maximum DC input of inverters is not reached.

The main components of a photovoltaic facility consist of the following major components:

» PV cells
» Support structure
» Inverter

The **individual PV cells** are commonly constructed from silicon and are linked together and placed behind a protective glass sheet to operate together as a PV panel. A single PV cell is sufficient to power a small device such as an emergency telephone, however to produce 50 MW of power, the proposed solar PV component will require numerous cells arranged in multiples/arrays which will be fixed to **support structures or mounts**.

In order to maximise the electricity generated these mounts need to be angled in such a fashion so to receive the maximum amount of solar radiation throughout the year. The preferred angle of the panels (which is dependent on the latitude of the proposed facility) may be adjusted to optimise for summer or winter solar radiation characteristics. The generated power can then be stored or evacuated into a local electricity grid to meet the load requirements. In the case of the latter, the electricity is evacuated to either a substation or a switching station which houses an inverter.

The **inverter** converts the electricity, which is produced as direct current, into alternating current which can be used by individuals drawing power from the national electricity grid.

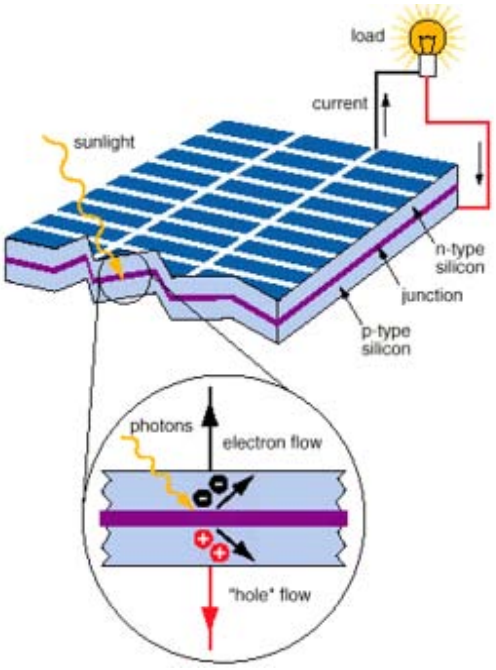

Figure 2.5: diagram indicating a typical PV cell

Figure 2.6: Photograph illustrating an array of PV panels.

2.6 Project Construction Phase

It can be expected that the construction period for the PV component will last approximately 12 months in total. Certain activities can and need to be overlapped to achieve a total construction period of 12 months (i.e. the assembly of the PV modules can commence while the support structures are being

completed and erected. The construction phase of the wind component is dependent on the amount of turbines to be installed but can be estimated at one to one and a half turbines per week. In order to construct the renewable energy facility and associated infrastructure, a series of activities will need to be undertaken. The construction process is discussed in more detail below:

» The **pre-construction phase** will include conducting surveys; undertaking site preparation and transporting the required components and equipment to site.
» The **construction phase** will include establishment of internal and external access roads; establishment of construction areas; construction of the power block (i.e. generator transformer/small substation); assembly of the PV panels and wind turbines; establishment of ancillary infrastructure (i.e. power line); and connection of the substation to the Eskom power grid.
» The **post-construction phase** will include site remediation.

Limited on-site labour camps are envisaged as construction workers will be accommodated in the nearby towns and transported to and from site on a daily basis. Overnight on-site worker presence would be limited to senior management and security staff.

2.6.1 Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to, geotechnical survey, site survey and confirmation of the final micro-siting/positioning of the wind turbines and PV panels, survey of substation site/s and survey of road and power line servitudes to determine tower locations.

2.6.2 Establishment of Access Roads within the Site

On a regional scale, the N1 as well as the N12 national roads provide good access to the subject site. This will assist in the transportation of the facility components during the construction phase. A secondary road traverses the study site from east to west. Access will be required from this road to the turbine and PV panel locations for construction purposes (and later limited access for maintenance). The road alignment will be informed by the final micro-siting/positioning of the wind turbines and PV panels.

Although the informal farm road/s are unlikely to have been subjected to vehicle loading of the same magnitude and intensity to that expected during construction of the renewable energy facility, it is assumed for the purposes of this assessment that it will be predominantly suitable for the construction-related

traffic in terms of load carrying capability and durability. It is, however, likely that access road upgrades will be required to satisfy the turbine suppliers track width and alignment requirements. Approximately 5.6 km length of temporary access roads and 82.2 km length of permanent access roads of 5m in width will have to be constructed for the proposed facility.

Turbine manufacturers typically specify criteria for vertical and horizontal alignment of access tracks to enable delivery of the turbine components. New access tracks would follow the existing ground profile as much as possible to minimise cut/fill requirements in construction. Any irregularities in road curving must have a maximum relative rise or fall of no more than 150 millimetres within any 30 metre section of road surface (refer to Figure 2.1).

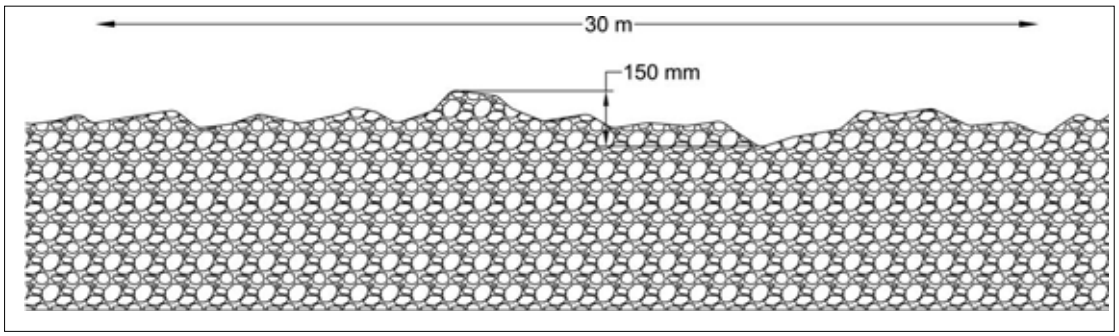

Figure 2.7: Maximum allowable rise and fall of road surfaces (Vestas Document no. 0002-0277 V03)

The road bend radii must be amended to accommodate the bending radii needed to transport all wind turbine components and the transportation equipment used by the transport supplier. The final layout of the site specific access roads will be determined following the identification of site related sensitivities and the final micro-siting/positioning of the wind and solar components. These access roads will have to be constructed in advance of any components being delivered to site, and will remain in place after completion for future access and possibly access for replacement of parts if necessary.

2.6.3 Undertake Site Preparation

Site preparation activities will include clearance of vegetation at the footprint of each component, establishment of laydown areas, the establishment of internal access roads and excavations for foundations. These activities will require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site.

Site preparation will be undertaken in a systematic manner to reduce the risk of open ground to erosion. In addition, site preparation will include search and rescue of floral species of concern (where required), as well as identification and excavation of any sites of cultural/heritage value (where required).

2.6.4 Establishment of Laydown Areas on Site

A laydown area will need to be established in close proximity to the location of the PV component of the facility, as well as at each turbine position for the storage of wind turbine components. The laydown area for each turbine during the construction process will need to accommodate the crane required for tower/turbine assembly, and should at least measure 50 m x 25 m. Laydown and storage areas will be required for the normal civil engineering construction equipment which will be required on site.

The concrete to be used for the foundations of the turbines and the solar array will be mixed at an existing batching plant located off site. No cement batching will take place on-site, which therefore eliminates the need for the establishment of an on-site batching plant.

2.6.5 Construct Foundation

Concrete foundations will be constructed for each of the turbines as well as for the support structures of the PV component. The foundation type selected for the turbines will be dependent on the ground conditions beneath the site (i.e. following a geotechnical investigation). The dimensions of the turbine foundations are foreseen to be 15m long x 15m wide x 2.5m deep. Foundations will be mechanically excavated.

2.6.6 Transport of Components and Equipment to Site

The equipment will be transported to the site using appropriate National and Provincial roads, and the dedicated access/haul road onto the site itself. The components for the proposed facility will be transported to site in sections by road and rail. Smaller components of the proposed facility associated with the PV component can be transported by rail to the existing Biesiespoort station which is located on the study site.

The wind turbine, including the tower, will be brought on site by the turbine supplier in sections on flatbed trucks. Turbine units which must be transported to site consist of the tower (in segments), nacelle, and three rotor blades. These will include abnormally long loads associated with rigid turbine blades, as well as abnormally heavy loads associated with the 80-ton nacelles. Traffic movement

will peak with the commencement of construction activities, with a smaller concentration (associated with the evacuation of cranes and civil equipment) at the end of the construction period.

The individual components are defined as abnormal loads in terms of Road Traffic Act (Act No 29 of 1989)[2] by virtue of the dimensional limitations (abnormal length of the blades) and load limitations (i.e. the nacelle). In addition, components of various specialised construction and lifting equipment are required on site to erect the wind turbines and need to be transported to site. In addition to the specialised lifting equipment/cranes, the normal civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.).

The components required for the establishment of the substation (including transformers) as well as the power lines (including towers and cabling) will also be transported to site as required. The dimensional requirements of the load during the construction phase (length/height) may require alterations to the existing road infrastructure (e.g. widening on corners), accommodation of street furniture (e.g. street lighting, traffic signals, telephone lines etc), and protection of road-related structures (i.e. bridges, culverts, portal culverts, retaining walls etc) as a result of abnormal loading.

2.6.7 Assemble Wind Turbines and PV Panels

A large lifting crane will be brought on site and will be used to lift the turbine tower sections into place. The nacelle, which contains the gearbox, generator, and yawing mechanism, will then be placed onto the top of the assembled tower. Next, the rotor (i.e. the blades of the turbine) will be assembled/partially assembled on the ground. It will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while a large crane will be needed to put it in place. It will take approximately 2 days to erect a single turbine, although this will depend on the climatic conditions as a relatively wind-free day will be required for the installation of the rotor.

The smaller lifting crane will be required to move between the turbine sites and will make use of the permanent access roads (5 m wide) to be constructed on site. The crawler crane is self-powered and can move between locations should the ground conditions allow. However, in this case the crawler crane will be disassembled after each consecutive turbine erection and will be transported to the next turbine location by means of truck. Therefore no additional temporary

[2] A permit will be required for the transportation of these abnormal loads on public roads.

access roads will be required on site for the movement of the crawler crane between the proposed turbine locations.

The solar array components will be assembled on-site. The solar array will comprise the following components:

» PV panels
» Support structures
» Cabling (underground)

Numerous PV panels will be linked together in order to form a single operating unit which will be mounted on support structures. These support structures of the PV panels will also be fixed onto the ground by means of concrete foundations.

2.6.8 Construct On-site Substations

Two (2) 132 kV substations will be constructed within the site footprint for connection to the grid. The facility components will be connected to the substations via underground cabling. Figure 2.2 indicates the position of the substations, currently proposed. However the final position will be informed by the final micro-siting/positioning of the turbines. The substations will be constructed with high-voltage (HV) yard footprints of approximately 100m x 100m.

The construction of the substations would require a survey of the site; site clearing and levelling; and construction of access road/s (where required); construction of substation terrace and foundation; assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas.

The proposed substations would be constructed in the following simplified sequence:

» Step 1: Survey of the site
» Step 2: Site clearing and levelling and construction of access road to substation site
» Step 3: Construction of terrace and substation foundations
» Step 4: Assembly, erection and installation of equipment (including transformers)
» Step 5: Connection of conductors to equipment

» Step 6: Rehabilitation of disturbed areas and protection of erosion sensitive areas

2.6.9 Establishment of Service Buildings

A workshop as well as a contractor's equipment camp may also be required. The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.

2.6.10Connection of Wind Turbines and Solar Array to the Substations

The wind turbines as well as the solar array (PV panels) will be connected to the optimally positioned substations on site by means of underground electrical cables (33 kV). The installation of these cables will require the excavation of trenches, approximately 1 m in depth within which these cables can then be laid. The underground cables will be planned to follow the internal access roads, as far as possible.

2.6.11Connect Substations to Power Grid

Two (2) new overhead power lines (132 kV) are proposed in order for the on-site substations to connect to the Eskom national grid.

Substation 1 is located approximately 200m north of the solar array component and directly east of the existing 132 kV Hutchinson/Biesiespoort-1 line. The preferred method of connecting Substation 1 to the power grid is by means of turning-in to the existing 132kV Hutchinson/Biesiespoort-1 line with an overhead power line of up to 1 km in length. The alternative option would be to construct an overhead power line of up to 2.5 km in length in order to connect to Eskom's existing Biesiespoort substation which is located on-site (refer to Figure 2.2).

Substation 2 is located towards the eastern border of the study site. The preferred option of connecting Substation 2 to the power grid is by means of turning-in to the existing 400kV Droërivier/Hydra 2 line by means of an overhead power line of up to 1.5 km in length. The alternative option in this case would be to construct an overhead power line of up to 12 km in length in order to connect Substation 2 to Eskom's existing Victoria Substation (refer to Figure 2.2).

The authorised option for connection of both Substations to the power grid will be assessed, surveyed and pegged prior to construction.

2.6.12 Undertake Site Rehabilitation

As construction is completed in an area, and as all construction equipment is removed from the site, the site will be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation.

2.7. Project Operation Phase

SARGE provided an estimate of twenty eight (28) as the total amount of staff that may be employed during the operational phase of the proposed facility (i.e. 60% skilled staff and 40% unskilled staff). Twenty (20) of these possible job opportunities arises from the wind component and eight (8) from the solar component. Given the requirement for specialised skills for the construction of a facility of this type and South Africa's relative inexperience in the sector, the required operational and maintenance skills may need to be imported from other parts of South Africa or overseas. Therefore, the exact total number of potential employment opportunities is not known at this stage in time.

The solar array will operate continuously except during night time, unsuitable weather conditions which does not allow for incoming solar radiation, and during times of maintenance.

The PV panels will require cleaning from time to time to ensure maximum solar radiation absorption. The study site is located within a semi-arid region (Karoo) and will require the PV panels to be cleaned up to 4 times per annum. As per the information provided by the relevant engineers, approximately 1.5l of water will be required for each PV panel to be cleaned. This equates to a substantial amount of water needed as per the calculation below:

1.5 litres (per PV panel) x 210 000 panels x 4 = 1 260 00 litres of water per annum.

This therefore necessitates the need for a Water Use License Application (WULA) to be submitted to the Department of Water Affairs due to the volumes being in excess of those specified for a General Authorisation in terms of water use.

Each of the turbines within the facility will be operational except under circumstances of mechanical failure, extreme weather conditions, or maintenance activities. The wind turbines will be subject to scheduled maintenance and inspection twice yearly, as well as to unscheduled maintenance. Periodic oil

changes will be required. Any waste products (e.g. oil) will be disposed of in accordance with relevant waste management legislation.

2.8. Project Decommissioning Phase

The infrastructure (turbines and solar array) which will be utilised for the proposed facility is expected to have a lifespan of approximately 20 - 25 years (with maintenance). The equipment associated with this facility would only be decommissioned once it has reached the end of its life span. It is most likely that decommissioning activities of the infrastructure of the facility discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time.

The following decommissioning activities have been considered to form part of the project scope.

2.8.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate equipment and lifting cranes required for the wind component, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of construction equipment for both the wind and solar components.

2.8.2. Disassemble and Replace Existing Wind and Solar Components

Both the wind (turbine and tower sections) and solar components (PV panels and support structures) of the proposed facility will be disassembled once it reaches the end of its economic lifespan. A large crane would be required for disassembling the turbine and tower sections. Once disassembled, the components will be reused, recycled, or disposed of in accordance with regulatory requirements. If deemed necessary, the disassembled components would be replaced with more appropriate technology/infrastructure available at that time.

REGULATORY AND LEGAL CONTEXT CHAPTER 3

3.1 Policy and Planning Context for Renewable Energy Facility Development in South Africa

The need to expand electricity generation capacity in South Africa is based on **national policy** and informed by on-going strategic planning undertaken by the Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA) and Eskom. The hierarchy of policy and planning documentation that support the development of renewable energy projects such as wind and solar energy facilities is illustrated in Figure 3.1. These policies are discussed in more detail in the following sections, along with the provincial and local policies or plans that have relevance to the proposed renewable energy facility's development.

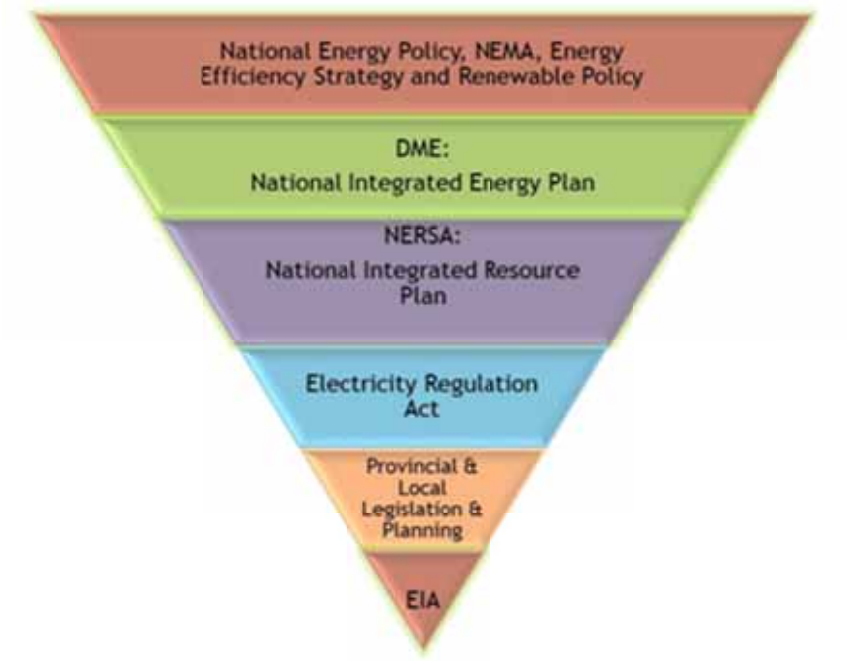

Figure 3.1: Hierarchy of electricity policy and planning documents

3.1.1 White Paper on the Energy Policy of the Republic of South Africa, 1998

Development within the energy sector in South Africa is governed by the White Paper on a National Energy Policy (the National Energy Policy), published by the Department of Minerals and Energy (DME) in 1998. This White Paper identifies key objectives for energy supply within South Africa, such as increasing access to

affordable energy services, managing energy-related environmental impacts and securing energy supply through diversity. Investment in renewable energy initiatives, such as the proposed facility, is supported by the White Paper on Energy Policy for South Africa. In this regard the document notes that government policy is based on an understanding that renewable energy sources have significant medium- and long-term commercial potential and can increasingly contribute towards a long-term sustainable energy future in South Africa. The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly **solar** and **wind** and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

3.1.2 Renewable Energy Policy in South Africa, 1998

The White Paper on Renewable Energy (DME, 2003) supplements the Energy Policy, and sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. The support for the Renewable Energy Policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind, and that renewable applications are, in fact, the least cost energy service in many cases from a fuel resource perspective (i.e. the cost of fuel in generating electricity from such technology); more so when social and environmental costs are taken into account. Government policy on renewable energy is therefore concerned with meeting economic, technical and other constraints on the development of the renewable industry.

In order to meet the long-term goal of a sustainable renewable energy industry, the South African Government has set the following 10-year target for renewable energy: "*10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013 to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1 667 MW) of the estimated electricity demand (41 539 MW) by 2013"* (DME, 2003).

The White Paper on Renewable Energy states "*It is imperative for South Africa to supplement its existing energy supply with renewable energies to combat Global Climate Change which is having profound impacts on our planet.*"

3.1.3 Integrated Energy Plan, 2003

In response to the requirements of the National Energy Policy, the DME commissioned the Integrated Energy Plan (IEP) to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance between the energy demand and resource availability to provide low cost electricity for social and economic development, while taking into account health, safety and environmental parameters.

The current IEP recognises that South Africa is likely to be reliant on coal for at least the next 20 years as the predominant source of energy; however there is potential and a need to diversify energy supply through increased use of natural gas and new and renewable energies.

3.1.4 National Integrated Resource Plan (NIRP), 2003/2004

In response to the National Energy Policy's objective relating to affordable energy services, NERSA commissioned a National Integrated Resource Plan (NIRP) in order to provide a long-term (from 2003 to 2022), cost-effective resource plan for meeting electricity demand, which is consistent with reliable electricity supply and environmental, social and economic policies. The planning horizon for the study was from 2003 to 2022. The objective of the NIRP is to determine the least-cost supply option for the country, provide information on the opportunities for investment into new power generating projects, and evaluate the security of supply. The Long-term Electricity Planning goal is to ensure sustainable development considering technical constraints, economic constraints, social constraints, and externalities (http://www.energy.gov.za/files/irp_frame.html).

Various demand side management and supply-side options are considered in the NIRP process, prior to identifying the least cost supply options for South Africa. The outcome of the process confirmed that coal-fired options are still required over the next 20 years and that additional base load plants will be required from 2010.

The first and interim IRP was developed in 2009 by the Department of Energy. The initial four years of this plan was promulgated by the Minister of Energy on 31 December 2009 and was updated on 29 January 2010.

After a first round of public participation in June 2010, the Revised Balanced Scenario (RBS) was published in October 2010. It laid out the proposed generation new build fleet for South Africa for the period 2010 to 2030. This

scenario was derived based on the cost-optimal solution for new build options, which was then “balanced” in accordance with qualitative measures such as local job creation.

A second round of public participation was conducted in November/December 2010, which led to several changes to the IRP model assumptions. The main changes were the disaggregation of renewable energy technologies to explicitly display solar photovoltaic (PV), concentrated solar power (CSP) and wind options (IRP 2010-2030 Final Report, Revision 2). The total percentage allocated to the renewable energy component for the IRP 2010 has been increased from 11.4GW to 17.8GW which equates to 42% now allocated to renewable energy.

3.1.5 Electricity Regulation Act, 2006

To contribute towards the renewable energy target set by the Government, socio-economic and environmentally sustainable growth, and kick start and stimulate the renewable energy industry in South Africa, Renewable Energy Feed-in Tariffs (REFIT) have been set by the National Energy Regulator of South Africa (NERSA). REFITs are, in essence, guaranteed prices for electricity supply rather than conventional consumer tariffs. The basic economic principle underpinning the REFITs is the establishment of a tariff (price) that covers the cost of generation plus a "reasonable profit" to induce developers to invest. This is quite similar to the concept of cost recovery used in utility rate regulation based on the costs of capital. Feed-in tariffs to promote renewable energy have now been adopted in over 36 countries around the world. The establishment of the Renewable Energy Feed-In Tariff (REFIT) in South Africa provides the opportunity for an increased contribution towards the sustained growth of the renewable energy sector in the country, the region and internationally, and promote competitiveness for renewable energy with conventional energies in the medium- and long-term. Under the National Energy Regulator Act, 2004 (Act No 40 of 2004), the Electricity Regulation Act, 2006 (Act No 4 of 2006) and all subsequent relevant Acts of Amendment, NERSA has the mandate to determine the prices at and conditions under which electricity may be supplied by licence to Independent Power Producers (IPPs).

3.2. Regulatory Hierarchy for Energy Generation Projects

The South African energy industry is evolving rapidly, with regular changes to legislation and industry role-players. The regulatory hierarchy for an energy generation project of this nature consists of three tiers of authority who exercise control through both statutory and non-statutory instruments – that is National, Provincial and Local levels.

At National Level, the main regulatory agencies are:

» *Department of Energy (formerly DME):* This department is responsible for policy relating to all energy forms, including renewable energy. Wind and solar energy is considered under the White Paper for Renewable Energy and the Department undertakes research in this regard. It is the controlling authority in terms of the Electricity Act (Act No 41 of 1987).
» *National Energy Regulator (NER):* This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for wind and solar energy developments to generate electricity.
» *Department of Environmental Affairs (DEA):* This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the EIA Regulations. DEA is the competent authority for this project, and charged with granting the relevant environmental authorisation.
» *Department of Transport - Civil Aviation Authority (CAA):* This department is responsible for aircraft movements and radar, which are aspects that influence wind energy development location and planning.
» *The South African Heritage Resources Agency (SAHRA):* The National Heritage Resources Act (Act No 25 of 1999) and the associated provincial regulations provides legislative protection for listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes.
» *South African National Roads Agency (SANRAL):* This department is responsible for all National road routes.

At Provincial Level, the main regulatory agencies are:

» *The Northern Cape Department of Environment and Nature Conservation (DENC) and Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)* are the commenting authorities for this project as it falls within the Northern and Western Cape Provinces.
» *The Department of Transport and Public Works* in both the Northern and Western Cape Province is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *Heritage Western Cape:* This body is responsible for all heritage related issues in the Western Cape Province.
» *Heritage Northern Cape:* This body is responsible for all heritage related issues in the Northern Cape Province.
» *Cape Nature*: This body has the statutory responsibility for biodiversity conservation in the Western Cape.
» *The Department of Agriculture* is responsible for all matters which affects agricultural land.

At Local Level, the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. In the Northern and Western Cape Province, both Local Municipalities and District Municipalities play a role. The relevant municipalities include Ubuntu Local Municipality, Beaufort West Local Municipality, Central Karoo District Municipality and the Pixley ka Seme District Municipality.

» In terms of the Municipal Systems Act (Act No 32 of 2000) it is compulsory for all municipalities to go through an Integrated Development Planning (IDP) process to prepare a five-year strategic development plan for the area under their control.
» Bioregional planning involves the identification of priority areas for conservation and their placement within a planning framework of core, buffer and transition areas. These could include reference to visual and scenic resources and the identification of areas of special significance, together with visual guidelines for the area covered by these plans.
» By-laws and policies have been formulated by local authorities to protect visual and aesthetic resources relating to urban edge lines, scenic drives, special areas, signage, communication masts, etc.

There are also numerous non-statutory bodies and environmental lobby groups that play a role in various aspects of planning and the environment that will influence renewable energy development.

3.3 Legislation and Guidelines that have informed the preparation of this EIA Report

The following legislation and guidelines have informed the scope and content of this EIA Report:

» National Environmental Management Act (Act No 107 of 1998)
» EIA Regulations, published under Chapter 5 of the NEMA (GN R385, GN R386 and GN R387 in Government Gazette 28753 of 21 April 2006)
» Guidelines published in terms of the NEMA EIA Regulations, in particular:
  * Guideline 3: General Guide to Environmental Impact Assessment Regulations, 2006 (DEAT, June 2006)
  * Guideline 4: Public Participation in support of the Environmental Impact Assessment Regulations, 2006 (DEAT, May 2006)
  * Guideline 5: Assessment of alternatives and impacts in support of the Environmental Impact Assessment Regulations, 2006 (DEAT, June 2006)

Acts, standards or guidelines which have informed the project process and the scope of issues assessed within this EIA are summarised in Table 3.1.

Table 3.1: Relevant legislative permitting requirements applicable to the Karoo Renewable Energy Facility EIA

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
	National Legislation		
National Environmental Management Act (Act No 107 of 1998)	» EIA Regulations have been promulgated in terms of Chapter 5. Activities which may not commence without an environmental authorisation are identified within these Regulations. » 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. » In terms of GNR 387 of 21 April 2006, a scoping and EIA process is required to be undertaken for the proposed project	» National Department of Environmental Affairs – competent authority. » DENC – provincial commenting authority. » DEA&DP - provincial commenting authority.	This EIA report is to be submitted to the competent and commenting authorities.
National Environmental Management Act (Act No 107 of 1998)	» In terms of the Duty of Care provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, stopped or minimised. » In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.	» National Department of Environmental Affairs (as regulator of NEMA).	» While no permitting or licensing requirements arise directly by virtue of the proposed project, this section will find application during the EIA phase and will continue to apply throughout the life cycle of the project.
Environment Conservation	» National Noise Control Regulations (GN	» National Department of	» There is no requirement for a

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
Act (Act No 73 of 1989)	R154 dated 10 January 1992).	Environmental Affairs » Provincial Environmental Departments - commenting authorities. » Local authorities » District & Local Municipalities	noise permit in terms of the legislation. As required in accordance with SANS 10328, a noise impact assessment has been undertaken as part of the EIA process. » Noise impacts are expected to be associated with the construction phase of the project and are likely to present an intrusion impact to the local community. » On-site activities should be limited to 6:00am to 6:00pm Monday – Saturday (excluding public holidays). Should activities need to be undertaken outside of these times, the surrounding communities will need to be notified and appropriate approval will be obtained from the DEA and the Local Municipality.
National Water Act (Act No 36 of 1998)	» In terms of Section 19, the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to prevent and remedy the effects of pollution to water resources from occurring, continuing or recurring.	» Department of Water Affairs (as regulator of National Water Act)	» A Water Use License is deemed necessary due to the volumes of water to be used for the cleaning of the PV panels exceeding those specified for a General Authorisation. An application will be submitted to Department of Water Affairs.

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	» A mining permit or mining right may be required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act. » Requirements for Environmental Management Programmes and Environmental Management Plans are set out in Section 39 of the Act.	» Department of Minerals and Energy	» As no borrow pits are expected to be required for the construction of the facility, no mining permit or right is required to be obtained.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	» Sections 18, 19 and 20 of the Act allow certain areas to be declared and managed as "priority areas." » Declaration of controlled emitters (Part 3 of Act) and controlled fuels (Part 4 of Act) with relevant emission standards.	» National Department of Environmental Affairs	» While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project. The Act provides that an air quality officer may require any person to submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with the Act.
National Heritage Resources Act (Act No 25 of 1999)	» Section 38 states that Heritage Impact Assessments (HIAs) are required for certain kinds of development including: » The construction of a road, power line, pipeline, canal or other similar linear development or barrier exceeding 300 m in length; » Any development or other activity which will change the character of a	» South African Heritage Resources Agency (SAHRA) as well as Heritage Western and Northern Cape – National heritage sites (grade 1 sites) as well as all historic graves and human remains.	» A permit may be required should identified cultural/heritage sites on site be required to be disturbed or destroyed as a result of the proposed development. » Section 4 of the NHRA provides that within 14 days of receipt of notification the relevant Heritage Resources Authority must notify the proponent to submit an

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
	site exceeding 5 000 m^2 in extent. » The relevant Heritage Resources Authority must be notified of developments such as linear developments (such as roads and power lines), bridges exceeding 50 m, or any development or other activity which will change the character of a site exceeding 5 000 m^2; or the re-zoning of a site exceeding 10 000 m^2 in extent. » This notification must be provided in the early stages of initiating that development, and details regarding the location, nature and extent of the proposed development must be provided » Stand alone HIAs are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils the provisions of Section 38. In such cases only those components not addressed by the EIA should be covered by the heritage component.		impact assessment report if they believe a heritage resource may be affected.
Nature Conservation Ordinance (Act 19 of 1974)	» Article 63 prohibits the picking of certain fauna (including cutting, chopping, taking, and gathering, uprooting, damaging, or destroying). Schedule 3 lists endangered flora and Schedule 4 lists protected flora. » Articles 26 to 47 regulate the use of wild animals.	» National Department of Environmental Affairs	» Compliance requirements
National Environmental	» In terms of Section 57, the Minister of	» National Department of	» As the applicant will not carry on

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
Management: Biodiversity Act (Act No 10 of 2004)	Environmental Affairs has published a list of critically endangered, endangered, vulnerable, and protected species in GNR 151 in Government Gazette 29657 of 23 February 2007 and the regulations associated therewith in GNR 152 in GG29657 of 23 February 2007, which came into effect on 1 June 2007. » In terms of GNR 152 of 23 February 2007: Regulations relating to listed threatened and protected species, the relevant specialists must be employed during the EIA phase of the project to incorporate the legal provisions as well as the regulations associated with listed threatened and protected species (GNR 152) into specialist reports in order to identify permitting requirements at an early stage of the EIA phase. » The developer has a responsibility for: » The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations). » Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all	Environmental Affairs	any restricted activity, as is defined in Section 1 of the Act, no permit is required to be obtained in this regard. » A specialist ecological assessment has been undertaken for the proposed project (refer to Appendix F). » A permit may be required should any protected plant species on site be disturbed or destroyed because of the proposed development.

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
	development within the area are in line with ecological sustainable development and protection of biodiversity. » Limit further loss of biodiversity and conserve endangered ecosystems.		
Conservation of Agricultural Resources Act (Act No 43 of 1983)	» Regulation 15 of GNR1048 provides for the declaration of weeds and invader plants, and these are set out in Table 3 of GNR1048. Declared Weeds and Invaders in South Africa are categorised according to one of the following categories: » Category 1 plants: are prohibited and must be controlled. » Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread. » Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands. » These regulations provide that Category 1, 2 and 3 plants must not occur on land and that such plants must be controlled by the methods set out in Regulation 15E.	» Department of Agriculture	» While no permitting or licensing requirements arise from this legislation, this Act will find application during the EIA phase and will continue to apply throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented.
National Veld and Forest	» In terms of Section 21 the applicant	» Department of Water Affairs	» While no permitting or licensing

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
Fire Act (Act 101 of 1998)	would be obliged to burn firebreaks to ensure that should a veld fire occur on the property, that it does not spread to adjoining land. » In terms of section 12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material. » In terms of section 17, the applicant must have such equipment, protective clothing, and trained personnel for extinguishing fires.		requirements arise from this legislation, this act will find application during the operational phase of the project. Due to the fire prone nature of the area, it must be ensured that the landowner and developer are part of the local Fire Protection Agency.
National Forests Act (Act No 84 of 1998)	» Protected trees: According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'. » Forests: Prohibits the destruction of indigenous trees in any natural forest without a licence.	» Department of Water Affairs	» A permit or license is required for the destruction of protected tree species and/or indigenous tree species within a natural forest.
Aviation Act (Act No 74 of 1962) 13th amendment of	» Any structure exceeding 45 m above ground level or structures where the top	» Civil Aviation Authority (CAA)	» This act will find application during the operational phase of

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
the Civil Aviation Regulations (CARS) 1997	of the structure exceeds 150 m above the mean ground level, the mean ground level considered the lowest point in a 3 km radius around such structure. » Structures lower than 45 m, which are considered as a danger to aviation shall be marked as such when specified. » Overhead wires, cables etc., crossing a river, valley, or major roads shall be marked and in addition their supporting towers marked and lighted if an aeronautical study indicates it could constitute a hazard to aircraft. » Section 14 of Obstacle limitations and marking outside aerodrome or heliport – CAR Part 139.01.33 relates specifically to appropriate marking of wind energy facilities.		the project due to CAA having to approve the layout and provide an obstacle approval. Appropriate marking is required to meet the specifications as detailed in the CAR Part 139.01.33.
Hazardous Substances Act (Act No 15 of 1973)	» This Act regulates the control of substances that may cause injury, or ill health, or death because of their toxic, corrosive, irritant, strongly sensitising, or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation,	» Department of Health	» It is necessary to identify and list all the Group I, II, III, and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
	modification, disposal or dumping of such substances and products. » Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc, nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared to be Group I or Group II hazardous substance; » Group IV: any electronic product; » Group V: any radioactive material. » The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.		
National Road Traffic Act (Act No 93 of 1996)	» The Technical Recommendations for Highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. » Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging	» Provincial Department of Transport (provincial roads) » South African National Roads Agency Limited (national roads)	» An abnormal load/vehicle permit may be required to transport the various components to site for construction. These include: » Route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads. » Transport vehicles exceeding the dimensional limitations (length) of 22 m. » Depending on the trailer configuration and height when loaded, some of the power station

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
	effect on road pavements, bridges, and culverts. » The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.		components may not meet specified dimensional limitations (i.e. height and width).
Development Facilitation Act (Act No 67 of 1995)	» Provides for the overall framework and administrative structures for planning throughout the Republic. » Sections 2 - 4 provide general principles for land development and conflict resolution.	» Provincial Environmental Department - commenting authority. » Local Municipality, District Municipality	» The applicant must submit a land development application in the prescribed manner and form as provided for in the Act. A land development applicant who wishes to establish a land development area must comply with procedures set out in the DFA.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	» Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land.	» Provincial Environmental Department - commenting authority. » Local Municipality, District Municipality	» Subdivision will have to be in place prior to any subdivision approval in terms of Section 24 and 17 of LUPO. » Subdivision is required to be undertaken following the issuing of an environmental authorization

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
			for the proposed project.
National Environmental Management: Waste Act (Act No 59) of 2008	» The Minister may by notice in the *Gazette* publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. » The Minister may amend the list by— *(a)* adding other waste management activities to the list; *(b)* removing waste management activities from the list; or *(c)* making other changes to the particulars on the list. » In terms of the Regulations published in terms of this Act (GN 718), A Basic Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities. » Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that *(a)* the containers in which any waste is stored, are intact and not corroded or in any other way rendered unlit for the safe storage of waste; *(b)* adequate measures are taken to prevent accidental spillage or leaking; *(c)* the waste cannot be blown away; *(d)* nuisances such as odour, visual impacts and breeding of vectors do not arise; and	National Department of Water and Environmental Affairs (hazardous waste and effluent) Provincial Department of Environmental Affairs (general waste)	As no waste disposal site is to be associated with the proposed project, **no permit** is required in this regard. Waste handling, storage and disposal during construction and operation is required to be undertaken in accordance with the requirements of this Act, as detailed in the EMP.

Legislation	Applicable Requirements	Relevant Authority	Compliance requirements
	(e) pollution of the environment and harm to health are prevented		
Promotion of Access to Information Act (Act No 2 of 2000)	» All requests for access to information held by state or private body are provided for in the Act under S11.	» National Department of Environmental Affairs.	» No permitting or licensing requirements. This act may find application during the project EIA.
Promotion of Administrative Justice Act (Act No 3 of 2000)	» In terms of Section 3 the government is required to act lawfully and take procedurally fair, reasonable and rational decisions » Interested & affected parties have right to be heard	» National Department of Environmental Affairs.	» No permitting or licensing requirements. This act will find application during the project EIA.
Northern Cape Nature Conservation Act (Act No. 9 of 2009)	» The Act provides for: (a) the sustainable utilisation of wild animals, aquatic biota and plants; (b) the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; (c) offences and penalties for contravention of the Act; (d) the appointment of nature conservators to implement the provisions of the Act; (e) the issuing of permits and other authorisations. (f) lists of protected species for the Province.	» Department of Environmental and Nature Conservation – Northern Cape	» No permitting or licensing requirements. This act may find application during the project EIA.

APPROACH TO UNDERTAKING THE EIA PROCESS CHAPTER 4

An Environmental Impact Assessment (EIA) process refers to that process (dictated by the EIA Regulations) which involves the identification of and assessment of direct, indirect and cumulative environmental impacts associated with a proposed project. The EIA process comprises two phases: **Scoping Phase** and **EIA Phase**. The EIA process culminates in the submission of an EIA Report (including an environmental management programme (EMP)) to the competent authority for decision-making. The EIA process is illustrated below:

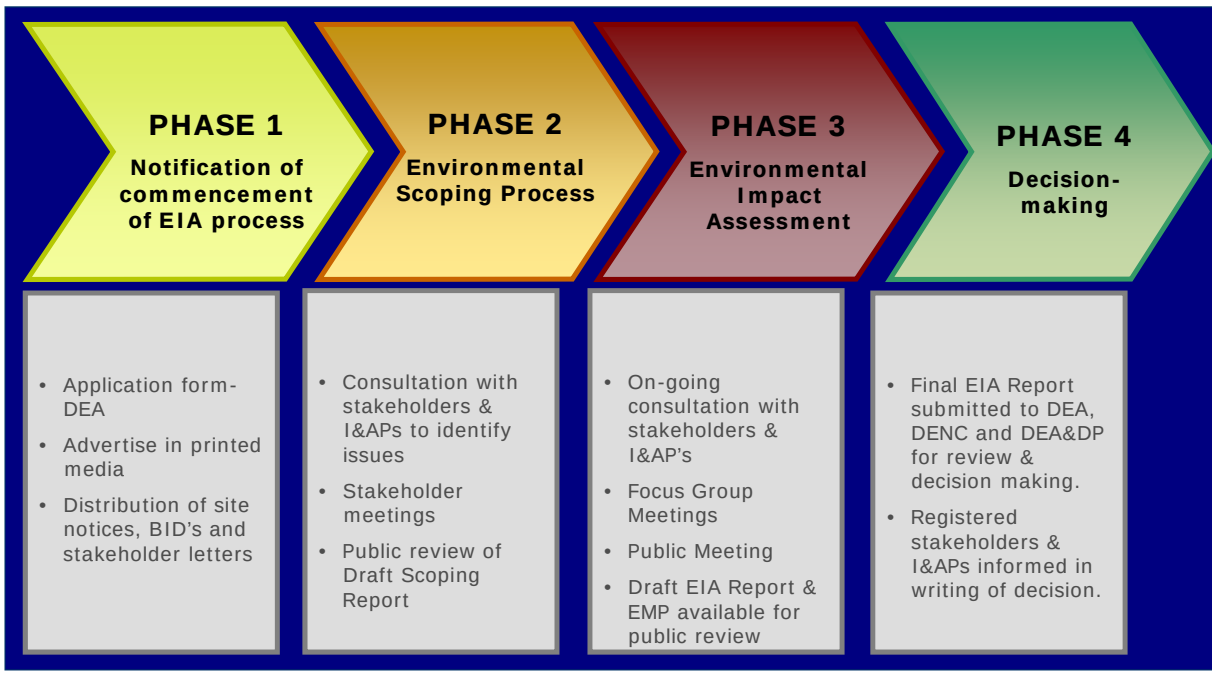

Figure 4.1: Phases included within an EIA process

The EIA Phase for the proposed Karoo Renewable Energy Facility has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006[3], in terms of Section 24(5) of NEMA (Act No. 107 of 1998). The environmental studies for this proposed project were undertaken in two phases, in accordance with the EIA Regulations.

4.1. Phase 1: Scoping Study

[3] This EIA process was conducted in accordance with the EIA Regulations that were current at the time of application for authorisation (i.e. the EIA Regulations of April 2006).

The Scoping Study provided I&APs with the opportunity to receive information regarding the proposed project, participate in the process and raise issues of concern.

The Scoping Report aimed at detailing the nature and extent of the proposed facility, identifying potential issues associated with the project, and defining the extent of studies required within the EIA. This was achieved through an evaluation of the proposed project, involving the project proponent, specialist consultants, and a consultation process with key stakeholders that included both relevant government authorities and interested and affected parties (I&APs). In accordance with the requirements of the EIA Regulations, feasible project-specific alternatives (including the "do-nothing" option) were identified for consideration within the EIA process.

The Draft Scoping Report was made available at public places for I&AP review and comment. All the comments, concerns, and suggestions received during the Scoping Phase and the review period were included in the Final Scoping Report and Plan of Study for EIA. The Final Scoping Report was submitted to the National Department of Environmental Affairs (DEA) on the 20th December 2010. The Final Scoping Report was accepted on 25 March 2011 (refer to authority correspondence included in Appendix B). In terms of this acceptance, an EIA was required to be undertaken for the proposed project, in line with the approved Plan of Study for EIA.

4.2. Phase 2: Environmental Impact Assessment

Through the Scoping Study, no environmental fatal flaws were identified with the development of the proposed renewable energy facility, and no absolute 'no-go' areas were identified within the broader area evaluated. A number of issues and potentially sensitive areas requiring further study for both the renewable energy facility development site as well as the associated infrastructure were highlighted. These issues have been assessed in detail within the EIA phase of the process (refer to Chapter 6).

The EIA Phase aimed to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed project.
» Assess potentially significant impacts (direct, indirect, and cumulative, where required) associated with the proposed renewable energy facility and associated infrastructure.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&AP are afforded the opportunity to participate in the EIA process, and that their issues and concerns are recorded.

The EIA addresses potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with all phases of the project including design, construction, operation and decommissioning, and aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The EIA process followed for this project is described below.

4.3. Overview of the EIA Phase

The EIA Phase has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of NEMA. Key tasks undertaken within the EIA phase included:

» Consultation with relevant decision-making and regulating authorities (at National, Provincial and Local levels).
» Undertaking a public involvement process throughout the EIA process in accordance with Regulation 56 of Government Notice No R385 of 2006 in order to identify any additional issues and concerns associated with the proposed project.
» Preparation of a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with Regulation 59 of Government Notice No R385 of 2006).
» Undertaking of independent specialist studies in accordance with Regulation 33 of Government Notice No R385 of 2006.
» Preparation of this Draft EIA Report in accordance with the requirements of the Regulation 32 Government Notice No R385 of 2006.

These tasks are discussed in detail below.

4.3.1. Authority Consultation

Consultation with the regulating authorities (i.e. DEA, DENC and DEA&DP) and Organs of State which have jurisdiction in respect of the activity to which the application relates has continued throughout the EIA process. On-going consultation included the submission of a Final Scoping Report (submitted to DEA in December 2010) following a 30-day public review period (and consideration of stakeholder comments received).

The following will also be undertaken as part of this EIA process:

» Submission of a Final Environmental Impact Assessment (EIA) Report following the 30-day public review period.
» Provision of an opportunity for DEA, DENC and DEA&DP representatives to visit and inspect the proposed site and the study area.

» Consultation with Organs of State that may have jurisdiction over the project:
  * National, provincial, and local government departments (including DEA, DENC and DEA&DP, South African Heritage Resources Association, Department of Agriculture, Department of Water Affairs etc.)
  * Ubuntu Local Municipality (Northern Cape Province)
  * Beaufort West Local Municipality (Western Cape Province)
  * Central Karoo District Municipality (Western Cape Province)
  * Pixley ka Seme District Municipality (Northern Cape Province)
  * Parastatals including South African National Roads Agency Limited and Eskom
  * Conservation authorities (i.e. Cape Nature and WESSA)
  * Potentially affected and neighbouring landowners and tenants

A record of all authority consultation undertaken prior to the commencement of the EIA Phase is included within the Scoping Report. A record of the consultation in the EIA process is included within Appendix E.

4.3.2 Public Involvement and Consultation: EIA Phase

The public involvement process undertaken by Batho Earth, was initiated at the start of the EIA process and has continued throughout the Scoping and EIA Phases. The aim of the public participation process is primarily to ensure that:

» Information containing all relevant facts in respect of the proposed project was made available to potential stakeholders and I&APs.
» Participation by potential I&APs was facilitated in such a manner that all potential stakeholders and I&APs were provided with a reasonable opportunity to comment on the proposed project.
» Comment received from stakeholders and I&APs was recorded, considered, and incorporated into the EIA process.

Landowners within 100m of the proposed study area have been identified and also notified of the proposed facility (Refer to Appendix C for surrounding landowner map). Through on-going consultation with key stakeholders and I&APs, issues raised through the Scoping Phase for inclusion within the EIA study were confirmed. All relevant stakeholder and I&AP information has been recorded within a database of affected parties (refer to Appendix C for a listing of recorded parties). While I&APs were encouraged to register their interest in the project from the onset of the process, the identification and registration of I&APs has been on-going for the duration of the EIA process and the project database has been updated on an on-going basis.

In order to accommodate the varying needs of stakeholders and I&APs, as well as ensure the relevant interactions between stakeholders and the EIA specialist team, the

following opportunities have been provided for I&APs issues to be recorded and verified through the EIA phase, including:

» **Focus group meetings** (pre-arranged)
» One-on-one **consultation meetings** and telephonic consultation sessions (consultation with various parties, for example with directly affected landowners and local municipalities, by the project participation consultant as well as specialist consultants)
» Written, faxed or e-mail **correspondence**.
» **Public meeting** and **stakeholder meetings** (during the EIA Phase).

During the EIA Phase, **Focus Group meetings** as well as a **Public Meeting** was held in order to provide feedback of the findings of the EIA studies undertaken. Stakeholders were invited to attend the public meeting -

» **Focus Group Meeting with Central Karoo District Municipality**
Date: 22 March 2011
Time: 09:20 – 10:00
Venue: Offices of Central Karoo District Municipality, Beaufort West

» **Focus Group Meeting with Ubuntu Local Municipality**
Date: 23 March 2011
Time: 09:30 – 10:15
Venue: Offices of Ubuntu Local Municipality, Victoria West

» **Public Meeting in Victoria West**
Date: 23 March 2011
Time: 16:00 – 17:00
Venue: Committee Meeting Room, Victoria West City Hall, Victoria West

Records of all consultation undertaken are included within Appendix E.

4.3.3. Identification and Recording of Issues and Comments

Issues and comments raised by I&APs over the duration of the EIA process have been synthesised into Comments and Response Reports (refer to Appendix E for the Comments and Response Reports compiled from both the Scoping and EIA Phases).

The Comments and Response Reports include responses from members of the EIA project team and/or the project proponent. Where issues are raised that the EIA team considers beyond the scope and purpose of this EIA process, clear reasoning for this view is provided.

4.3.4 Assessment of Issues Identified through the Scoping Process

Based on the findings of the Scoping Study, the following issues were identified as being of low significance, and therefore not requiring further investigation within the EIA:

1. Agricultural Potential and Land Capability

Due to the prevailing unfavourable climatic conditions for arable agriculture as well as prevalence of soils with limited depth, no further detailed Agricultural Potential and Land Capability investigation was required during the EIA Phase. The aspects which are covered within the Agricultural Potential and Land Capability assessment have been addressed by other relevant specialist studies during the EIA phase. Issues which required further investigation within the EIA phase are indicated in Table 4.1 below.

Table 4.1: Specialist studies undertaken within the EIA phase

Specialist	Area of Expertise	Refer to Appendix
David Hoare Consulting	Ecological impact assessment	Appendix F
Avisense Consulting	Avifauna impact assessment	Appendix G
Outeniqua Geotechnical Services	Geology, soils & erosion potential study	Appendix H
Albany Museum	Heritage / Archaeology	Appendix I
Lloyd Rossouw	Palaeontology	Appendix J
MetroGIS	Visual impact assessment	Appendix K
MENCO	Noise impact assessment	Appendix L
Batho Earth	Social Impact Assessment	Appendix M

Specialist studies considered direct and indirect environmental impacts associated with the development of the proposed renewable energy facility and all associated components. Issues were assessed in terms of the following criteria:

» The **nature**, a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score of between 1 and 5 is assigned as appropriate (with a score of 1 being low and a score of 5 being high).
» The **duration**, wherein it is indicated whether:
  * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  * the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  * medium-term (5–15 years) – assigned a score of 3;

- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5.

» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
- 0 is small and will have no effect on the environment;
- 2 is minor and will not result in an impact on processes;
- 4 is low and will cause a slight impact on processes;
- 6 is moderate and will result in processes continuing but in a modified way;
- 8 is high (processes are altered to the extent that they temporarily cease); and
- 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability** *of occurrence*, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned:
- Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
- Assigned a score of 2 is improbable (some possibility, but low likelihood);
- Assigned a score of 3 is probable (distinct possibility);
- Assigned a score of 4 is highly probable (most likely); and
- Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).

» The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
» The **status**, which is described as positive, negative, or neutral.
» The degree to which the impact can be reversed.
» The degree to which the impact may cause irreplaceable loss of resources.
» The *degree* to which the impact can be *mitigated.*

The **significance** is determined by combining the criteria in the following formula:

S=(E+D+M)P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

As SARGE has the responsibility to avoid or minimise impacts and plan for their management (in terms of the EIA Regulations), the mitigation of significant impacts is discussed. Assessment of impacts with mitigation is made in order to demonstrate the effectiveness of the proposed mitigation measures. A draft Environmental Management Plan is included as Appendix N.

The specialist EIA studies are contained within Appendices F - M.

4.3.5 Public Review of Draft EIA Report and Feedback Meeting

This Draft **EIA Report** has been made available for public review from **1 April 2011 to 5 May 2011** at the following locations:

» Victoria West Public Library
» Beaufort West Public Library
» Karoo Vleisboere Corporation
» www.savannahsa.com

All registered I&APs were notified of the availability of the report by letter. In addition, newspapers advertisements were placed as follows:

» Victoria West Messenger
» The Courier

4.3.6 Final EIA Report

The final stage in the EIA Phase will entail the capturing of responses from I&APs on the Draft EIA Report in order to refine it. It is this final report upon which the decision-making environmental authorities make a decision regarding the proposed project.

4.4 Assumptions, Limitations and Gaps in Knowledge

The following assumptions and limitations are applicable to the studies undertaken within this EIA Phase:

» All information provided by SARGE and I&APs to the Environmental Team was correct and valid at the time it was provided.
» Only one site is available for the establishment of the proposed renewable energy facility and will be considered in the EIA, and no other sites are available to be included as alternative sites in the EIA. This is based on the detailed wind analysis

(with specific measurements on site) which has been done to date as well as on land availability, access to the site, grid connectivity, etc.

» It is assumed that the development site identified by SARGE represents a technically suitable site for the establishment of a renewable energy facility and associated infrastructure.
» Studies assume that any potential impacts on the environment associated with the proposed development will be avoided, mitigated, or offset.
» The EIA study was conducted based on a preliminary layout of the renewable energy facility which was provided by SARGE. The layout is deemed preliminary at this stage, with approximately 80% accuracy.

Details of specific assumptions, limitations and/gaps in knowledge for each of the environmental aspects/specialist studies undertaken are highlighted in the specialist studies contained in Appendix F - M.

DESCRIPTION OF THE AFFECTED ENVIRONMENT CHAPTER 5

This section of the Draft EIA Report provides a description of the environment that may be affected by the proposed Karoo Renewable Energy Facility near Victoria West in the Northern and Western Cape Province. This information is provided in order to assist the reader in understanding the possible effects of the proposed project on the environment. Aspects of the biophysical, social and economic environment that could directly or indirectly be affected by, or could affect, the proposed development have been described. This information has been sourced from both existing information available for the area as well as collected field data, and aims to provide the context within which this EIA is being conducted. A more detailed description of each aspect of the affected environment is included within the specialist reports contained within Appendices F - M.

5.1 Location of the Study Area

The proposed project site is located within the Ubuntu Local Municipal area, which forms part of the Pixley Ka Seme District Municipality. A small section of the study area (the farm Phaisantkraal 1) falls within the jurisdiction of the Beaufort West Local Municipality which forms part of the Central Karoo District Municipality in the Western Cape Province (Refer to Figure 5.1). The main town within the Ubuntu Local Municipal area is Victoria West, with less populated towns such as Loxton and Richmond. The Beaufort West Local Municipality include the towns of Beaufort West, and the smaller settlements of Merweville and Nelspoort which are situated in the Central Karoo.

The Biesiespoort Substation is located within the eastern section of the site, located on the Farm Nobelsfontein 227. The Biesiespoort/Kromrivier 132 kV distribution power line traverses the western section of study site, while the 400kV Droërivier-Hydra 2 transmission power line traverses the south-eastern portion of the Farm Phaisantkraal 1, which forms part of the study area.

On a regional scale the site can be accessed via a secondary road which traverses the site from east to west and which connects the N1 and N12 national roads which run to the south-east and west of the study site respectively. A number of less significant local roads lead from this secondary road to various parts of the site. The N12 national road joins up with the N1 approximately 8km to the south-west of the study site. The R63 road is situated north west of the proposed development property. The 200 km^2 study area is therefore nestled between the N12, N1 and R63 roads, and is well-connected to major routes in this region.

5.2 Climate

The climate of the study area can best be described as being semi-arid to arid, typical of the Northern Cape. Rainfall occurs in late summer to autumn, peaking in March. The rainfall for the area varies from 200 to 400mm per year which classifies the area as being arid[4]. Mean minimum and maximum temperatures for Victoria West are -8°C and 36.6°C respectively.

The predominant wind direction during the summer months is indicated as being south-south-east. During the winter period, the predominant wind direction changes to a westerly and an easterly direction as indicated in the wind roses (Figure 5.1) for the study area below.

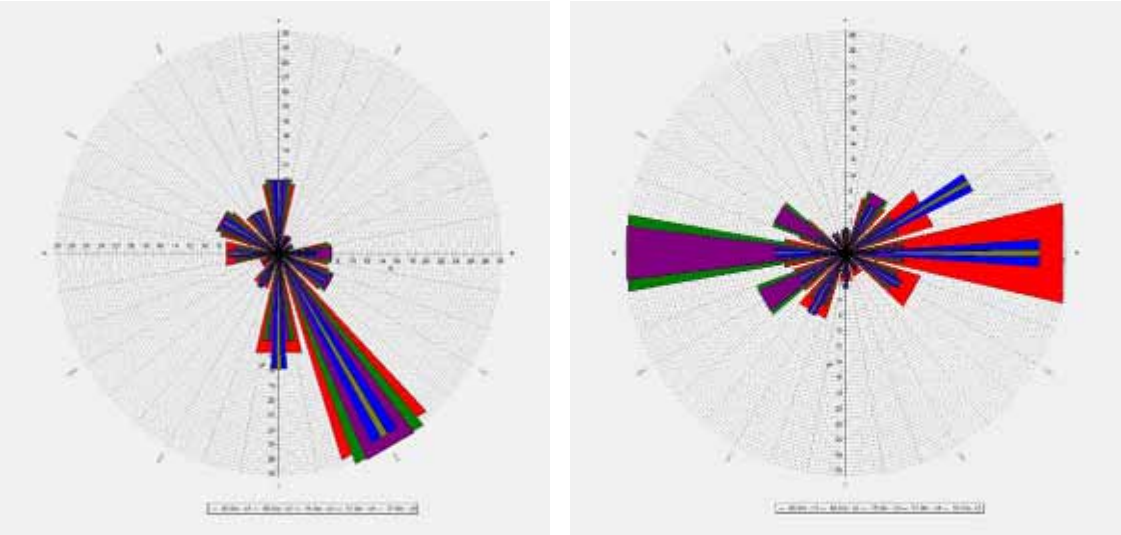

Figure 5.1: Wind roses indicating predominant wind directions of the study area during the summer (left) and winter months (right).

5.3 Regional Setting

The study area occurs on land that ranges in elevation from 1040m in the south west to 1840 m at the top of the hills. The topography is classified as lowlands with mountains. The terrain surrounding the site is generally flat, but frequently interrupted with clusters of prominent hills. The well-known tourist attraction the "Three Sisters" is in fact a cluster of such hills, and is located about 12km south of the site. Some of the upper tributaries of the Sout River originate in the study area. These originate to the west of the site close to the N12 and flow southwards. Similarly, the upper origins of the Buffel River originate to the east of the site and flow southwards.

The main economic activity in this rural environment is described as livestock farming. The towns of Victoria West, Beaufort West and Richmond (located outside of the actual study area) account for the highest population concentrations within the region, which

[4] All areas receiving less than 400 mm rainfall are considered to be arid

has an average of 1,6 persons per km^2. The study area itself consists of a landscape of wide-open expanses and minimal development.

The region has a rural character with a number of individual farming homesteads/dwellings occurring within the study area. Land cover is dominated by *shrubland*, with some *thicket, bushland and bush clumps* along the drainage lines (refer to Figure 5.2). Small, isolated pockets of irrigated agriculture also occur within the study area. *Karroid broken veld* is the dominant vegetation type in the study area, becoming *false upper karoo* in the north, with very limited disturbance. No conservation areas are present within the study area.

5.4 Social Characteristics of the Study Area

The site selected for the renewable energy facility is located on private, agricultural land. Six (6) farmsteads are located on the study site with permanent residents (farmers) occupying these farmsteads. The farms Nobelsfontein 227, Annex Nobelsfontein 234, Ezelsfontein 235 and Rietkloofplaaten 239 are the property of the developer, SARGE. These farms have been the property of the Roux family for quite some time. The Nobelsfontein Water project (a water bottling project) is also being undertaken on the farms Nobelsfontein 227 and Annex Nobelsfontein 234. The two farms Modderfontein 228 and Phaisantkraal 1 belong to Mr. Marais who have inherited the properties. Sheep farming is undertaken on all the properties. Mr. Marais also operates a guest house on the farm Modderfontein 228.

The proposed study area falls within the Ubuntu Local Municipal area, which forms part of the Pixley Ka Seme District Municipality (Northern Cape Province). Even though a small section of the study area (farm Phaisantkraal and bordering properties) falls within Beaufort West Municipal area in the Western Cape Province, focus has been placed on the socio-economic character of the Ubuntu Local Municipal area, as well as the Pixley Ka Seme District Municipality due to the fact that the largest part of the study area is situated within these municipal boundaries.

5.4.1 Demographic Profile

According to the 2001 Census figures, the total population within the Ubuntu Local Municipality totals 16 376 which indicates a decrease in the population from the 1996 figures (population total of 19 712). The Community Survey undertaken in 2007 indicates the total population to be 16 153 which again indicates a decrease in the population (Ubuntu LM IDP, 2009). This decrease would have far reaching consequences for the municipality's service delivery, as well as with regards to grants and subsidies made available to them. The decrease could be the result of a stagnating economy that is unable to provide school leavers with sufficient job opportunities. The total population

for the Beaufort West area (including Nelspoort and Merweville) was estimated at 40 000 for 2010 (BKS, 2004).

The age profile of the population reveals that the majority of the residents of the Ubuntu Local Municipality fall within the age category of 15 to 34 years (5 450 individuals), followed by the 35 to 64 age category (4 550). Approximately 3 601 individuals make up the 5 to 14 years category according to the 2001 Census Statistics. The age structure in the Beaufort West Municipal area is also very young and the majority of the economic inactive section of the population is younger than 18 years (BKS, 2004).

The level of education among the population of Ubuntu Local Municipality is relatively low which impacts on the employment potential of the population and therefore also on the local economic development and job creation initiatives (Ubuntu LM IDP, 2010). Literacy and educational levels within the Beaufort West Municipal area is also described as being low (BKS, 2004). The low level of education, mainly amongst historically previously disadvantaged females is indeed of concern.

The area is scarcely populated with the majority of the residents living in scattered towns and settlements. The farms in the study area mainly house the property owners and the farm workers. Some property owners do not permanently reside on their properties.

5.4.2 Economic Profile

According to the Statistics of South Africa's 2001 survey, the labour force in the Ubuntu Local Municipality include 6 189 individuals. This includes both the employed (66%) and unemployed (34%), but exclude those that are economically inactive, but who would normally form part of the labour market (Ubuntu LM IDP, 2009). The unemployment rate in the Beaufort West area is calculated at 58% which can be classified as high, with subsequent high poverty rates. Approximately 36% of the economically active people (18 years and older) are unemployed in the Beaufort West Local Municipality.

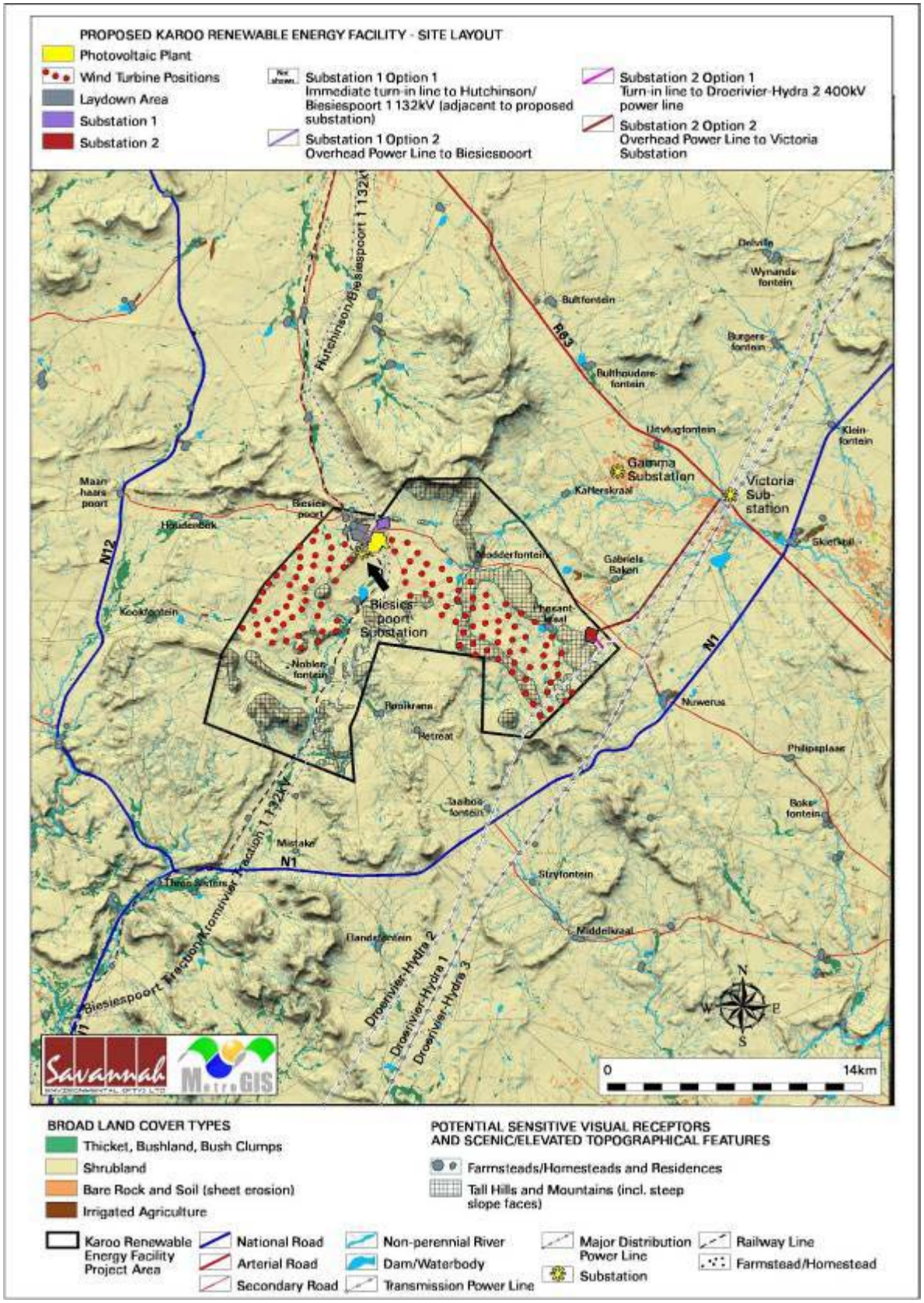

Figure 5.2: Land Cover / Land Use map of the broader study area

The labour market of the Ubuntu Local Municipality essentially represents 62% of the total population. Of the employed labour force, 69% earn less than R800 per month, which gives a strong indication of the poverty that exists among the majority of residents living within the Ubuntu Local Municipality.

The main employment sector in the Ubuntu Local Municipal area is agriculture, more specifically livestock farming, followed by the wholesale and trade sectors. A few people are employed within the manufacturing and construction sector (Ubuntu LM IDP, 2009). Within the Beaufort West Municipal area, the majority of those employed are employed within the commerce, community services and agricultural sectors (BKS, 2004).

5.4.3 Infrastructure and Basic Services

The provision of services with regards to sanitation, potable water, housing, creation and sustaining of employment opportunities and housing remain challenges which need to be addressed.

» *Housing:* the majority of the population of the Ubuntu Local Municipality resides in formal housing. A housing backlog estimated at 1554 houses exists. The housing backlog within the Beaufort West Municipality amounts to more than 3 000 houses and is increasing on a daily basis.
» *Sanitation*: sanitation services in Ubuntu Local Municipality are provided in the formal towns, however informal settlements still make use of the bucket system which illustrates the need for the upgrade of the sanitation infrastructure and services provided. Within the towns of Beaufort West and Nelspoort, all areas, except a very small number of informal houses in Beaufort West itself have access to water-borne sanitation.
» *Health Services*: the provision of health services in the area seem to be insufficient and therefore one of the socio-economic goals of the Ubuntu Local Municipality is the establishment of health programmes as well as the provision of improved health services (hospitals, clinics and mortuaries) to the benefit of all the residents. The high infection rate with regards to HIV/Aids as well as alcohol abuse in the region is a source of concern. Awareness creation among the local residents is critical to combat the spread of these diseases and to limit family violence and crime associated with alcohol abuse (Ubuntu LM IDP, 2009). The Beaufort West Municipal area include one provincial hospital, three municipal clinics, one district municipal clinic and nine mobile clinics which provides service the rural and remote areas.
» *Water Provision*: the Ubuntu Local Municipality is located in the Karoo which can be classified as a semi-desert area. Limited natural surface water is found in the area and rainfall is low which hampers the provision of water with regards to both quantity and quality, to the water users. The majority of the residents in the Beaufort West area have access to potable water. Water services are also of a high standard.

» *Electricity Provision*: according to the IDP of 2009, all formal houses in the Ubuntu Local Municipality are provided with electricity. The electricity distribution system is however in a poor condition and needs to be upgraded. All towns within the Beaufort West Municipality have access to Eskom supplied electricity.

5.5 Heritage of the Study Area

It has been established that the semi-arid Karoo region stretching across the Eastern Cape, Western Cape and Northern Cape is marginal regarding precolonial human settlement, although is rich in archaeological sites, rock art as well as rock engravings which are found widespread over the Karoo landscape. There is a variety of archaeology within the proposed area, ranging from the Early Stone Age, Middle Stone Age, Later Stone Age and pastoralism within the last 2000 years. These are described in more detail below:

» *The Early Stone Age (ESA) and Middle Stone Age (MSA)*

One relatively small in size late Early Stone Age hand axe was documented in the flat floodplain area on site. Predominately singular isolated surface scatters of Middle Stone Age stone artefacts were observed within the exposed unvegetated areas on the flat floodplain areas, around particular rocky outcrops and at the base of ridges.

» *The Later Stone Age (LSA) and Pastoralism within the last 2000 years*

Occurrences of Middle Stone Age and Later Stone Age stone artefacts were observed within the open exposed areas, flood plains and at the base of rocky outcrops and ridges. The stone artefacts were manufactured using a variety of raw materials such as shale, hornfels, quartz and silcrete and included flakes, broken flakes, blades, scrapers, cores, rejuvenated cores and facetted platforms flakes peculiar to the Middle Stone Age, some stone artefacts having been retouched and utilized as identified by the edge-damage. Three probable stone artefact knapping (manufacturing) sites were also documented within the area proposed for development. Ceramic sherds of Khoekhoen pottery possibly belonging to one pot was documented on the farm Nobelsfontein 227. A few broken ostrich eggshell fragments were found in association with scatters of mainly Later Stone Age stone artefacts and within the rock shelters that contained rock paintings.

» *Rock Art*

Rock paintings and rock engravings were documented on two of farms within the area proposed for development. The rock paintings were mainly red ochre finger paintings and contained images of human figures and geometric and abstract paintings. The rock engravings occurred mainly on boulders with a dark / black patination and contained mainly colonial images, animal figures and abstract patterns and cross-hatching.

» *Historical period*

Stone-wall structures resembling mainly large rectangular kraals and smaller circular pens, foundations of historical dwellings and animal traps occurred within the area proposed for development. Ruins of one farm house, possibly constructed out of sun-dried bricks and later modified with modern building materials, was documented on the farm Phaisantkraal 1. Some of the stone-wall structures and the area around the ruins of the farm house contained waste midden dumps that contained mainly rusted tin, metal and historical ceramic-wares and glass.

Human remains were found exposed along the side of a 3m - 4m high river donga and one burial could be observed in the side of the donga approximately 1m below the surface with a few human remains exposed at the surface on the farm Nobelsfontein 227.

5.6 Palaeontology

The proposed energy facility is entirely underlain by sediments and rocks of the Karoo Supergroup, which are assigned to the Lower Beaufort Group (Adelaide Subgroup). The deposits of the Adelaide Subgroup are subdivided into the Abrahamskraal and Teekloof Formations. The Teekloof Formation is a 400m thick argillaceous unit, renowned for its rich fossil heritage. Fragmentary fossil remains of plants, fishes and reptiles have been found in siltstone and mudstone horizons and in mud-pebble conglomerate deposits in the Biesiespoort area.

The study area is capped by late Cenozoic sheet wash and channel related deposits, which have not as yet yielded fossil remains. However, Quaternary palaeontological sites are occasionally found in Pleistocene alluvial terraces and dongas along rivers and streams dissecting the western Karoo basin. Rock engravings on the farm Klipkraal, near Nelspoort to the southeast, suggest the possibility that a giant long-horned buffalo, which became extinct more than 10 000 years ago, previously occurred in the area. Earliest human occupation of the Karoo is indicated by the occurrence of characteristic Early Stone Age prepared core stone tools commonly found in the vicinity of Victoria West.

5.7. Biophysical Characteristics of the Site and Surrounds

5.7.1 Geography and Terrain

The dominant topographical unit or terrain type of the study area is described as lowlands with mountains. The study area is undulating in nature with various small outcrops of rock and hills, with the northern and south-western portions of the study area being characterised by mountainous terrain. Areas consisting of steep, rocky slopes as well as ridges and cliffs which are associated with the Horseshoe and its outlying

koppies, occur towards the northern boundary of the study site. The elevation ranges from 1 040m in the south west to 1 760m at the top of the hills towards the north.

There are numerous well-defined drainage lines traversing the study area. The eastern portion of the study area forms the source of the Brakrivier which is a first order tributary of the Buffelsriver which eventually flows into the Kariegariver 80km east of Beaufort West. The western portion of the study area drains south-westwards into the Kromriver which is a first order tributary of the Soutriver which joins the Kariegariver at Beervleidam and forms the Grootriver. A number of smaller farm dams occur on the site and within the surrounding area. Dense, woody vegetation are situated along the bigger drainage lines and both natural and artificial wetlands occurring on site.

The terrain surrounding the site can be described as being mostly flat, but is frequently interrupted with clusters of prominent hills. The cliffs of Gys Roosberg occur to the north of the site while Skeurberg and its outliers are situated towards the south. The well-known tourist attraction known as the Three Sisters is in fact a cluster of such hills, and is located about 12km south of the site. Figure 5.3 provides a shaded relief map of the study area and its surrounds, which indicates the elevation above sea level in metres.

5.7.2 Geology and Soil

The study area is dominantly underlain by the Poortjie Member (Permian era) of the Teekloof Formation which forms the upper part of the Adelaide Subgroup of the Beaufort Group (Refer to Figure 5.4). The Teekloof Formation comprises mainly mudstones and subordinate sandstones but the Poortjie Member has a slightly higher ratio of sandstone to mudstone than the rest of the Teekloof Formation and is therefore mapped as a separate unit at the base of this formation. Isolated outcrops of Hoedemaker and Oukloof Members occur overlying the Poortjie Member at higher altitudes in the southwestern, southeastern and northern extremities of the study area.

There are numerous Jurassic dolerite intrusions (dykes and sills) mapped within the study area and these features have a distinct control over the landscape development as the dolerite is generally harder than the country rocks into which they are emplaced. Consequently, the dolerite outcrops form areas of higher relief. Quaternary alluvium is mapped along major drainage lines and in lowland areas where thick accumulations of unconsolidated sediment have accumulated. Rock outcrops are widespread in the upland areas of high relief.

There are no geological faults mapped on the 1:250 000 scale in the study area or in the immediate vicinity thereof. The anticipated seismic activity is rated as VI on the Modified Mercalli Scale but peak horizontal ground accelerations are typically less than 50cm/s with a 10% chance of being exceeded at least once in a 50 year period.

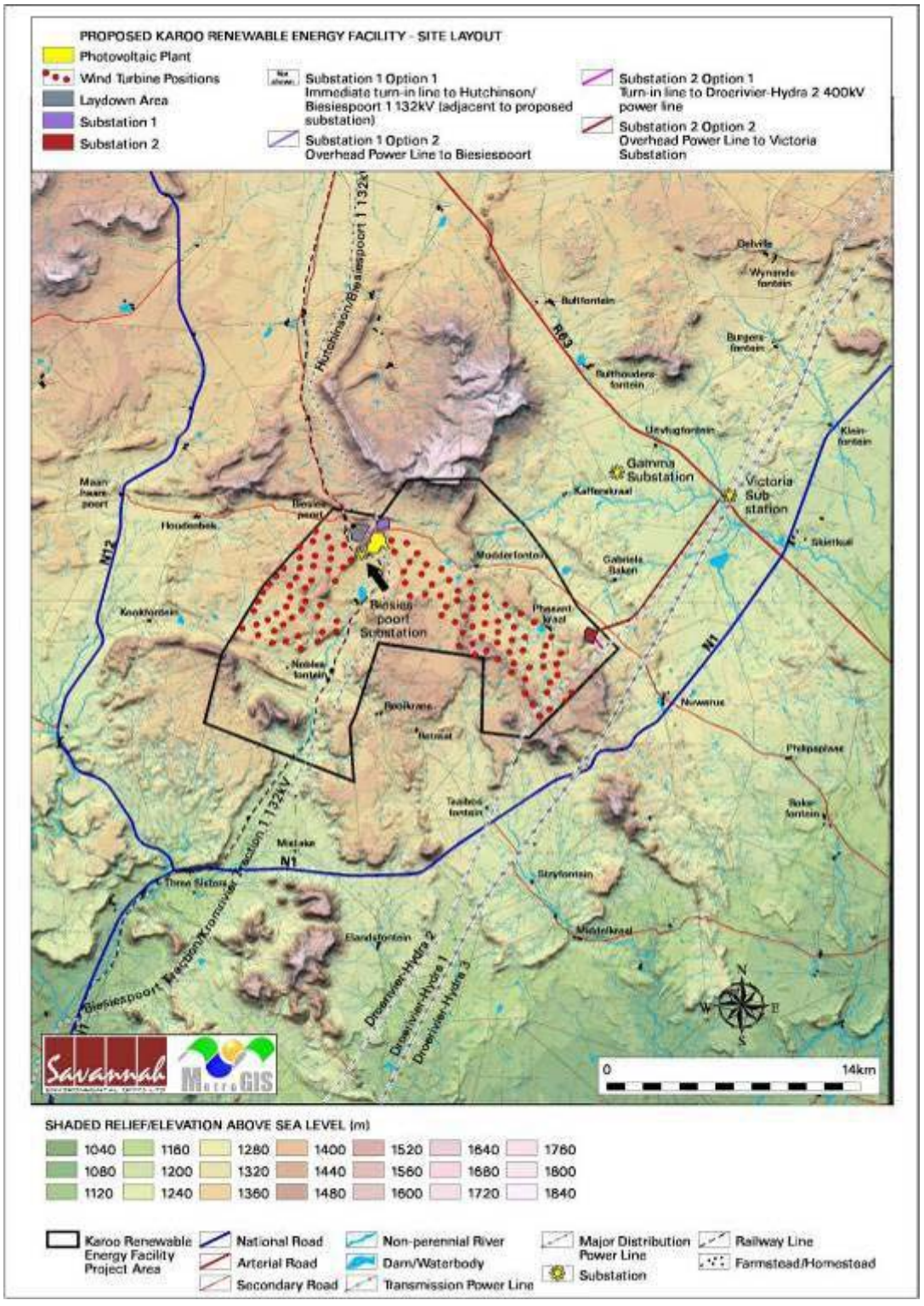

Figure 5.3: Shaded relief map (indicating topography and elevation above sea level) of the broader study area.

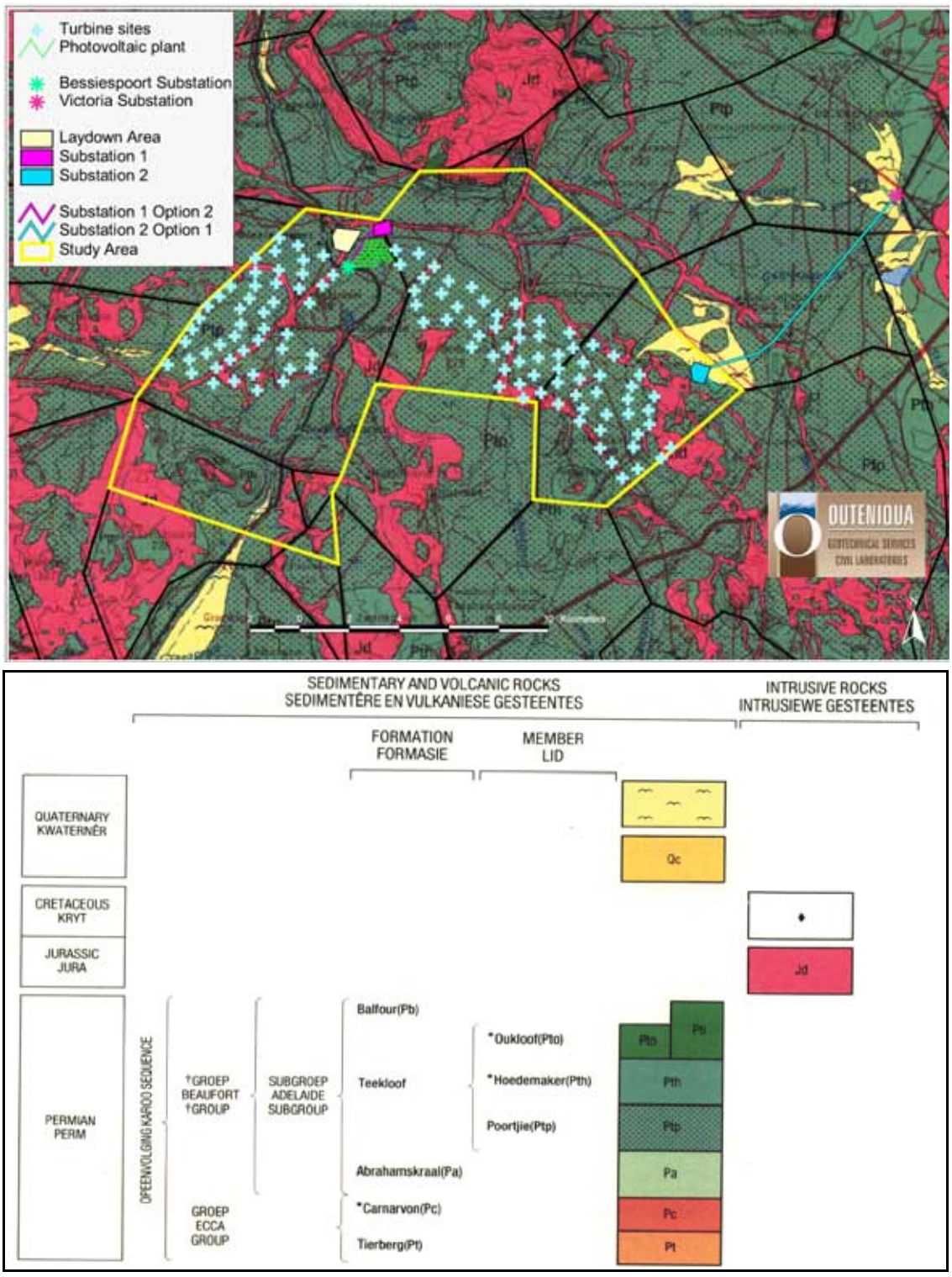

Figure 5.4: Geological map of the study area

5.7.3 Soils, Agricultural Potential and Land Capability

The soils of the majority of the study area are shallow in nature, and overlie hard or weathering rock and are of low agricultural potential. The study area is covered by three land types, as shown in Figure 5.5 namely Fb, Ia and Ib

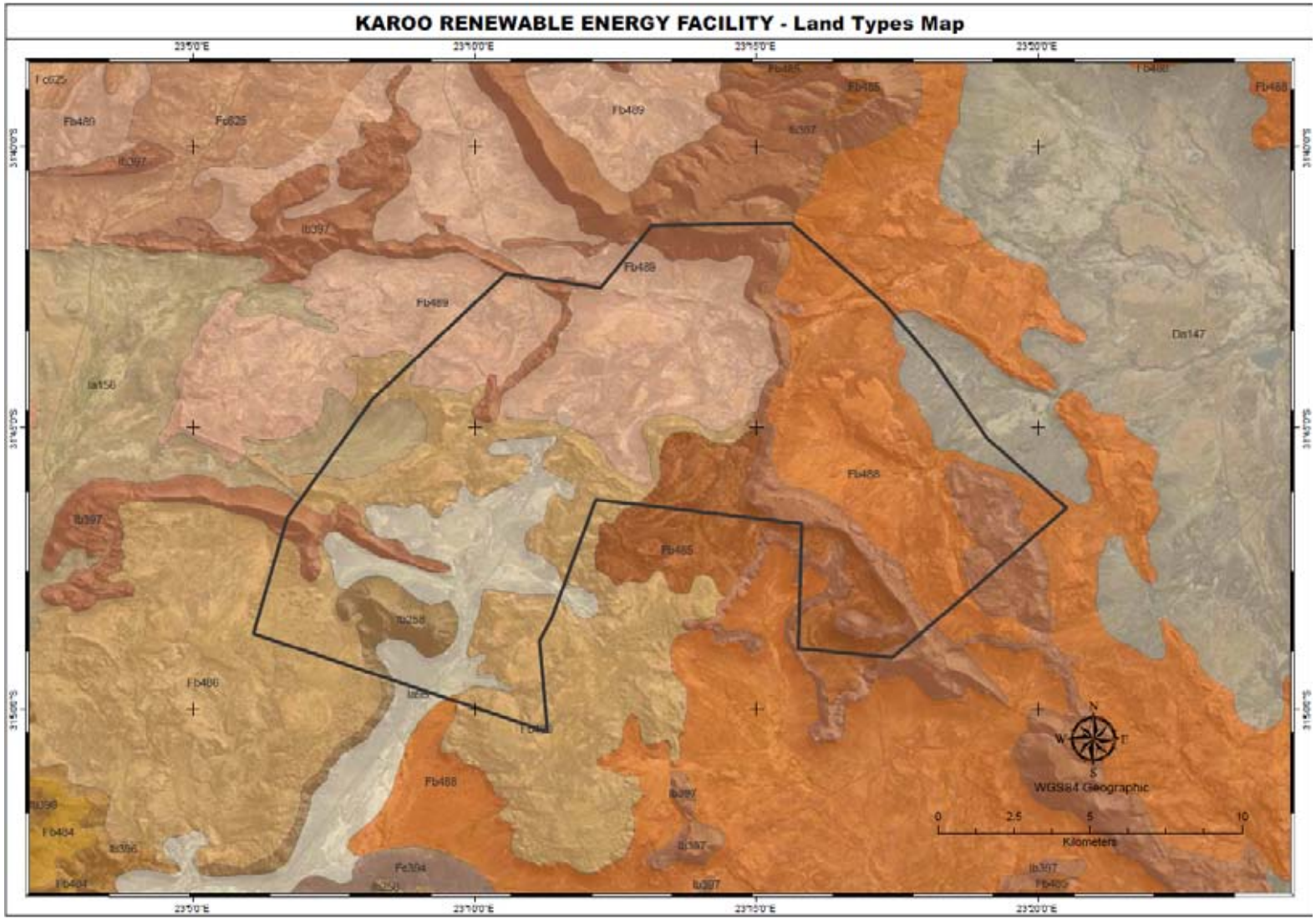

Figure 5.5: Fb, Ia and Ib land types occurring within the identified study site for the proposed Karoo renewable energy facility

The Fb land type is described as Glenrosa and/or Mispah forms and accommodates pedologically young landscapes. The most dominant soil forming process is that of weathering which gives rise to orthic topsoil horizons and clay illuviation. The Mispah and Glenrosa soil forms dominate this landscape. The Ia land types indicate that at least 60% of the soils of these land types are pedologically youthful, deep and unconsolidated deposits, while the Ib land type indicates that exposed rock make up 60% to 80% of the land type. The Fb land type dominates the northern, eastern and a portion of the southern sections of the area, while the western section and a portion of the southern section are dominated by the Ia and Ib land types.

The soil of the Ia95 land type (south-western portion of the site) comprise deep, well-drained soil that exhibit a weak or moderate developed structure. These are soils of high agricultural potential. These soils are mainly of the Oakleaf, Hutton and Valsrivier soil forms. The ***low rainfall***, however, inhibits dry-land crop production. The Ib285 land type is dominated by rock outcrops and is of low agricultural potential. The soils of the majority of the study area are generally shallow, overlying hard or weathering rock, and are of low agricultural potential.

5.7.4 Ecological Profile

The landcover of the study area consists of natural vegetation (Fairbanks *et al*. 2000). Topocadastral maps of the area indicate some linear infrastructure including roads and a railway line, but no cultivation or other transformation on site. From the above it is clear that the study area has not been impacted upon to a great degree by human activities. It is possible, however, that livestock farming has affected the vegetation to some degree. This area of the country consists primarily of farms used as rangeland for commercial livestock production. Commercial farming systems are characterised by land stocked at economically sustainable levels. These regions have been commercially farmed as stock ranches for close to 100 years. Degradation of vegetation has been blamed on high stocking rates of domestic livestock in commercial farming areas. The study area is no exception and degradation due to overgrazing is likely, at least in certain places.

The study area is located within the Nama-Karoo Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006) which indicates three vegetation types occurring within the study site, namely Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld (Refer to Figure 5.5). Transformation rates within these vegetation types are low compared to the overall extent of the vegetation types. The vegetation on site is also not part of any Centre of Floristic

Endemism or classified in any conservation plan as being important to conserve. The terrestrial vegetation on site is therefore not considered to be of high conservation value. These three vegetation types are described in more detail below.

Eastern Upper Karoo occurs on flats and gently sloping plains and is dominated by dwarf microphyllous shrubs with grasses from the genera *Aristida and Eragrostis* (Mucina et al. 2006). There are some endemics in this vegetation, including the succulent shrubs. ***Southern Karoo Riviere*** is found on the narrow riverine flats in the southern parts of the Karoo, especially on heavier and salt-laden soils on broad alluvia (Mucina *et al*. 2006). It consists of a complex of Acacia karroo thickets up to 5 m tall fringed by tall Salsola-dominated shrubland up to 1.5 m tall. ***Upper Karoo Hardeveld*** is found on steep slopes of koppies, butts, mesas and parts of the Great Escarpment covered with large boulders and stones. The vegetation is a sparse dwarf Karoo scrub with drought tolerant grasses of genera such as *Aristida, Eragrostis* and *Stipagrostis*. There are a number of endemics in this vegetation (Mucina *et al*. 2006), including succulent shrubs, low shrubs, tall shrubs, herbs and succulent herbs.

All three vegetation types occurring in the study area are classified as ***Least Threatened***[5] (Driver *et al*. 2005; Mucina *et al*., 2006).

[5] Vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds.

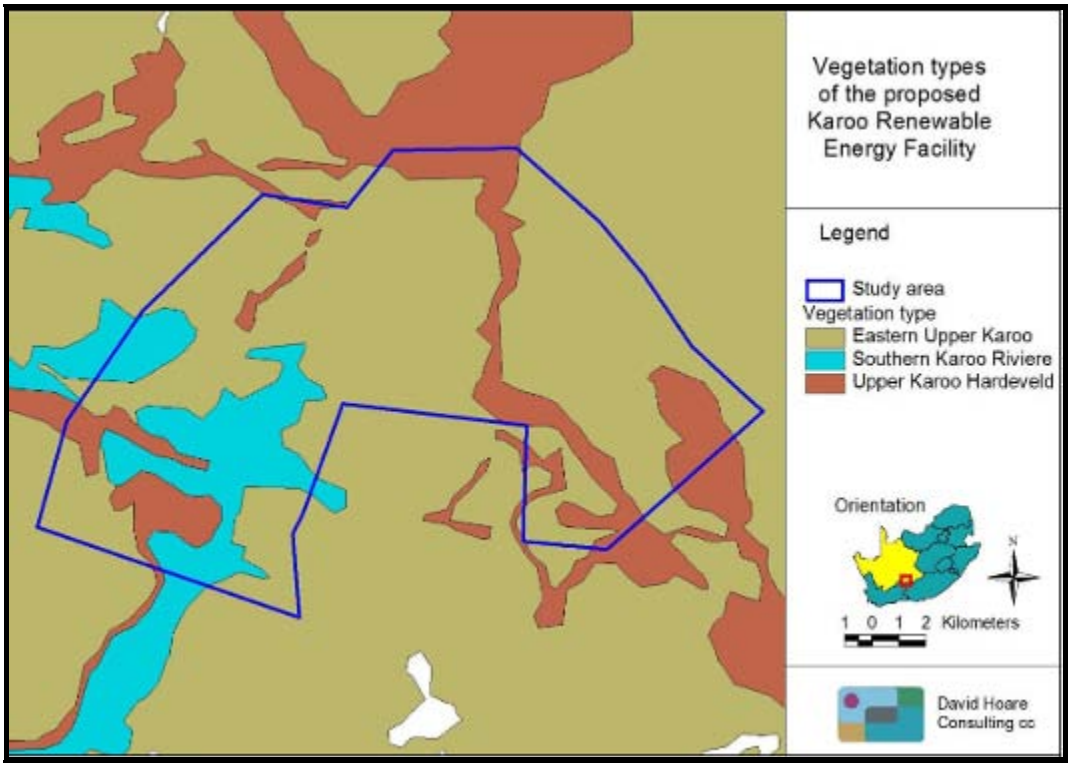

Figure 5.6: Map illustrating the vegetation types in the study area

Red Data Species

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1 of the ecology specialist study (refer to Appendix F). There are no threatened, near threatened or critically rare plant species that could potentially occur on site. There are no protected trees that have a geographical distribution that includes the study area.

All Red List vertebrates (mammals, reptiles, amphibians etc.) that could occur in the study area are listed in Appendix 2 of the specialist ecology study (refer to Appendix F). Those vertebrate species with a geographical distribution that includes the study area and habitat preference that includes habitats available in the study area are discussed further.

» There is one threatened mammal species classified as Critically Endangered, the Riverine Rabbit that could occur in available habitats in the study area. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers.
» There are three mammal species of low conservation concern that could occur in available habitats in the study area. This includes three species classified nationally as Near Threatened, the Honey Badger, Geoffroy's Horseshoe Bat and Leseur's Wing-gland Bat, all three of which are classified as Least Concern globally.

» The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is classified as Least Concern globally and Near Threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act.
» There is one reptile species of conservation concern that has a distribution that includes the study area and which could occur in available habitats in the study area. This is the Namaqua Plated Lizard, classified as Near Threatened. This species is found in dry sandy areas, bare rocky hillsides and Acacia scrub.

Over 220 bird species are considered likely to occur within the anticipated, broader impact zone of the proposed development (these are listed in Appendix 1 of Avian Impact Assessment, refer to Appendix G), including 70 endemic or near-endemic species, 15 red-listed species, as well as five species which are both endemic and red-listed which includes Ludwig's Bustard, Blue Korhaan, Blue Crane, Black Harrier and possibly Cape Vulture. The site falls to the west of the Platberg-Karoo Conservancy Important Bird Area (Barnes 1998), which is known to support critical or regionally significant populations of Red-listed species such as Ludwig's and Kori Bustards, Blue Korhaan, Blue Crane, Secretarybird, Martial Eagle, Tawny Eagle and Lesser Kestrel, and Greater Flamingo.

Ninety-two species were seen during a site visit undertaken in March 2011 (these are listed in Appendix 1 of Avian Impact Assessment), including two sightings of pairs of Blue Crane, each with broods of two, well-developed young breeding pairs of both Martial Eagle and Verreaux's Eagle on cliffs and/or power line towers within and on the near periphery of the proposed development site, and at least two sightings of small aggregations of Lesser Kestrel.

The cliffs of Gys Roosberg to the north and Skeurberg and its outliers in the south hold at least four resident pairs of Verreaux's Eagles with a further 3-4 pairs on the eastern half of the Horseshoe range. The same cliffs probably also support pairs of Rock Kestrel and Jackal Buzzard, and possibly hold 1-2 pairs each of Peregrine Falcon and/or Lanner Falcon, Booted Eagle, Black Stork and Cape Eagle Owl. In addition, two pairs of Martial Eagle and two pairs of Verreaux's Eagle nest on transmission line towers in the general area.
The habitat on site from an avian perspective is relatively uniform, dominated by open, rocky, undulating or montane Karoo veld, with steep, rocky slopes, ridges and cliffs associated with the Horseshoe and its outlying koppies, denser, woody vegetation along the bigger drainage lines (and stands of alien trees), and both natural and artificial wetlands - river courses, vleis and dams.

Table 2 in the Avifauna specialist study (refer to Appendix G) contains a list of priority bird species considered likely to occur within the impact zone of the proposed renewable energy facility.

ASSESSMENT OF IMPACTS: CHAPTER 6
RENEWABLE ENERGY FACILITY & ASSOCIATED INFRASTRUCTURE

The generation of electricity from the proposed Karoo Renewable Energy Facility will be accomplished by implementing the following renewable energy technologies:

» **150 Wind Turbines** with a total generating capacity of **450 MW** (i.e. turbine footprints are foreseen to cover a total area of approximately 3.37 ha). The turbines will have a maximum height of 125m each.
» An array of **photovoltaic (PV) panels** with a generating capacity of up to **50 MW** (i.e. to cover a total area of approximately 97 ha including roads between the rows of PV panels).

In conjunction with the abovementioned solar components, the following associated infrastructural requirements will also be established:

» Two (2) **132 kV substations** with high-voltage (HV) yard footprints of approximately 100m x 100m each;
» **Foundations** to support both the turbine towers (15m x 15m for each turbine foundation) as well as the PV panels;
» **Cabling** between the project components, to be lain underground where practical;
» Two (2) new **overhead 132 kV power lines -**

From Substation 1:

- Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1km length of power line) or alternatively
- Substation 1 Option 2: To connect to Eskom's existing Biesiespoort substation (up to 2.5 km length of power line).

From Substation 2:

- Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line) or alternatively
- Substation 2 Option 2: To connect to Eskom's existing Victoria Substation (up to 12 km length of power line).

» **Internal access roads** (5 m wide and 82.15 km in length) linking the wind turbines and PV component with the other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new internal access roads; and
» **Small office and/or workshop building** (40 m x 20 m) for maintenance and storage purposes

The establishment of a renewable energy facility project is comprised of several phases, including pre-construction, construction, operation, and decommissioning. The **construction activities** involved for the proposed facility will include the following:

» Conduct pre-construction surveys
» Establishment of access roads within the site
» Undertaking site preparation (i.e. including clearance of vegetation; and stripping of topsoil)
» Establishment of laydown areas on site
» Construction of foundations for wind turbines and solar array support structures
» Transportation of components and equipment to site
» Assembly of wind turbines and solar array
» Construction of the on-site substations
» Establishment of the service related buildings (i.e. a workshop, an operations and maintenance facility, including a storage building)
» Connection of the components (wind turbines and solar array) to the on-site substations
» Connection of the on-site substations to the Eskom grid
» Undertake site remediation

The **operational activities** will include the following:

» The operation of the wind turbines and the solar array
» Site operation and maintenance

The **decommissioning activities** will include the following:

» Removal of project infrastructure
» Site rehabilitation

The construction and decommissioning activities have the potential to impact on the receiving environment in terms of habitat destruction, disturbance, and alteration; impacts on biodiversity; threatened fauna and flora species; and ecological processes; soil degradation; erosion; and increased erosion potential; impacts on heritage sites; and impacts on the visual aesthetics.

Environmental issues specific to the operation phase of a renewable energy facility include amongst others visual impacts through the visual dominance of the wind turbines within the landscape; avian mortality through collisions/electrocutions with the power lines, turbines and PV panels; and low frequency noise associated with rotation of the blades.
These and other environmental issues were originally identified through a scoping evaluation of the proposed facility. Potentially significant impacts have now been assessed during this EIA Phase. This EIA process has involved key input from specialist consultants, the project developer, and from key stakeholders and interested and

affected parties. The significance of impacts associated with a facility of this nature is always project specific, and therefore impacts may vary significantly between facilities.

This chapter serves to assess the identified potentially significant environmental impacts associated with the development of the proposed facility, and to make recommendations for the management of these impacts for inclusion in the draft Environmental Management Plan (Refer to Appendix N).

6.1. Assessment of Alternatives

This chapter provides an assessment of the feasible and reasonable project alternatives considered through the EIA process, as required in terms of the EIA Regulations. The following alternatives have been considered:

- **'Do nothing' alternative:** SARGE does not establish the renewable energy facility (i.e. maintain status quo).
- **Site specific alternatives**: Relating to the layout of the wind turbines, solar array and internal access roads over the broader identified site of 202 km^2.
- **Alternative servitudes for power line routing:** Two (2) 132 kV power lines are proposed to feed into the Eskom electricity grid as discussed earlier in this chapter. Two alternative corridors have been assessed for each of the two substations in the EIA process.

The sections which follow provide a summary of the assessment of these project alternatives.

6.1.1 The 'do nothing' Alternative

An increasing pressure exists on countries across the globe to increase their portion of renewable energy generation due to concerns such as climate change and resource exploitation (i.e. coal and oil). The South African Government has set a target of 10 000 GWh renewable energy contributions to final energy consumption by 2013. The target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro. This amounts to approximately 4% (1 667 MW) of the total estimated electricity demand (41 539 MW) by 2013. In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, IPPs are being encouraged to develop renewable energy projects and contribute to these targets.

The 'do nothing' alternative will result in SARGE not undertaking the establishment of the proposed Karoo Renewable Energy Facility on the identified site, that is, maintaining the status quo, with the following resultant impacts:

» The potential to harness and utilise the excellent renewable resources at the identified site would be lost.
» The project would not assist the South African Government in reaching their renewable energy targets as published in the Renewable Energy White Paper.
» The National electricity grid would not benefit from the additional power that could be received from the proposed facility.
» The local communities would not benefit from the potential employment creation opportunities.

This is, therefore, not a preferred alternative.

6.1.2 Alternative Servitude for the Power Line Routing

The EIA through the sections which follow, considers two alternative power line routes for each of the two proposed on-site substations (Refer to Figure 6.1), as follows:

» ***From Substation 1:***
- Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1km length of power line) or alternatively
- Substation 1 Option 2: To connect to Eskom's existing Biesiespoort substation (up to 2.5 km length of power line).

» ***From Substation 2:***
- Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line) or alternatively
- Substation 2 Option 2: To connect to Eskom's existing Victoria Substation (up to 12 km length of power line).

6.2. Areas of disturbance associated with the proposed Karoo Renewable Energy Facility

In order to assess the impacts associated with the proposed renewable energy facility, it is necessary to understand the extent of the affected area. The affected area primarily includes the turbines, solar array, substations and associated access roads. A study area of approximately 202 km^2 is being considered as a larger study area for the construction of the proposed renewable energy facility. The area to be occupied by the turbines, solar array and associated infrastructure is illustrated in Figure 6.1.

6.2.1. Permanently affected areas on site

From the results of the facility layout determination, it is apparent that the effective utilised area within the site is only approximately 1.436 km^2 in extent. This amounts to 0.8 % of the total 202 km^2 originally earmarked for development, and is broken down in the table below.

Permanently affected areas within the farm boundaries are summarised as follows.

Facility component –permanent	**Approximate extent (in m^2)**
150[6] turbine footprints (i.e. each 15 m x 15 m)	33 750 (for 150 turbines)[7]
Solar array	970 000
Permanent access roads[8] underlain with 33 kV cabling where possible (5 m wide and 82.15 km long)	410 775
Substation footprints (100 m x 100 m) x2	20 000
Small office and/or workshop building (40 m x 20 m)	800
TOTAL (m^2)	**1 435 325 m^2** (of a total area of 202 km^2) **~ 0.8 % of site**

The permanent area lost to the proposed renewable energy facility (assuming 150 turbines and an area of 97 ha for the solar array) will therefore amount to ~0.8 % of the total 202 km^2 of the broader site[9].

6.2.2. Temporarily affected areas on site

Temporarily affected areas comprise laydown areas for turbines (i.e. each with a minimum footprint of 50 m x 25 m), temporary access roads (5m wide and 5.6 km long) as well as a general construction laydown area of 66 ha in extent. The 33 kV cabling to connect the turbines and the solar array to the on-site substations will make use of the permanent access roads to be constructed on site. A trench of approximately 1 m deep will be excavated in which the cabling will be laid; thereafter the area will be rehabilitated.

[6] The current turbine layout has 113 turbines as a result of the design process thus far which has taken environmental and technical constraints into consideration. However, the EIA application remains for a facility of up to 150 turbines.

[7] The area would be reduced to 25 425m^2 for 113 turbines.

[8] Assuming a width of 5m and a length of 82.155 km.

[9] The permanent area lost to the proposed renewable energy facility (assuming 150 turbines and an area of 97 ha for the solar array) amounts to ~**0.8 %** of the total 202 km^2 of the broader site.

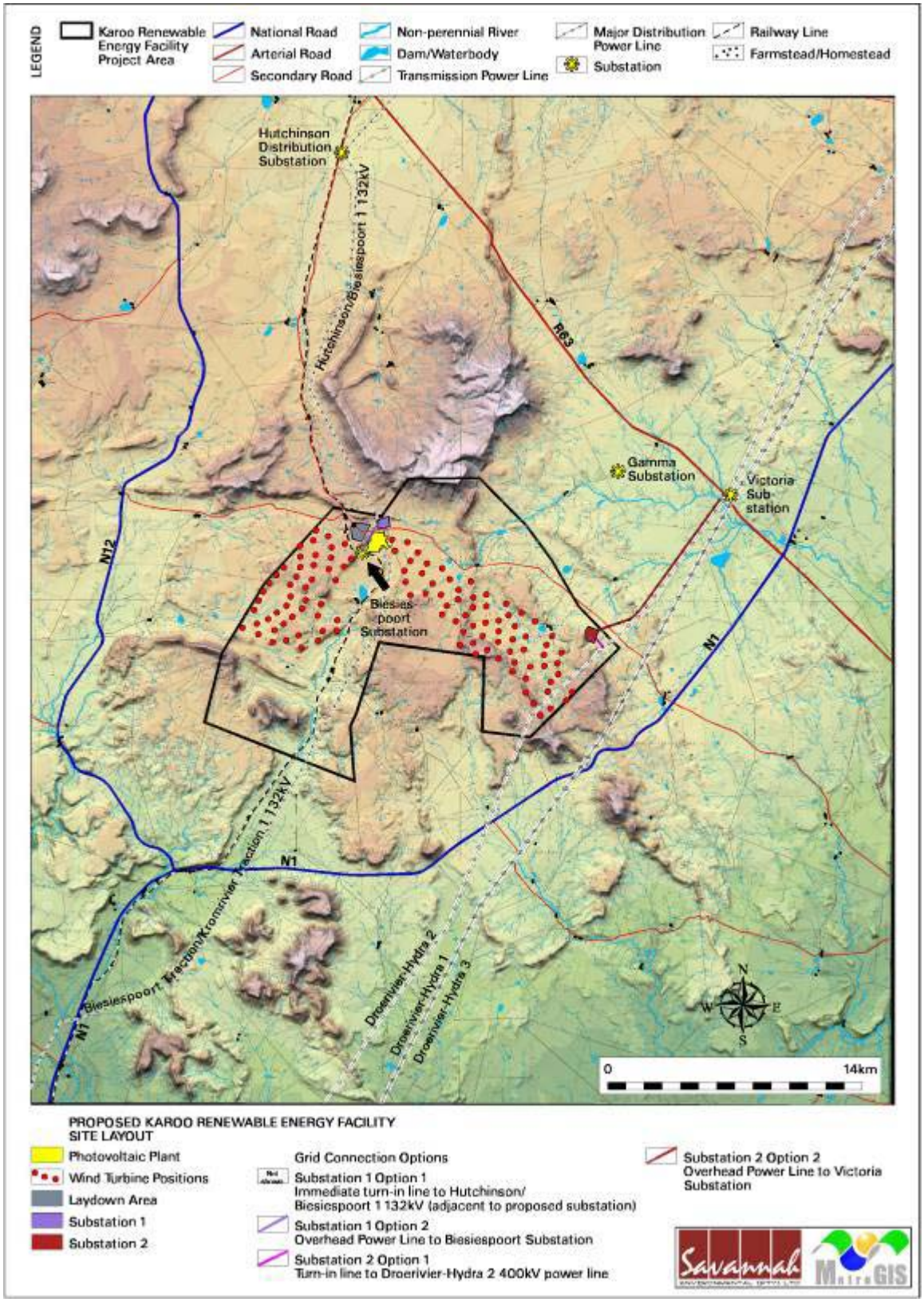

Figure 6.1: Locality map showing provisional wind turbine and PV plant layout, power line corridors and substations

Facility component –temporary	Approximate extent (in m^2)
Laydown areas for turbines (i.e. each 50 m x 25 m)	187 500 (for 150 turbines)[10]
Temporary access roads[11] (5 m wide and 5.6 km long)	28 000
General construction laydown area	660 000
TOTAL (m^2)	**875 500 m^2** (of a total area of 202 km^2) **~ 0.43 % of site[12]**

6.3. Assessment of the Potential Impacts associated with the Construction and Operation Phases

The sections which follow provide a summary of the findings of the assessment undertaken for potential impacts associated with the construction and operation of the proposed renewable energy facility. Issues were assessed in terms of the criteria detailed in Chapter 4. The nature of the potential impact is discussed, and the significance is calculated with and without the implementation of mitigation measures. Recommendations are made regarding mitigation and management measures for potentially significant impacts and the possibility of residual and cumulative impacts are noted.

6.3.1 Assessment of Potential Impacts on Ecology

Major potential impacts on the ecology of the proposed study area are described briefly below. There are two major ways that a renewable energy development may impact on the ecological environment: a) through direct impacts on individual organisms and b) through impacts on habitat structure and functioning.

Areas of potentially high sensitivity are shown in Figure 6.2. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Broad scale mapping, desktop assessments, detailed mapping from aerial photography and detailed fieldwork were used to provide information on the location of sensitive features. There are a number of features that need to be

[10] The area would be reduced to 141 250m^2 for 113 turbines.

[11] Assuming a width of 5 m and a length of 5.6 km.

[12] The temporary area of disturbance (assuming 150 turbines) amounts to ~0.43% of the total 202 km^2 of the broader site.

taken into account in order to evaluate sensitivity in the study area. These include the following:

1. Perennial and non-perennial rivers, streams and drainage lines: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal;
2. Potential occurrence of populations of a Red List animal species that has been evaluated as having a high chance of occurring within natural habitats within the study area (the Riverine Rabbit).

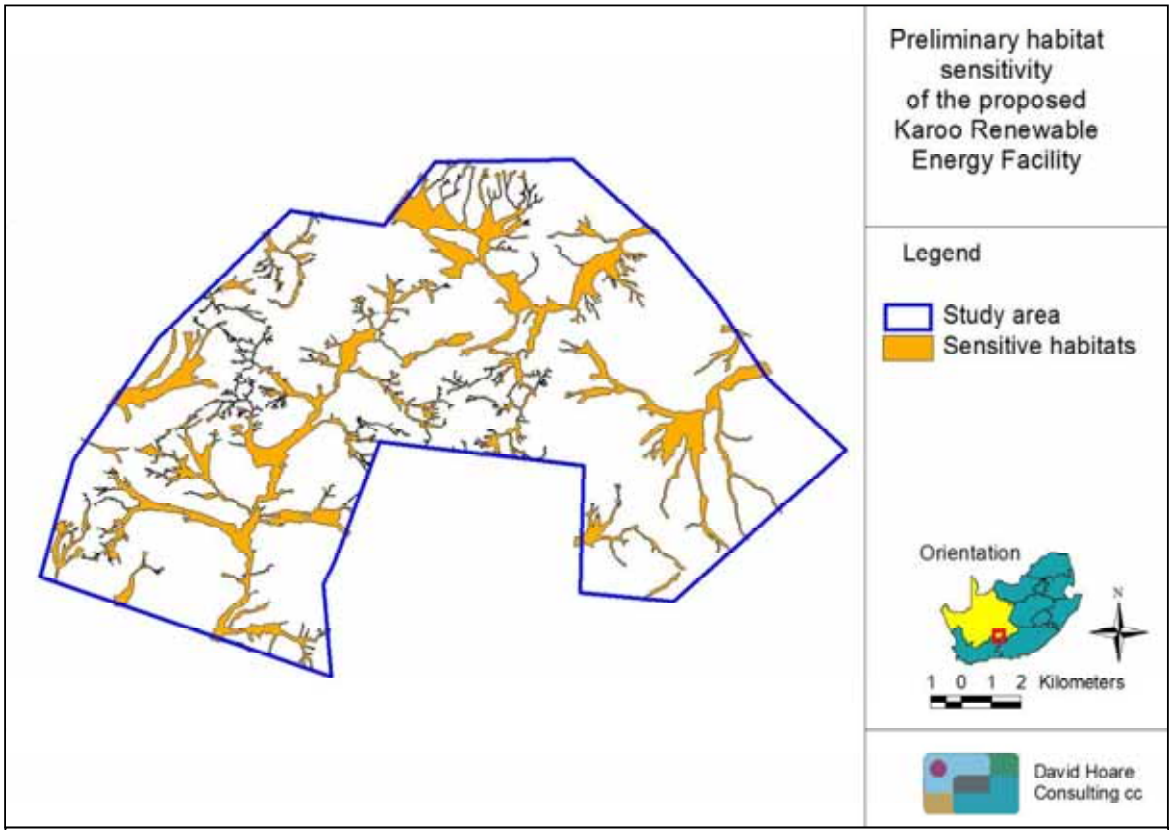

Figure 6.2: Map indicating the sensitive ecological areas in the study area

There are three vegetation types that are mapped for the area that includes the site, namely Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld. All three vegetation types occurring in the study area are classified as Least Threatened (Driver *et al*. 2005; Mucina *et al*., 2006). Transformation rates within these vegetation types are low compared to the overall extent of the vegetation types. The vegetation on site is also not part of any Centre of Floristic Endemism or classified in any conservation plan as being important to conserve.

Drainage lines (wetlands) represent particularly vital natural corridors as they function both as wildlife habitat, providing resources needed for survival, reproduction and movement, and as biological corridors, providing for movement

between habitat patches. Drainage lines on site are classified as sensitive. From a sensitivity point of view, the main drainage lines are more sensitive and therefore important to protect than the very ephemeral ones. Wetlands, riparian zones and watercourses are defined in the National Water Act as a water resource and any activities that are considered that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998).

There is one threatened mammal species classified as Critically Endangered, the **Riverine Rabbit** that could potentially occur in available habitats in the study area. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. The Namakwa District map of Critical Biodiversity Areas shows various drainage lines within a defined geographical area as being important habitat for this species (indicated in red in Figure 6.3). Grids in which this species has been documented to occur are shown as green squares in Figure 6.3. It can be seen that the study area (brown polygon in Figure 6.3) occurs within grids in which this species has been previously recorded and contains a number of drainage areas in which potential habitat for this species could occur. Based on known distribution and potential availability of suitable habitat, there is, therefore, a high risk of this species occurring on site.

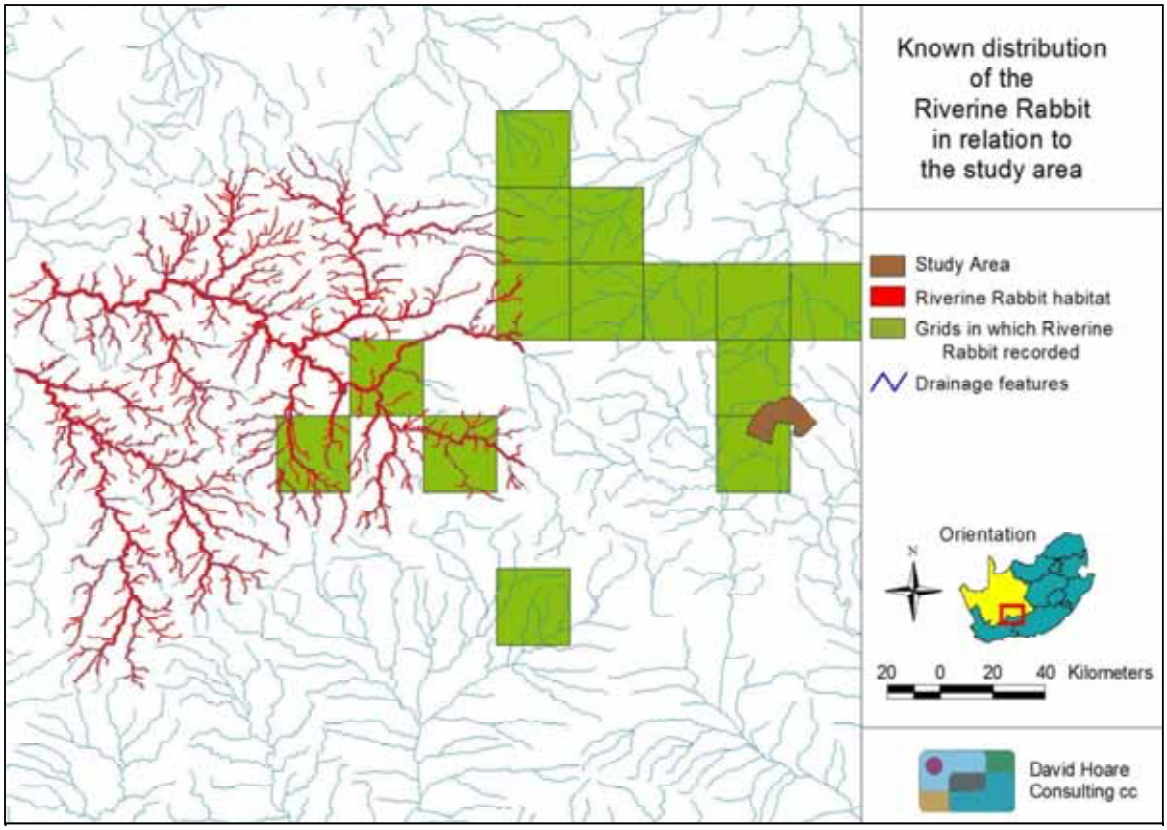

Figure 6.3: Riverine Rabbit distribution

The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is classified as Least Concern globally and Near Threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act. There is one reptile species of conservation concern that has a distribution that includes the study area and which could occur in available habitats in the study area. This is the Namaqua Plated Lizard, classified as Near Threatened. This species is found in dry sandy areas, bare rocky hillsides and Acacia scrub.

A risk assessment was undertaken which identified five main potential negative impacts on the ecological receiving environment. The significance of these impacts was assessed during the EIA phase after collection of relevant field data. The identified potential negative impacts are the following (with potential significance without mitigation measures given in brackets):

1. Impacts on indigenous natural vegetation (LOW to MEDIUM).
2. Impacts on threatened animals (ZERO to LOW).
3. Impacts on wetlands and/or watercourses (ZERO to HIGH).
4. Establishment and spread of declared weeds and alien invader plants (MEDIUM).

Impact table summarising the significance of impacts on the vegetation and general ecology (with and without mitigation)

Impacts associated with construction and operation of the PV plant

The following tables summarise the potential impacts associated with the construction and operation of the proposed PV plant.

Nature: Loss of habitat within indigenous natural vegetation types The vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value.		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	Low (4)	low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	No
Mitigation: » Avoid unnecessary impacts on natural vegetation surrounding the PV power plant. Impacts should be contained, as much as possible, within the footprint of the infrastructure.	
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.	
Residual Impacts: Some loss of this vegetation type will definitely occur.	

Nature: Impacts on individuals of threatened animal species (Riverine Rabbit)

There is one threatened and four near threatened species that could occur on site. The threatened species is of greatest concern. This assessment is specifically on the potential impact of the infrastructure on the threatened (Critically Endangered) Riverine Rabbit, which was evaluated as having the potential to occur on site. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. Based on the field assessment, it was evaluated that potentially suitable habitat is present in the north-eastern part of the site. No individuals of the species were found on site and land owners on site have indicated that no previous sitings have taken place on site. It was, nevertheless, possible for the species to occur there. The assessment below is based on this possibility.

	Without mitigation	**With mitigation**
Extent	regional (3)	regional (3)
Duration	permanent (5)	Short-term (1)
Magnitude	low (4)	low (4)
Probability	improbable (2)	improbable (2)
Significance	**low (24)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

» Avoid impacts on natural habitats suitable for the riverine rabbit.

Cumulative impacts:

Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands) may exacerbate this impact.

Residual Impacts:

Unlikely to occur.

Nature: Damage to wetland areas resulting in hydrological impacts

There are a number of dry stream beds and drainage areas present on the study area, of which two small upper reaches are directly affected by the proposed PV power plant. According to the National Water Act, these are classified as wetlands or water resources. Construction may lead to some direct or indirect loss of or damage to these affected areas or changes to the catchment of these areas.

	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly likely (4)	Highly likely (4)
Significance	**medium (48)**	**medium (40)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

» Control stormwater and runoff water and inhibit erosion.
» Obtain a permit from DWA to impact on any wetland or water resource.
» Place erosion control features at crossings of drainage lines.

Cumulative impacts:

Soil erosion, alien invasions, may all lead to additional impacts on wetland habitats that will exacerbate this impact.

Residual Impacts:

Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

Nature: Establishment and spread of declared weeds and alien invader plants

Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica, Opuntia imbricata, Prosopis glandulosa, Prosopis velutina, Atriplex numularia,* and *Nicotiana glauca*. The shrub, *Prosopis glandulosa*, is potentially the most problematic. This species invades riverbeds, riverbanks and drainage lines in semi-arid and arid regions and has been recorded near to the site. There is therefore the potential for alien plants to spread or invade following disturbance on site.

	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	highly probable (4)	improbable (2)
Significance	**medium (48)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove » Establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

Impacts associated with construction and operation of the wind component

The following tables summarise the potential impacts associated with the construction and operation of the wind component of the facility.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	Low (4)	low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Avoid unnecessary impacts on natural vegetation surrounding the wind turbines. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts:		

Some loss of this vegetation type will definitely occur.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove » Establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss and damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

Impacts associated with the construction and operation of the two on-site substations

The following tables summarise the potential impacts associated with the construction and operation of the two substations proposed for the facility.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	minor (2)	minor (2)
Probability	definite (5)	definite (5)
Significance	**medium (40)**	**medium (40)**
Status (positive or negative)	negative	negative

Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Avoid unnecessary impacts on natural vegetation surrounding the substations. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions and damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will definitely occur.		

Nature: Damage to wetland areas resulting in hydrological impacts There are a number of dry stream beds and drainage areas on site, of which one small drainage line may be directly affected by substation 2. According to the National Water Act, these are classified as wetlands or water resources. Construction may lead to some direct or indirect loss of or damage to these affected areas or changes to the catchment of these areas.		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	low (4)	Low (4)
Probability	probable (3)	improbable (2)
Significance	**medium (30)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Control stormwater and runoff water and inhibit erosion. » Move position of substation 2, two hundred meters (200 m) to the north-west, OR ensure the infrastructure is located in an area that does not impact on any wetland / water source. » Obtain a permit from DWA to impact on any wetland or water resource.		
Cumulative impacts: Soil erosion and alien invasive plant species, may all lead to additional impacts on wetland habitats that will exacerbate this impact.		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	highly probable (4)	improbable (2)
Significance	**medium (48)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove » Establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

Impacts associated with the construction and operation of the overhead power lines

Two overhead power lines (132kV each) will be constructed which will connect the two proposed on-site substations to the grid. There are two alternative power line alignments proposed for each substation (four in total).

Nature: Loss of habitat within indigenous natural vegetation types The vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value. Power line towers occupy a very small footprint relative to the overall extent of the vegetation types.		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	Medium-term (3)	Medium-term (3)

Magnitude	minor (1)	minor (1)
Probability	definite (5)	definite (5)
Significance	**low (25)**	**low (25)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Avoid unnecessary impacts on natural vegetation surrounding the servitude of the overhead powerlines. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions and damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will definitely occur.		

Nature: Damage to wetland areas resulting in hydrological impacts There are a number of dry stream beds and drainage areas on site. A small number of these will potentially be affected by the Substation 2 option 2 power line. None of the other power line options affect drainage lines / watercourses. According to the National Water Act, these are classified as wetlands or water resources. Construction may lead to some direct or indirect loss of or damage to these affected areas or changes to the catchment of these areas.		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**medium (36)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Ensure that tower structures are placed a minimum of 30 m outside of drainage lines / watercourses OR » Obtain a permit from DWA to impact on any wetland or water resource.		
Cumulative impacts:		

Soil erosion, alien invasions, may all lead to additional impacts on wetland habitats that will exacerbate this impact.
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove » Establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

Impacts associated with the construction of access roads and underground cables between turbines and between the solar array

In order to assess potential impacts of internal access roads, it was assumed that any area within the area occupied by the turbines and the solar array could be affected. It was assumed that underground cabling will be installed beneath the internal access roads as far as possible.

Nature: Loss of habitat within indigenous natural vegetation types

The vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value.		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	Low (4)	low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Avoid unnecessary impacts on natural vegetation surrounding the servitude of the overhead powerlines. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will definitely occur.		

Nature: Damage to wetland areas resulting in hydrological impacts There are a number of dry stream beds and drainage areas on site, of which a large number are directly affected by the proposed internal access roads. According to the National Water Act, these are classified as wetlands or water resources. Construction may lead to some direct or indirect loss of or damage to these affected areas or changes to the catchment of these areas.		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	moderate to high (7)	moderate (6)
Probability	Definite (5)	Highly likely (4)
Significance	**high (65)**	**medium (48)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation: » Control stormwater and runoff water and inhibit erosion. » Obtain a permit from DWA to impact on any wetland or water resource. » Place erosion control features at crossings of drainage lines. » No structures must be placed within the drainage channel.
Cumulative impacts: Soil erosion and alien invasive plant species, may all lead to additional impacts on wetland habitats that will exacerbate this impact.
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	highly probable (4)	improbable (2)
Significance	**medium (48)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove » Establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss and damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

Comparative Assessment of Power line Alternatives

The power line options will not have impacts on the same natural components and may have different relative impacts on some natural features. A summary of potential impacts due to the various power line options is given in Table 6.1

below. The four power line options are similar in their impact on the environment. The exception is the power line of Substation 2 option 2, which is significantly longer and potentially affects a number of drainage lines. Nevertheless, all potential impacts can still be adequately mitigated, and any of the power line options is therefore potentially suitable.

No preferred power line alternative is therefore recommended for either of the two substations, seeing that the proposed impacts on the environment will be similar for all.

Table 6.1: Summary of the significance of impacts for different power line options after mitigation measures have been applied.

	Substation 1		Substation 2	
Impact	**Option 1**	**Option 2**	**Option 1**	**Option 2**
Vegetation	Low	Low	Low	Low
Threatened animals	Zero	Zero	Zero	Zero
Wetlands	Zero	Zero	Zero	Low
Weeds	Low	Low	Low	Low

Implications for Project Implementation

The following recommendations are made to reduce impacts or provide additional information that can lead to reduction or control of impacts:

» Internal access roads must be planned in such a way as to avoid drainage lines, as far as possible.
» Planning of infrastructure position needs to take some factors into account with respect to existing disturbance on site. Existing road infrastructure should be used as far as possible for providing access to proposed turbine and PV panel positions. Where no road infrastructure exists, new roads should be placed within existing disturbed areas or environmental conditions must be taken into account to ensure the minimum amount of damage is caused to natural habitats and that the risk of erosion or down-slope impacts are not increased. Road infrastructure and cable alignments should coincide as far as possible.
» Substation 2 will have to be relocated, 200 m to the north-west, or it must be ensured that the infrastructure is located in an area that does not impact on any wetland / water source.
» A permit will have to be obtained from DWA to impact on any wetland or water resource.

6.3.2 Assessment of Potential Impacts on Avifauna

The proposed Karoo Renewable Energy Facility is located in an area on the fringes of a national Important Bird Area, known to support good populations of a number of threatened and/or endemic bird species, as well as high densities of other, ecologically valuable species. The proposed facility is likely to have a detrimental effect on these birds, during both the construction and operational phases of the development. The scale of the development renders these impacts potentially significant, and accentuates the need for full compliance with the stipulated mitigation and monitoring measures.

The worst affected taxa are likely to be large raptors (Verreaux's and Martial Eagles) nesting on existing transmission power line towers on the Karoo flats, or else on the cliffs of Gys Roosberg, the Horseshoe and some outlying ridge lines, and using these topographic features for slope soaring. The areas surrounding the locations or habitats most frequently used by these birds (known nesting areas, well defined ridge lines) should be considered as highly sensitive, and should be excluded from all development. Another possible impact of the facility will be displacement effects on, and collision mortality of Ludwig's Bustard and Blue Crane. Pre- and post-construction monitoring will be vital to improve understanding of the risk posed by the facility on local bustards, and how best to mitigate this risk.

Impacts of the proposed facility are most likely to be manifest in the following ways:

» Disturbance and displacement of resident/breeding/visiting raptors (especially Verreaux's Eagle, Martial Eagle, Tawny Eagle, Secretarybird, Lesser Kestrel, and possibly Booted Eagle, Black Harrier, Peregrine Falcon and Lanner Falcon) from nesting and/or foraging areas by construction and/or operation of the facility, and /or mortality of these species in collisions with the turbine blades or associated new power lines while slope-soaring or hunting, or by electrocution when perched on power infrastructure.

» Disturbance and displacement of seasonal influxes or resident populations of large terrestrial birds (especially Ludwig's Bustard and Blue Crane, but including Kori Bustard and Blue Korhaan) from nesting and/or foraging areas by construction and/or operation of the facility, and /or mortality of these species in collisions with the turbine blades or associated new power lines while commuting between resource areas (croplands, nest sites, roost sites/wetlands).

» Disturbance and displacement of resident/breeding Karoo endemics – especially Cinnamon-breasted Warbler and African Rock Pipit on the higher-lying ridges fringing the study area by construction and/or operation of the facility.

» Displacement of seasonal influxes of wetland birds from established flight lines in and out of resource areas either within or near to the development area, and/or mortality of these species in collisions with the turbine blades or associated new power lines.

Impact table summarising the significance of impacts on avifauna (with and without mitigation)

Nature: Disturbance during the construction phase Noise, movement and temporary occupation of habitat during the building process are likely to impact all birds in the area to some extent, but sensitive, sedentary and/or habitat specific species will most adversely affected.		
	Without mitigation	***With mitigation***
Extent	Medium (4)	Medium (4)
Duration	Short (1)	Short (1)
Magnitude	Medium-High (6)	Medium (5)
Probability	Definite (5)	Definite (5)
Significance	**Medium (55)**	**Medium (50)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium-High
Irreplaceable loss of resources	Possible	Probably not
Can impacts be mitigated	Yes	
Mitigation measures: » Abbreviating construction time » Scheduling activities around avian breeding and/or movement schedules (timing to be determined after pre-construction monitoring) » Lowering levels of associated noise » Reducing the size of the inclusive development footprint		
Cumulative impacts: » Likely, given that at least one other, large FACILITY project is proposed for the adjacent property to the east.		
Residual impacts: » Some priority species may move away regardless of mitigation.		

Nature: Habitat loss Destruction of habitat for priority species, either temporary – resulting from construction activities peripheral to the built area, or permanent - the area occupied by the completed development.		
	Without mitigation	***With mitigation***
Extent	Medium (4)	Medium-Low (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Medium (4)	Medium (3)

Probability	Definite (5)	Definite (5)
Significance	**Medium - High (65)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Possible	Probably not
Can impacts be mitigated	Yes	
Mitigation measures: » Minimising habitat destruction caused by the construction of the facility by keeping the lay-down areas as small as possible » Building as few temporary roads as possible » Reducing the final extent of developed area to a minimum.		
Cumulative impacts: Yes, more renewable energy developments in the immediate area will increase habitat losses exponentially. At least one, large facility is proposed for neighbouring properties.		
Residual impacts: » Some species may be permanently lost to the area regardless of mitigation.		

Nature: Disturbance during the operational phase Noise and movement generated by operating turbines and maintenance activities associated with the turbines and/or the PV installation is sufficient to disturb priority species, causing displacement from the area, adjustments to commute routes with energetic costs, or otherwise affecting nesting success or foraging efficiency.		
	Without mitigation	***With mitigation***
Extent	Medium (5)	Medium-Low (5)
Duration	Lifetime of the facility (4)	Lifetime of the facility (4)
Magnitude	Medium (7)	Medium (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium-High (64)**	**Medium (60)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Possible	Possible
Can impacts be mitigated	Yes, to a slight degree	
Mitigation measures: » Abbreviating maintenance times » Scheduling activities in relation to avian breeding and/or movement schedules (timing to be determined after pre-construction monitoring) » Lowering levels of associated noise.		
Cumulative impacts: » Considerable potential, especially given that there is at least one large project		

proposed for the same general area.
Residual impacts:
» Some priority species may be permanently lost from the area.

Nature: Mortality during the operational phase Collision of priority species with the wind turbine blades, power lines, or electrocution of the same on new power infrastructure.		
	Without mitigation	***With mitigation***
Extent	Medium (4)	Medium-Low (3)
Duration	Lifetime of the facility (4)	Lifetime of the facility (4)
Magnitude	High (8)	Medium-High (7)
Probability	Highly probable (4)	Probable (4)
Significance	**Medium-High (64)**	**Medium (56)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Possibly not
Can impacts be mitigated	Yes	
Mitigation measures: » Careful siting of turbines and PV array/s » Painting turbine blades » Bird friendly power hardware » Monitoring priority bird movements and collisions » Turbine management sensitive to these data – radar assisted if necessary		
Cumulative impacts: » Yes, if more turbines, PV arrays and power lines are built in the same general area, (which seems likely), more collision hot-spots are likely, and mortality rates may increase exponentially.		
Residual impacts: » Some casualties may be incurred regardless of mitigation.		

Comparative Assessment of Power line Alternatives

In both the cases of Substation 1 and 2, the option which proposes the shorter power line route is preferred in terms of potential impacts on avian habitat disturbance as well as collision risk. Substation 1 Option 1 and Substation 2 Option 1 are the preferred power line route options for this facility.

Implications for Project Implementation

» The proposed development will affect populations of regionally or nationally threatened (and impact susceptible) birds (both wetland and terrestrial species) likely to occur within or close to the proposed turbines.

» Responsible implementation of required mitigation measures should reduce detrimental construction and operational phase impacts to tolerable and sustainable levels, especially if every effort is made to monitor impacts throughout and to learn as much as possible about the effects of wind energy developments on South Africa avifauna.
» The impacts of this development must be viewed in the context of the potential cumulative effects generated by at least one other wind energy project proposed for the same general area.

Mitigation of these impacts will be best achieved in the following ways:

» Minimising the disturbance impacts associated with the construction and/or operation of the facility, by abbreviating construction time and maintenance times, scheduling activities around avian breeding and/or movement schedules (actual timing to be refined by the results of pre-construction monitoring), and lowering levels of associated noise.
» Minimising habitat destruction caused by the construction of the facility by keeping the lay-down areas as small as possible, building as few temporary roads as possible, and reducing the final extent of developed area to a minimum.
» Excluding development from areas:
    - Within 500 m of any cliff lines or elevated ridges within the development area to reduce collision risk, primarily for slope soaring raptors.
    - Within 1500 m of any known or suspected Verreaux's Eagle nest sites (Figure 6.3) to reduce disturbance and collision risk for this species.
    - Within 2500 m of any known or suspected Martial Eagle nest sites (Figure 6.3) to reduce disturbance and collision risk for this species.
» These exclusion areas as listed above will affect the location of Substation 2 in the south-east which will have to be distanced from a nesting site of a Verreaux Eagle (Figure 6.3).
» Ensuring that lighting on the turbines is kept to a minimum, and is coloured (red or green) and intermittent, rather than permanent and white, to reduce confusion effects for nocturnal migrants.
» Minimising the length of any new power lines installed, and ensuring that all new lines are marked with bird flight diverters along their entire length, and that all new power infrastructure is adequately insulated and bird friendly in configuration. Hence, the strongly preferred power line link options are the two short lines feeding directly into the nearby, existing transmission network (Fig. 1). The relatively low cost of marking the entire length of a new line during construction, especially quite a short length of line in an area frequented by collision prone birds, more than offsets the risk of not marking the correct sections, causing unnecessary mortality of birds, and then

incurring the much greater cost of retro-fitting the line post-construction. In situations where new lines run in parallel with existing, unmarked power lines, this approach has the added benefit of reducing the collision risk posed by the older line.

» Ensuring that all new power infrastructure (pylons, conductors, transformers, substations) is adequately insulated and bird friendly in configuration.

» Carefully monitoring the local avifauna pre- and post-construction, and implementing appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded for any of the priority species listed in this report. An essential weakness of the EIA avifauna study, given the time constraints, is the lack of knowledge about the actual movements of key species (bustards, cranes, eagles, other raptors, flamingo's, storks) through the impact area. Such knowledge must be generated as quickly and as accurately as possible in order for this and other wind energy proposals in the area to proceed in an environmentally sustainable way. Radar tracking systems, however expensive, may be the best and most practical solution to this problem.

» Ensuring that the results of pre-construction monitoring are applied to project-specific impact mitigation in a way that allows for the potential cumulative effects on the local/regional avifauna of any other wind energy projects proposed for this area, including the proposed Karroo Renewable Energy Facility. Viewed in isolation, each of these projects may pose only a limited threat to the avifauna of the area. However, in combination they may result in the formation of significant barriers to energy-efficient travel between resource areas for regionally important bird populations, and/or significant levels of mortality in these populations in collisions with what may become a substantial array of many hundreds of turbines.

» Additional mitigation might include re-scheduling construction or maintenance activities on site, shutting down problem turbines either permanently or at certain times of year or in certain conditions, or installing a 'DeTect' or similar radar tracking system to monitor bird movements and institute temporary shut-downs as and when required.

» Committing this project for inclusion in a Birds & Wind Energy Specialist Group (BAWESG)/FitzPatrick Institute research programme, including exploration of the use of remote controlled gliders to map slope soaring potential of ridges targeted for wind energy development, and the long-term behavioural and demographic impacts of wind energy developments on Verreaux's Eagle populations.

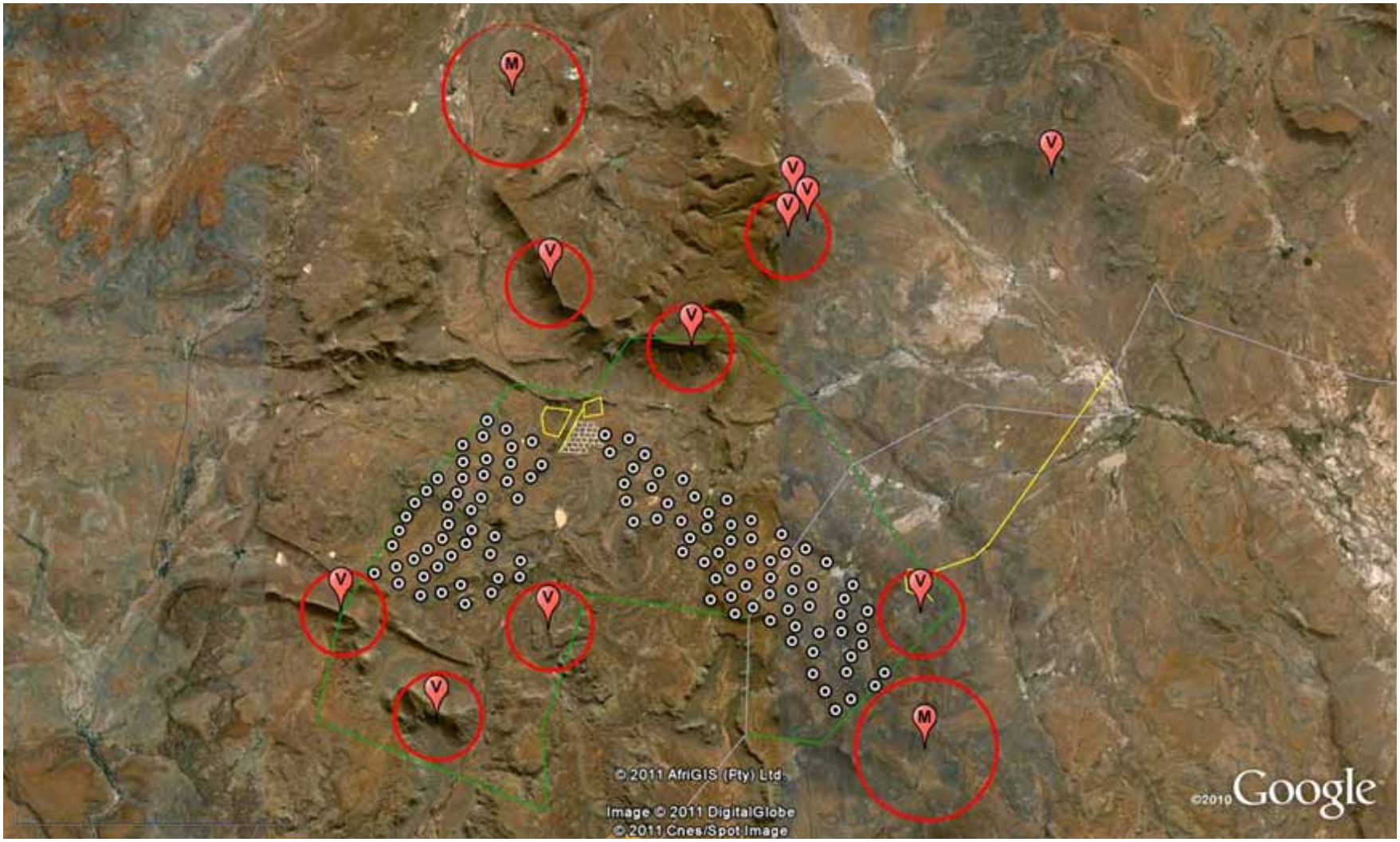

Figure 6.3: Development exclusion areas (red circles) around large eagle nest sites found or known in the vicinity of the proposed facility. "V" = Verreaux's Eagle, "M" = Martial Eagle.

6.3.3 Assessment of Potential Impacts on Geology, Soils, and Erosion Potential

The environmental impact assessment aimed to evaluate the impact that the proposed activity will have on the geological environment and attempted to provide mitigating measures to minimise the impact.

The most significant activity in terms of impacts on soil is the bulk earthworks for platforms for structures including turbines, solar array, substations and the construction of internal access roads. Relatively minor earthworks are envisaged for the proposed new power lines from the proposed new substations to the existing Eskom infrastructure.

The most important geological issues are the direct negative impacts of soil and rock degradation in the proposed areas of activity. This would affect ecosystems operating in the soil and the hydrological regime. Indirect negative impacts could include increased siltation in watercourses downstream caused by an increase in erosion from the site or increased dust pollution away from the site.

Impact table summarising the significance of impacts on Geology, Soils, and Erosion Potential (with and without mitigation)

Nature: Soil degradation– Excavation and removal of soil for roads and structures. Impacts may occur directly through bulk earthworks for platforms for structures including turbines, the solar array, substations and the construction of internal access roads. Relatively minor earthworks are envisaged for the proposed new power lines of the facility.		
	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Long term (4)	Medium term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**Moderate (55)**	**Moderate (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources	Yes	
Can impacts be mitigated	Yes, to a certain extent.	
Mitigation measures: » Use existing roads where possible. » Design platforms and roads according to contours to minimise cut and fill operations. » Control activity outside of construction disturbance areas.		

» Rehabilitate soil in disturbance areas after construction.
Cumulative impacts:
» Although the impact of soil removal for the proposed activity has a moderate significance, the cumulative impact of soil removal in the area is considered low due to undeveloped nature of the area.
Residual impacts:
» Minor negative – slow regeneration of topsoil.

Nature: Soil degradation – Loosening, mixing, wetting & compacting of in situ soil during earthworks.

This may occur directly through the loosening, mixing, wetting, as well as compaction of in situ soil during construction activities/earthworks.

	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**Moderate (50)**	**Moderate (35)**
Status	Negative	Negative
Reversibility	Irreversible	Reversible
Irreplaceable loss of resources	Yes	Minor
Can impacts be mitigated	Yes, to a certain extent	

Mitigation:

» Use existing roads where possible.
» Design platforms and roads according to contours to minimise cut and fill operations.
» Control activity outside of construction disturbance areas.
» Rehabilitate soil in disturbance areas after construction.

Cumulative impacts:

» The cumulative impact of soil pollution is considered low due to the undeveloped nature of the study area.

Residual impacts:

» Minor negative – slow regeneration of vegetation & soil.

Nature: Soil degradation – Pollution of soil by waste products (human and synthetic) and contaminants used in construction (e.g. fuel, oil, chemicals, cement).

Soil pollution through the use of contaminants during the construction phase (e.g. fuel, oil, cement).

	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Medium term (2)	Very short term (1)
Magnitude	Low (4)	Minor (2)

Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (12)**
Status	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources	Yes	Minor
Can impacts be mitigated	Yes, to a certain extent	
Mitigation: » Control use and disposal of potential contaminants or hazardous materials. » Control human ablution facilities » Remove contaminants and contaminated topsoil and replace topsoil in affected areas.		
Cumulative impacts: » The cumulative impact of soil pollution is considered low due to the undeveloped nature of the study area.		
Residual impacts: » Minor negative – slow regeneration of soil processes in and under topsoil		

Nature: Soil degradation – Soil erosion by wind and water.
The majority of the site is underlain by rocks of the Teekloof Formation at a relatively shallow depth and the soil cover in this area is likely to be less than 1m thick. In the south-eastern portion of the site, thick Quaternary alluvium consisting mainly of gravelly silty sands, has been mapped and this soil cover is likely to be thicker than 1m. This area, and other similar areas, will be sensitive to severe water erosion. The presence of shallow rock in most other areas, and in particular in areas of high relief, will restrict severe erosion. Unconsolidated or partly consolidated fine-grained soils of low plasticity along drainage lines and on moderate to steep slopes or at the base of steep slopes are most vulnerable to severe levels of water erosion.

	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Very short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Moderate (30)**	**Low (18)**
Status	Negative	Negative
Reversibility	Irreversible	Practically irreversible
Irreplaceable loss of resources	Yes, moderate to low	Minor
Can impacts be mitigated	Yes	
Mitigation: » Restrict size of construction disturbance areas. » Control activity outside of disturbance areas. » Implement effective erosion control measures. » Carry out earthworks in phases across site to minimise exposed ground at any one time.		

» Keep to existing roads, where practical, to minimise loosening of undisturbed ground. » Protect and maintain bare slopes, excavations and material stockpiles to minimise erosion and instability
Cumulative impacts: » The cumulative impact of soil erosion in the area is considered low due to the undeveloped nature of the area.
Residual impacts: » Minor – Localised movement of sediment. Slow regeneration of soil processes

Nature: Siltation of waterways and dams downstream from site

An increase in siltation of watercourses downstream from the study site may arise due to an increase in soil erosion from the site. The majority of the site is underlain by rocks of the Teekloof Formation at a relatively shallow depth and the soil cover in this area is likely to be less than 1m thick. In the south-eastern portion of the site, thick Quaternary alluvium consisting mainly of gravelly silty sands, has been mapped and this soil cover is likely to be thicker than 1m. This area, and other similar areas, will be sensitive to severe water erosion.

	Without mitigation	***With mitigation***
Extent	Regional (3)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Minor (2)
Probability	Highly probable (4)	Probable (3)
Significance	**Moderate (44)**	**Low (21)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources	Yes, low	Yes, minor
Can impacts be mitigated	Yes	

Mitigation:

» Install anti-erosion measures such as silt fences, geosynthetic erosion protection and/or flow attenuation along watercourses below construction sites.
» No development in or near water courses/natural drainage lines as sediment transport is higher in these areas.

Cumulative impacts:

» The cumulative impact of siltation in the area is considered low.

Residual impacts:

» Minor localised movement of soil across site

Nature: Dust pollution from construction site affecting surrounding areas.

The areas surrounding the study site may be potentially affected by the dust generated from construction activities taking place for the proposed facility.

	Without mitigation	***With mitigation***
Extent	Regional (2)	Local (1)
Duration	Very short term (1)	Very short term (1)

Magnitude	Low (4)	Minor (2)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Moderate (28)**	**Low (16)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources	Yes, low	Yes, minor
Can impacts be mitigated	Yes	
Mitigation: » Install dust covers on stockpiles » Use suitable gravel wearing course on access roads » Apply straw bales or dampen dusty denuded areas.		
Cumulative impacts: » The cumulative impact of dust in the area is considered low.		
Residual impacts: » Minor localised movement of soil across site		

Comparative Assessment of Power line Alternatives

The alternative options with the longer transmission line lengths have obvious greater potential impact on the geological environment. Therefore Substation 1 Option 1, and Substation 2 Option 1 are the preferred alternative options for connecting the proposed facility to the power grid.

Implications for Project Implementation

» Potential impacts identified in the study have a low to moderate impact on the geological environment.
» With effective implementation of mitigating measures these impacts can be largely mitigated to an acceptable level.
» The cumulative impact on the geological environment is considered low due to the localised and scattered nature of the proposed activity and the scarcity of development in the vicinity of the site.
» Negative impacts can be mitigated to a large degree by the implementation of an appropriate and effective EMP. Generic specification guidelines relating specifically to the earthworks contract have been included in the specialist geology report.
» A basic preliminary assessment of the geotechnical nature of the study area will afford the opportunity to identify any potential fatal flaws with the proposed site.

6.3.4 Assessment of Potential Impacts on Heritage Sites and Palaeontology

The proposed Karoo Renewable Energy Facility site is of medium archaeological sensitivity. Occurrences of Middle Stone Age and Later Stone Age stone artefacts were observed within the open exposed areas, flood plains and at the base of rocky outcrops and ridges. Ceramic sherds of Khoekhoen pottery possibly belonging to one pot was documented on the farm Nobelsfontein 227. A few broken ostrich eggshell fragments were found in association with scatters of mainly Later Stone Age stone artefacts and within the rock shelters that contained rock paintings. Rock paintings and rock engravings were documented on two of farms within the area proposed for development.

Stone-wall structures resembling mainly large rectangular kraals and smaller circular pens, foundations of historical dwellings and animal traps occurred within the area proposed for development. Ruins of one farm house, possibly constructed out of sun-dried bricks and later modified with modern building materials, was documented on the farm Phaisantkraal 1.

Human remains were found exposed along the side of a 3m-4m high river donga and one burial could be observed in the side of the donga approximately 1m below the surface with a few human remains exposed at the surface on the farm Nobelsfontein 227.

The study area is capped by late Cenozoic sheet wash and channel related deposits, which have not as yet yielded fossil remains. However, Quaternary palaeontological sites are occasionally found in Pleistocene alluvial terraces and dongas along rivers and streams dissecting the western Karoo basin. Rock engravings on the farm Klipkraal, near Nelspoort to the southeast, suggest the possibility that a giant long-horned buffalo, which became extinct more than 10 000 years ago, previously occurred in the area. Earliest human occupation of the Karoo is indicated by the occurrence of characteristic Early Stone Age prepared core stone tools commonly found in the vicinity of Victoria West.

Areas of the proposed development site which are located within igneous bedrock (dolerite) represent no Palaeontological impact. However the zones that transect low relief strata of the fossiliferous Teekloof Formation are likely to be impacted by substantial excavations into fresh bedrock.

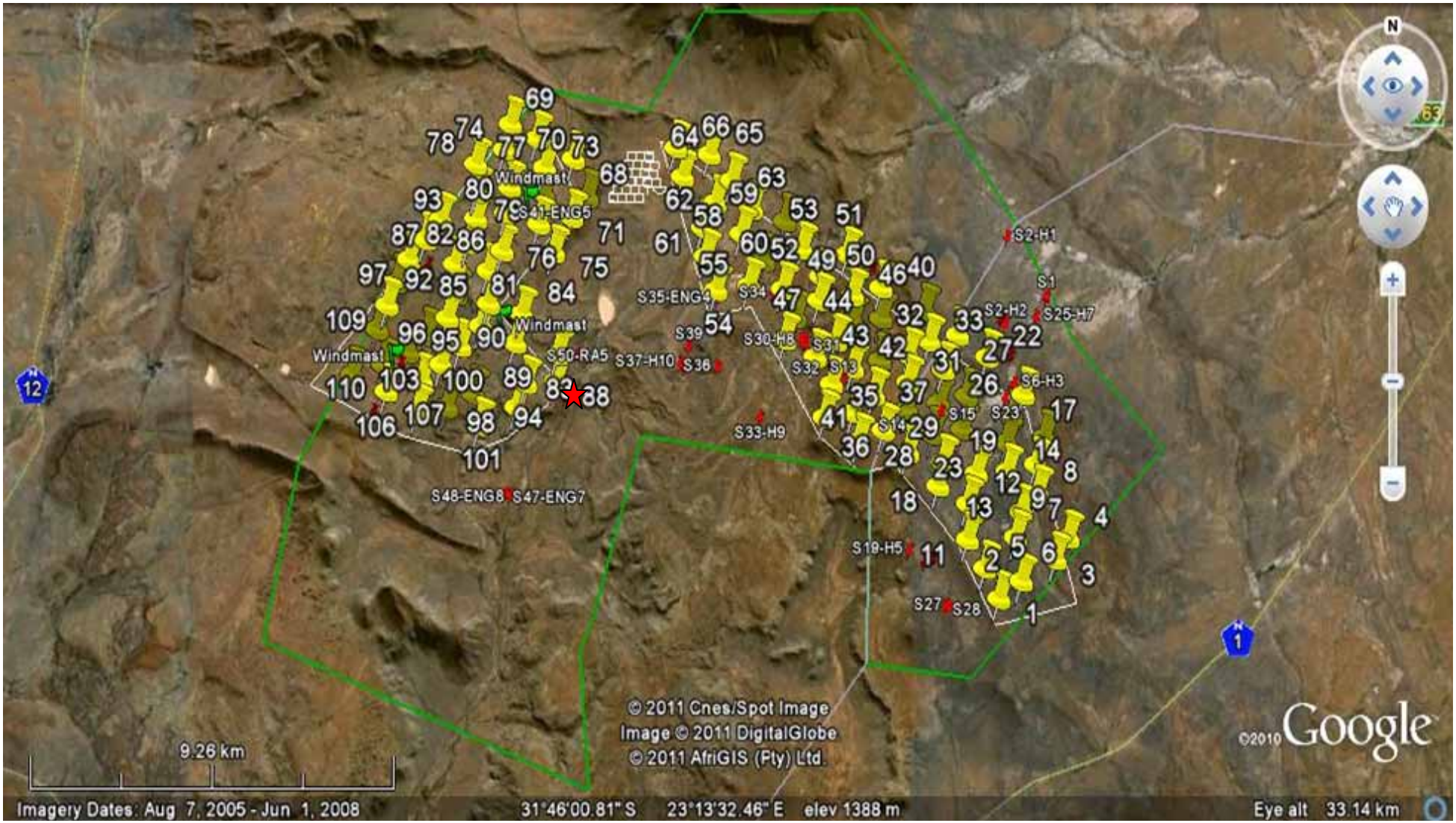

Figure 6.4: Aerial view of the proposed plots of the wind turbines and PV panels, and the sites documented during the survey (the star indicates the area of the exposed human remains).

Impact table summarising the significance of impacts on Heritage Sites and Palaeontology (with and without mitigation)

Nature: Impacts on archaeological material

The proposed Karoo Renewable Energy Facility development including the construction of the PV solar panels, wind turbines, powerlines and associated infrastructure could possibly impact on the archaeological heritage and material remains of the site.

	Without mitigation	***With mitigation***
Extent	International (3)	Local (3)
Duration	Long Term (5)	Short (2)
Magnitude	Very High (10)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (54)**	**Low (14)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Reversible
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated	Yes	

Mitigation measures:

» The exposed human remains must be reported to the South African Heritage Resources Agency (SAHRA) so that they may appoint the relevant archaeologist/s to remove the exposed human remains.
» No construction activities may take place within 100m of the documented rock shelters containing rock paintings and boulders containing rock engravings.
» The ridges and rocky outcrops surrounding the locations of the turbines and solar panels must be investigated prior to construction to establish whether undocumented rock shelters contain rock paintings and rocky outcrops contain boulders with rock engravings. If any are encountered the recommendations in point 2 will be implemented.
» No construction activities may take place within 100m of the documented stone-wall structures.
» If it is inevitable that construction activities must take place within 100m of any documented and undocumented rock shelters containing paintings, rocky outcrops with boulders containing rock engravings and stone-wall structures a perimeter fence must be erected to protect the sensitive area from any possible negative impact.
» It is possible that in situ archaeological sites/remains, and human remains may be uncovered during construction. Therefore, a professional archaeologist should be appointed during the vegetation removal and construction phases of the development. This includes the construction of new roads for heavy vehicles for the transport of the wind turbines, solar panels, and other infrastructure.

Cumulative impacts:

» Archaeological heritage remains (artefacts and sites) will be disturbed.

Residual impacts:

» Archaeological sites will be irreversibly disturbed.

Nature: Impacts to palaeontological material

Construction of wind energy turbines and a photovoltaic solar plant, as well as associated infrastructures is likely to impact on fossil-bearing bedrock which is mainly composed of lowermost strata of the Teekloof Formation. These sediments are regarded as of high overall palaeontological significance, especially with regard to potential impact on terrestrial tetrapods, plants, silicified wood and trace fossils. Quaternary alluvial deposits in the area, especially near water courses and drainage lines, are of medium overall palaeontological significance and have the potential to yield microfossil and fossil mammal remains as well as Early Stone Age artefacts. The palaeontological heritage indentified in the area may be affected by development that calls for fresh cuttings along new access roads, substantial bedrock excavations such as borrow pits, as well as foundation excavations for wind turbines, photovoltaic panels, pylons and associated building structures.

	Without mitigation	***With mitigation***
Extent	Local High (5)	Local Low (1)
Duration	Permanent (5)	Short-duration (1)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**48 (Medium)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Yes
Can impacts be mitigated	Yes	

Mitigation measures:

» Pre-excavation survey of localities demarcated for the construction of the substations, photovoltaic plant, wind turbine and pylon positions in order to identify potential fossil material already visible at ground surface and which might be damaged during early stages of the development

» Make specific recommendations for second phase mitigation once excavation has taken place.

Cumulative impacts:

» Palaeontological material will be disturbed.

Residual impacts:

» Palaeontological material will be irreversibly disturbed.

Comparative Assessment of Power line Alternatives

Substation 1 Option 1, and Substation 2 Option 1 are the preferred alternative options for connecting the proposed facility to the power grid from both a heritage and palaeontological perspective.

Implications for Project Implementation

» No construction activities may take place within 100m of the documented rock shelters containing rock paintings and boulders containing rock engravings which are located on the farm Phaisantkraal 1.
» The ridges and rocky outcrops surrounding the locations of the turbines and solar panels must be investigated prior to construction to establish whether undocumented rock shelters contain rock paintings and rocky outcrops contain boulders with rock engravings.
» No construction activities may take place within 100m of the documented stone-wall structures located on the farm Phaisantkraal 1.
» If it is inevitable that construction activities must take place within 100m of any documented and undocumented rock shelters containing paintings, rocky outcrops with boulders containing rock engravings and stone-wall structures a perimeter fence must be erected to protect the sensitive area from any possible negative impact.
» It is possible that in situ archaeological sites/remains, and human remains may be uncovered during construction. Therefore, a professional archaeologist should be appointed during the vegetation removal and construction phases of the development in order to make rapid assessments of any material found. This includes the construction of new access roads.
» Construction activities that require localised trench or pit excavations, exposing fresh bedrock or old superficial deposits in the area, will require a Phase 1 Palaeontological Impact Assessment. Effective mitigation of palaeontological heritage for this project is only feasible once the positions of individual structures and access roads have been finalised. At this stage, pre-excavation surveying of selected sites and access roads is necessary where development will take place directly on potential fossil-bearing strata.

6.3.5 Assessment of Potential Visual Impacts

The region has a rural character, and the terrain surrounding the site is mostly flat, but frequently interrupted with clusters of prominent hills or “inselbergs”. The well-known tourist attraction known as the Three Sisters is in fact a cluster of such hills, and is located about 12km south of the site. The primary visual impact, namely that of the wind turbines is not possible to mitigate completely. The functional design of the structures cannot be changed in order to reduce visual impacts.

The visibility analysis (for the turbine) was undertaken from actual positions as set out in the provisional layout of the facility. Separate viewsheds were generated for the wind turbines (set at 125m above average ground level - the approximate hub heights of the proposed turbines) and the PV plant (set at 6m

above average ground level – the maximum height of the proposed PV panels) in order to simulate a worst case scenario:

» It is anticipated that the turbines will visible with a high frequency of visibility within the site itself, as well as immediately adjacent areas in all directions except the south west and the north, which are screened from visual impact. The latter area is screened by the pronounced escarpment. Similarly exposed areas likely to experience a high frequency of visual exposure include zones to the north west, north east, and to a lesser extent, to the south. Of relevance is the high level of visual exposure from steep slopes facing in the direction of the site.
» The turbines will be visible with a lower frequency of exposure from large, but discontinuous areas in most directions, but particularly to the west, south, north east and east of the site. These visually exposed areas are broken by the hilly topography.
» The turbines will also be visible (with a lower frequency) from discontinuous sections of the N1 and the N12. The R63 will be exposed to higher frequencies of visual exposure where it bypasses closest to the site.
» The facility will be visible from almost the entire section of secondary road linking the N1 and N12, running below the escarpment. The other secondary roads within the study area will be visually exposed in limited sections, and at a lower frequency of exposure.
» In addition, settlements and homesteads, especially those within a 10km radius (and including those within the site itself) will be visually exposed, with a low to moderate frequency of exposure.
» Within the visually exposed areas, it is envisaged that the nature of the structures, the largely natural state of the environment and the rural character of the study area would result in a significant visual contrast within the receiving environment. The site is, however, in close proximity to the Eskom Victoria Substation, as well as the new 765kV Gamma Substation which is to be constructed. Several power lines also traverse the area.
» The turbine structures would be easily and comfortably visible, especially within a 5km radius of the facility, and would constitute a high visual prominence, potentially resulting in a high visual impact.

The visibility map below (Figure 6.5) clearly illustrates that the turbines would be exposed to a large geographical area within this region. This is a result of the proposed facility's location on an elevated site within a relatively flat surrounding topography. The turbine structures would be easily and comfortably visible, especially within a 5km radius of the facility, and would constitute a high visual prominence, potentially resulting in a high visual impact.

This viewshed analysis not only indicates areas from which the wind turbines would be visible (any number of turbines with a minimum of one turbine), but also indicates the potential frequency of visibility (i.e. how many turbines are exposed). The dark orange areas indicate a high frequency (i.e. 95-113 turbines may be visible), while the light yellow areas represent a low frequency (i.e. 1-9 turbines may be visible).

From the viewshed analysis for the proposed PV Plant (Figure 6.6) it is clear that the PV plant would be visually exposed to small, contained areas, predominantly within the site itself, as well as from the south facing slopes of the escarpment to the immediate north west. An isolated zone to the south includes a number of visually exposed areas situated on the steep slopes facing in the direction of the site. This is some distance from the site, however (i.e. 6km).

The turbines represent the most visually prominent aspect of the proposed facility, and when their potential viewshed area is compared with that of the PV plant, it is clear that the PV plant will fall within, and be covered by the viewshed of the turbines.

Viewer incidence (Figure 6.7) is calculated to be the highest along the national and arterial roads (i.e. the N12, N1 and R63) as well as the secondary roads within the study area (i.e. especially the gravel road running to the north of the facility, linking the N1 and N12 highways). Commuters and tourists using these roads could be negatively impacted upon by visual exposure to the Facility.

Other than along the above roads, viewer incidence within a 10 km radius of the proposed Facility is concentrated in a number of settlements and homesteads.

The remaining areas consist predominantly of vacant natural land (grazing) and rural settlements and homesteads with a low occurrence of observers.

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed wind energy facility are displayed on are displayed in Figure 6.8. Here the weighted impact and the likely areas of impact have been indicated as a visual impact index. Values have been assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

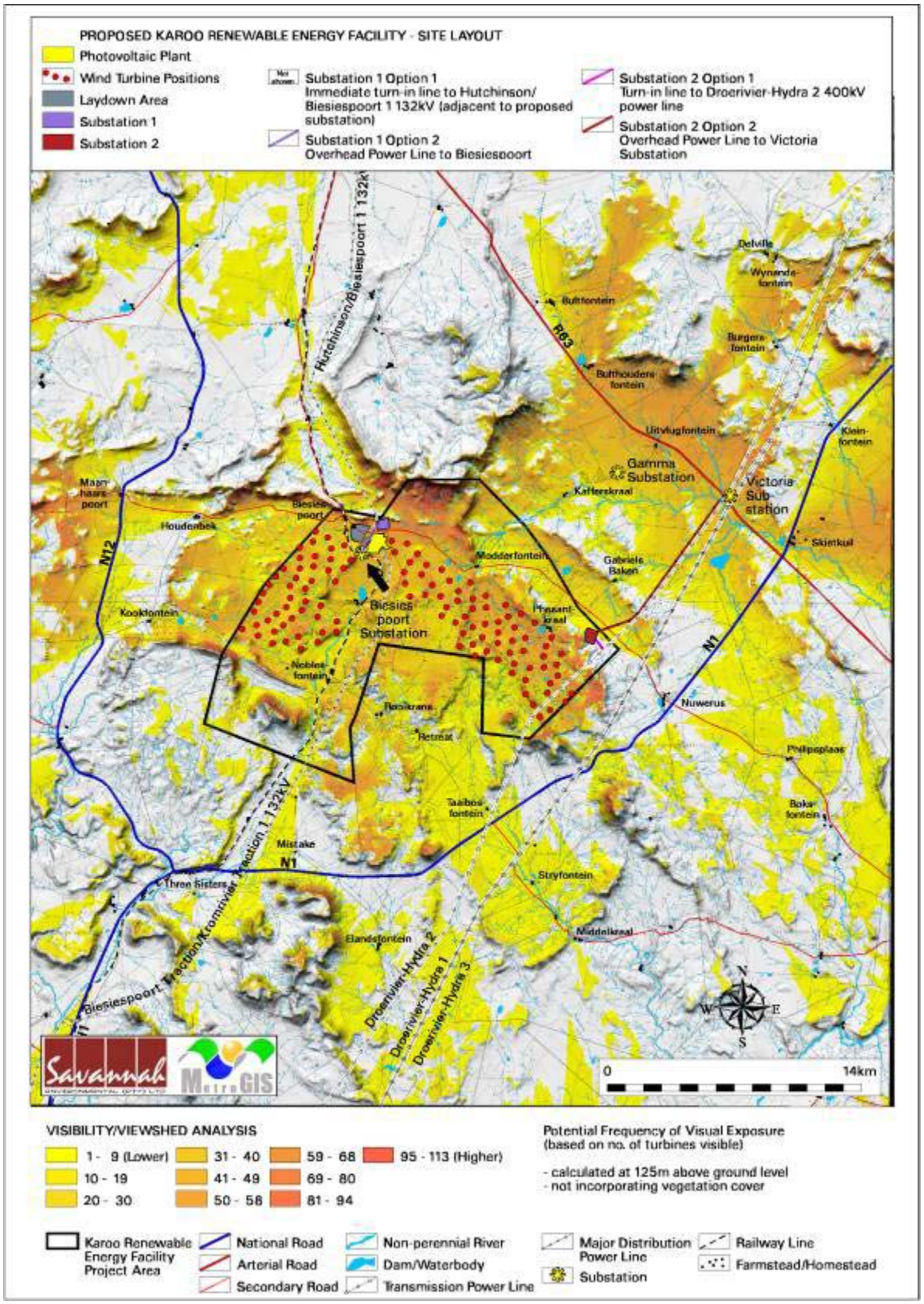

Figure 6.5: Potential visual exposure of the proposed turbines

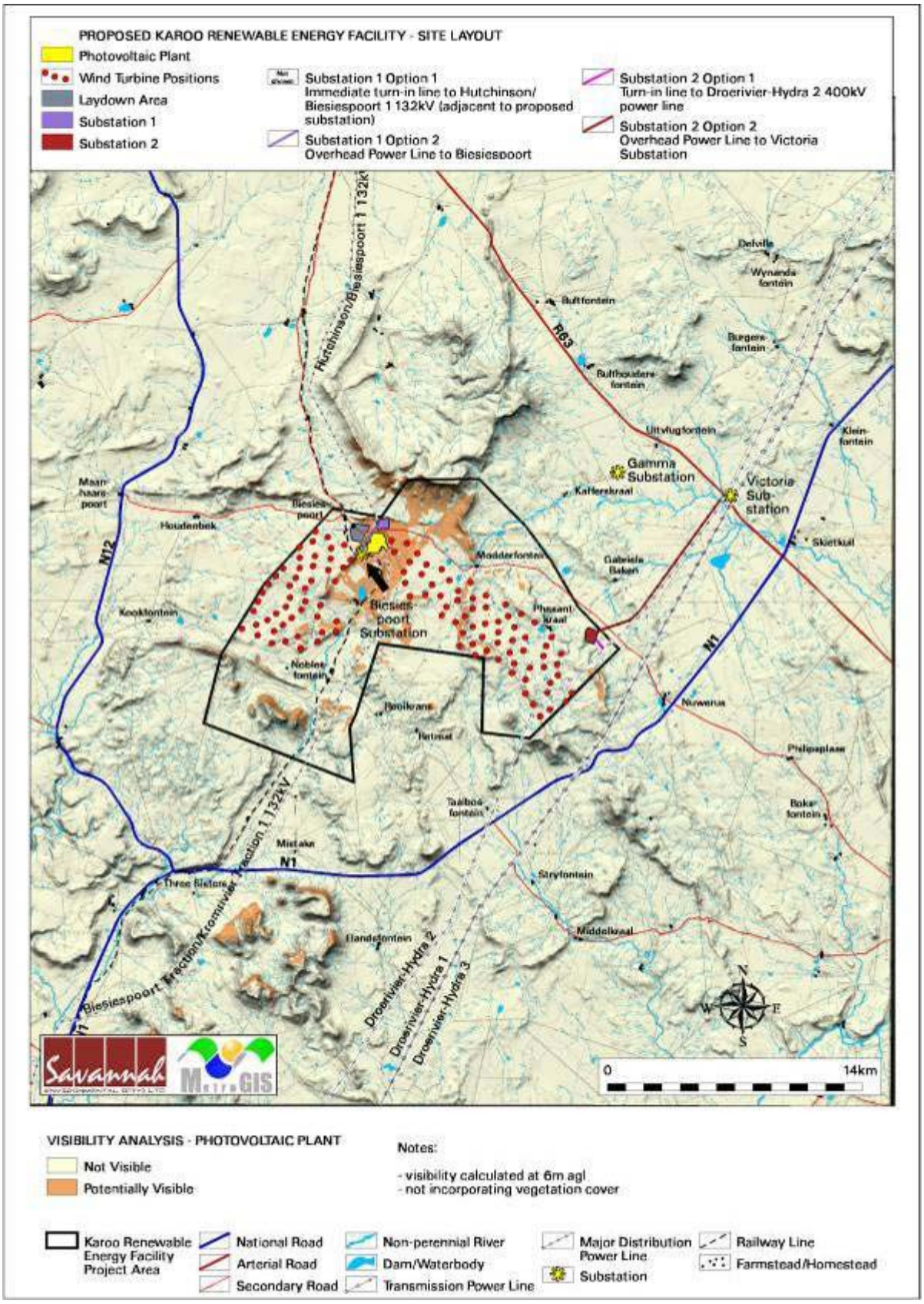

Figure 6.6: Potential visual exposure of the proposed PV plant

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact. The visual impact index map clearly indicates the core area of potentially high visual impact within a 5km radius of the proposed Facility.

Potential areas of very high visual impact within the 5km radius include almost the entire length of the gravel road joining the N1 and N12 (running below the escarpment and north of the facility as well as the “tall hills and mountains” on and adjacent to the site.

In addition, the following settlements and homesteads are likely to experience very high visual impact:

- Biesiespoort;
- Modderfontein;
- Phesantkraal;
- Gabriels Baken and
- Noblesfontein.

Limited stretches of the N1, N12 and other secondary roads between 5km and 10km from the Facility are likely to experience a high visual impact due to the higher frequency of observers travelling along these roads.

It is important to note that the above national roads function as important national and provincial tourist access routes, and as such carry tourists into and through the region.

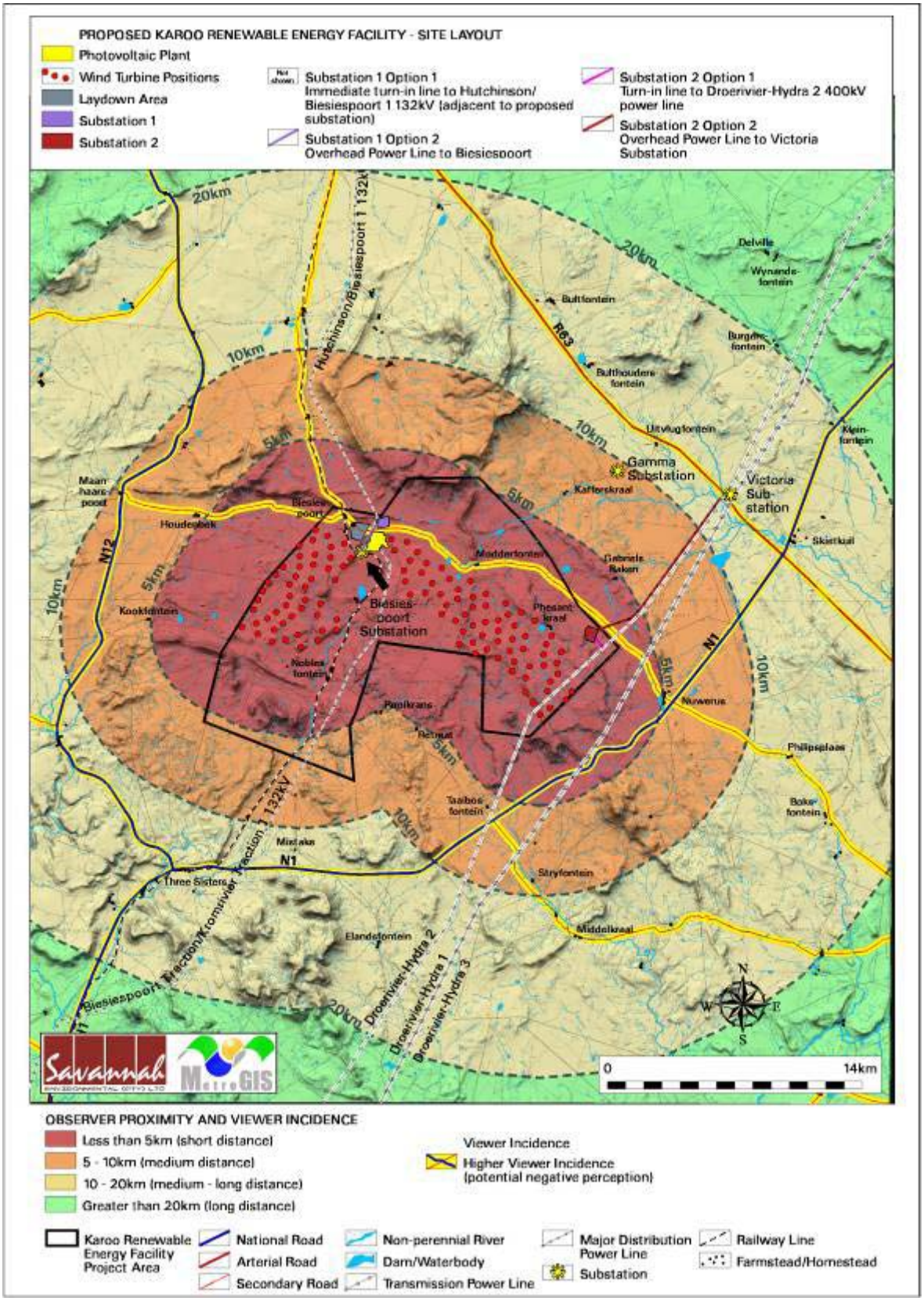

Figure 6.7: Observer proximity to the proposed renewable Energy Facility and areas of high viewer incidence

Visually exposed hills and mountains, as well as settlements and homesteads between 5km and 10km of the proposed development, are also likely to experience high visual impact. The latter include the following:

- Kafferskraal;
- Strydfontein;
- Taaibosfontein;
- Retreat;
- Rooikrans;
- Kookfontein and
- Maanhaarspoort

Between 10km and 20km from the proposed facility, potential visual impacts are expected to be moderate within visually exposed settlements and homesteads, including the following:

- Bultfontein;
- Bulthoudersfontein;
- Uitvlugfontein;
- Skietkuil;
- Philipsplaas;
- Elandsfontein and
- Three Sisters.

Limited stretches of the N1 and the N12, as well as very short stretches of secondary roads will also experience moderate visual impact.

Remaining impacts, where they occur at all, are expected to range from low to very low. It is, however, important to note the rugged beauty of the area, especially the wide open vistas and expanses. This gives the area an essential tourism potential, although one that has not yet been realised or optimised.

The construction of the turbines (and to a lesser degree the PV plant) in close proximity to features of natural beauty is likely to result in a negative visual impact on the natural scenic beauty of the area, and in fact of the region, which remains largely undeveloped and natural.

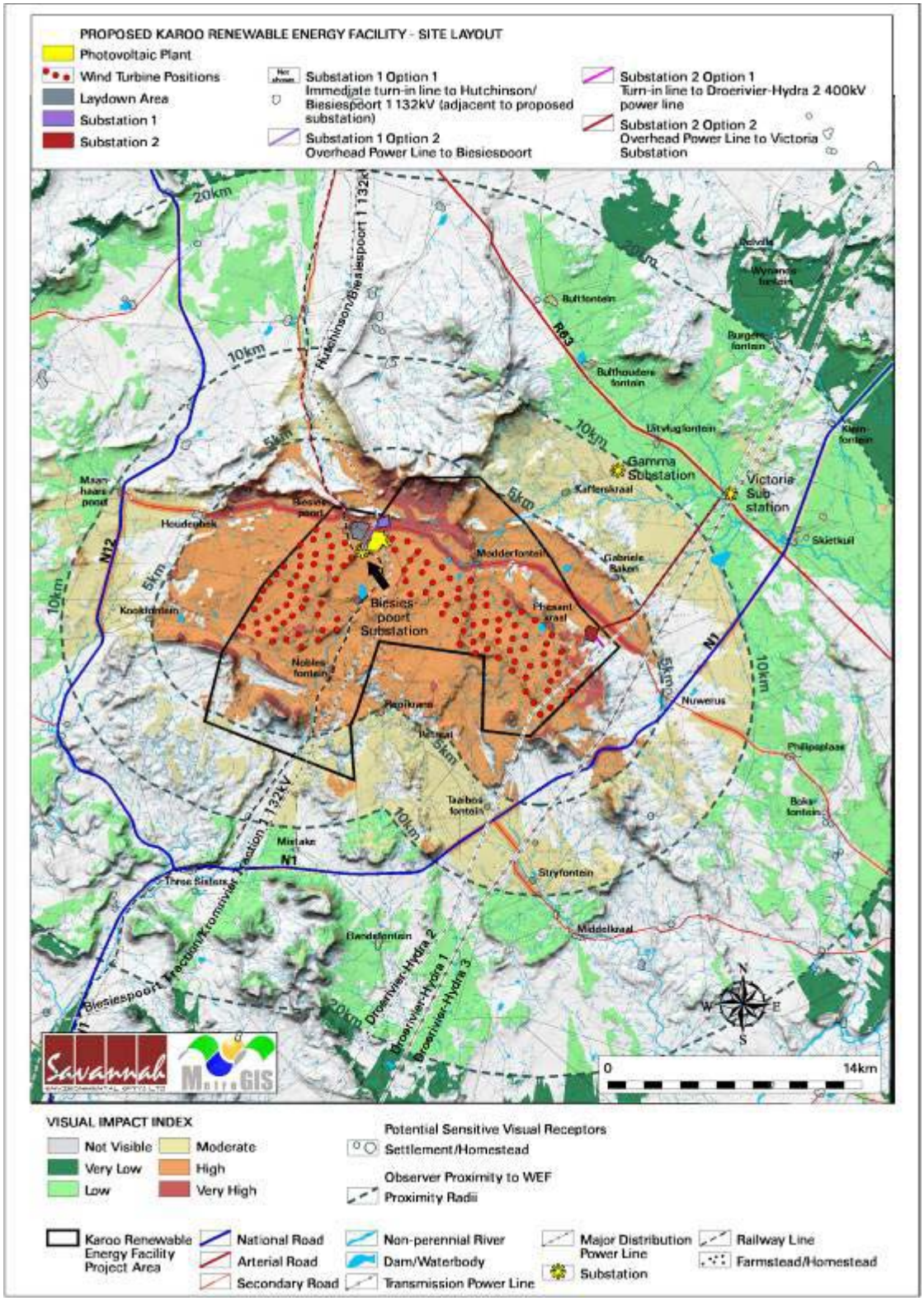

Figure 6.8: Visual impact index of the proposed Karoo Renewable Energy Facility

Impact tables summarising the significance of impacts on Visual Aesthetics (with and without mitigation)

Nature of Impact: Potential visual impact of construction on visual receptors in close proximity to the facility.

The duration of the construction phase of the facility is dependent on the number of turbines being constructed as well as the scale and extent of the proposed PV plant. During the construction period, there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and land owners in the area. In this environment, dust from construction work is also likely to represent a significant visual impact.

	Without mitigation	***With mitigation***
Extent	Local (4)	Local (4)
Duration	Very short term (1)	Very short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	High (4)	Improbable (2)
Significance	**Moderate (44)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during construction phase?	Yes	Yes

Mitigation:

- » Reduce the construction period through careful planning and productive implementation of resources.
- » Plan the placement of lay-down areas and temporary construction camps in order to minimise visual impact.
- » Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
- » Ensure that rubble, litter and disused construction materials are managed and removed regularly.
- » Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
- » Reduce and control construction dust through the use of approved dust suppression techniques.
- » Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

Cumulative impacts:

- » The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Nature of Impact: Potential visual impact on users of national, arterial and secondary roads in close proximity to the facility

Potential visual impact on users of major and secondary roads in close proximity to the proposed facility (i.e. within 5km) is expected to be high both before and after mitigation.

	Without mitigation	***With mitigation***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10)
Probability	High (4)	High (4)
Significance	**High (72)**	**High (72)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated	No	No

Mitigation:

» Planning: Location of turbines in low lying areas and on moderate slopes.

» Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.

Cumulative impacts:

» The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Nature of Impact: Potential visual impact on residents of settlements and homesteads in close proximity to the facility

The visual impact of the proposed facility on settlements and homesteads within 5km of the site is expected to be of high significance both before and after mitigation.

	Without mitigation	***With mitigation***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10)
Probability	High (4)	High (4)
Significance	**High (72)**	**High (72)**
Status (positive or negative)	Negative / Positive	Negative / Positive
Reversibility	Recoverable (3)	Recoverable (3)

Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: » Planning: Location of turbines in low lying areas and on moderate slopes. » Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: » The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: » None. The visual impact will be removed after decommissioning.		

Nature of Impact: Potential visual impact on sensitive visual receptors within the region. The visual impact on users of roads and on residents of settlements and homesteads within the region (i.e. beyond the 5km radius) is expected to be of moderate significance both before and after mitigation.		
	Without mitigation	***With mitigation***
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Probable (3)	Probable (3)
Significance	**Moderate (45)**	**Moderate (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: » Planning: Location of turbines in low lying areas and on moderate slopes. » Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: » The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.		

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Nature of Impact: Potential visual impact of the substations

The two substations could represent a potential visual impact - areas of vegetation will need to be removed for these structures, which are in essence industrial type structures in a natural environment. The Substations will all be located within the proposed WEF development footprint, and will be overshadowed by the much taller wind turbine structures. It is thus expected that the area of potential visual exposure will lie within that of the turbines.

	Without mitigation	***With mitigation***
Extent	Local (4)	N/a
Duration	Long term (4)	N/a
Magnitude	Low (4)	N/a
Probability	Improbable (2)	N/a
Significance	**Low (24)**	**N/a**
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a

Mitigation:

» Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.

Cumulative impacts:

» The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Nature of Impact: Potential visual impact of the internal access roads

Within the facility's footprint, access roads will be required, firstly to construct each turbine and the PV plant (construction phase), and secondly to maintain the turbines and PV plant (operational phase). This network of roads has the potential of manifesting as a network of landscape scarring, and thus a potential visual impact within the viewshed areas. This is especially relevant for steep slopes where cut and fill required to build access roads represents a significant visual intrusion within the landscape.

	Without mitigation	***With mitigation***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Improbable (2)

Significance	**Moderate (42)**	**Low (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: » Planning: layout and construction of roads and infrastructure with due cognisance of the topography. » Construction: rehabilitation. » Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: » The construction of access roads will increase the cumulative visual impact of disturbance due to vegetation clearing and disturbance within the region.		
Residual impacts: » None. The visual impact will be removed after decommissioning.		

Nature of Impact: Potential visual impact of lighting at night on observers in close proximity to the facility.

The area earmarked for the placement of the substations will be within the development footprint. Although the surrounding area has a relatively low incidence of populated places, light trespass and glare from the security and after-hours operational lighting (flood lights) for the substations will have some significance for residents in the area.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light facilitylects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. The facility may contribute to the effect of sky glow in an otherwise dark environment

	Without mitigation	***With mitigation***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	High (4)	Improbable (2)
Significance	**Moderate (56)**	**Low (28)**
Status (positive or	Negative	Negative

negative)		
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: » Planning: pro-active design and planning » Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: » The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: » None. The visual impact will be removed after decommissioning.		

Nature of Impact: Potential visual impact of shadow flicker on visual receptors in close proximity to the facility

Shadow flicker only occurs when the sky is clear, and when the rotor blades are between the sun and the receptor (i.e. when the sun is low). De Gryse in Scenic Landscape Architecture (2006) found that "most shadow impact is associated with 3-4 times the height of the object". Based on this research, a 500m buffer along the edge of the facility is submitted as the zone within which there is a risk of shadow flicker occurring. The preliminary layout for the turbines indicates that the settlements of Phesantkraal and Biesiespoort fall within this zone, and could thus experience shadow flicker during limited periods.

	Without mitigation	***With mitigation***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	None (0)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (20)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No

Mitigation:

» Planning: Relocation of turbines to beyond 500m from any settlement, homestead or public road.

» Decommissioning: removal of the wind turbines, PV plant and ancillary infrastructure after 20 to 30 years.

Cumulative impacts:

» The construction of 150 wind turbines, the PV plant, the substations and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Nature of Impact: Potential visual impact of the proposed facility on visual character and sense of place within the region

Sense of place Refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc) play a significant role.

A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light. Specific aspects contributing to the sense of place of this region include the rugged natural beauty of the area and the wide open vistas and expanses.

	Without mitigation	***With mitigation***
Extent	Regional (3)	N/a
Duration	Long term (4)	N/a
Magnitude	Moderate (6)	N/a
Probability	Probable (3)	N/a
Significance	**Moderate (39)**	**N/a**
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a

Mitigation:

» Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years.

Cumulative impacts:

» The construction of 150 wind turbines together with the substation/s and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Nature of Impact: Potential visual impact of the proposed facility on tourist routes and tourist potential within the region.

The aesthetic appeal of the local natural features (scenic mountains), the remote location of the area, its undeveloped nature and its unique sense of place afford the area a level of tourism potential. Although this tourism potential has not yet been realised or optimised, the N1 and N12 represent national tourist access routes which are fully optimised and utilised by tourists. Visual intrusion through the development of industrial type infrastructure within this environment could jeopardise the area's tourism value and potential.

	No mitigation	***Mitigation considered***
Extent	Regional (3)	N/a
Duration	Long term (4)	N/a
Magnitude	Low (4)	N/a
Probability	Improbable (2)	N/a
Significance	**Low (22)**	**N/a**
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable (3)	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a

Mitigation:

» Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years.

Cumulative impacts:

» The construction of 150 wind turbines together with the substation/s and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing power line infrastructure already present in the area, albeit limited in extent and scale.

Residual impacts:

» None. The visual impact will be removed after decommissioning.

Photo Simulations

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed Karoo Renewable Energy Facility, consisting of 113 turbines, within the receiving environment.

The purpose of the photo simulation exercise is to support the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions. The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility.

Figure 6.9: Post construction panoramic overview representative of medium distance visual experience that residents, commuters and tourists utilising the N12 between Victoria West and Beaufort West will have of the proposed facility

The above viewpoint is located along the N12 national road running north/south to the west of the proposed facility, adjacent to Maanhaarspoort. The

photo point is located on the northern side of the junction of the N12 and the gravel road linking it to the N1. This viewpoint is approximately 10km from the proposed facility. The viewing direction is south-easterly and approximately 35 wind turbines will be partially to fully visible in the middle distance.

Figure 6.10: Post construction panoramic overview from representative of a short distance visual experience that travellers, residents, farmers, commuters (using the train) and potential tourists utilising the area around the Biesiespoort Substation will have of the facility.

The above viewpoint is located on the gravel road that runs between the N12 and N1 national roads, approximately 1km north-west of the Biesiespoort Railway Station. The viewing direction is south-westerly and approximately 42 wind turbines will be partially to fully visible in the foreground, close to the viewer. Refer to the Visual Impact Assessment (Appendix K) for the remainder of the photo simulations.

Comparative Assessment of Power line Alternatives

From a visual perspective, the potential negative impact of the power lines may be mitigated by implementing Option 1 for both Substation 1 and 2. These options entail immediate turn-in lines with shorter and more direct links to the existing power grid as well as minimal additional infrastructure requirements.

Implications for Project Implementation

» There are not many options as to the mitigation of the visual impact of the facility. No amount of vegetation screening or landscaping would be able to hide structures of these dimensions situated on this site.
» In the medium to long distance, the visual impact of the wind turbines may be absorbed where these are viewed against the backdrop of mountainous topography. This is only relevant, however, where the turbines do not break the skyline created by the mountainous terrain beyond.
» Of particular concern are 3 turbines located in a particularly elevated position (i.e. on top of a landform more than 140m above the surrounding area) and 5 turbines located on slopes in excess of 18 degrees. The 8 turbines of concern should be repositioned to lower lying areas and more moderate slopes.
» Power line option 1 for both substation 1 and 2 should be favoured.
» Internal access roads should be planned with due cognisance of the topography. Roads should be laid out along the contour wherever possible, and should never traverse slopes at 90 degrees. Construction of roads should be undertaken with adequate drainage structures in place to forego potential erosion problems.
» A lighting engineer should be consulted to assist in the planning and placement of light fixtures for the turbines, the PV plant and the ancillary infrastructure in order to reduce visual impacts associated with glare and light trespass.
» Turbines located within 500m of any inhabited settlement, homestead or public road should be relocated to beyond this distance in order to negate the potential impact of shadow flicker.
» All activities associated with the construction phase, albeit temporary, should be managed so as to reduce / minimise visual impact during the phase.
» All construction areas, specifically trenches, road servitudes and cut and fill slopes should be appropriately rehabilitated after construction. This rehabilitation must also be monitored and maintained during operation.
» Within the greater region, the potential visual impact on sensitive visual receptors (i.e. users of roads and residents of settlements and homesteads) will be of moderate significance.

6.3.6 Assessment of Potential Noise Impacts

Increased noise levels are directly linked with the various activities associated with the construction of the renewable energy facility and related infrastructure, as well as the operational phase of the activity. Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources that are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc.
No noise will be emitted by the photovoltaic (PV) panels during operation of the facility.

Potentially Sensitive Noise Receptors were initially identified during the scoping phase and supported by a site visit during the EIA phase to confirm the status of the identified dwellings (Refer to Figure 6.11).

Figure 6.11: Aerial image indicating potentially sensitive receptors (marked as green dots) and boundaries of the proposed facility

In South Africa the document that addresses the issues concerning environmental noise is SANS 10103. SANS 10103 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. Ambient (background) noise levels were measured during the day and night time in accordance with the South African National Standard SANS 10103:2003. Unfortunately

SANS 10103 does not cater for instances when background ambient sound levels change due to the impact of external forces.

Unfortunately there was significant wind during the site visit which made ambient sound measurements difficult. During periods with low winds, ambient sound levels during the day ranged between 20.7 dBA ($L_{A,min}$) and 22.9 dBA (L_{A90}). Day ambient sound levels between 25 dBA and 35 dBA is expected in areas away from any activity with little or no air movement.

Night-time ambient sound levels ranged from less than 20 dBA ($L_{A,min}$) to more than 35 dBA (L_{A90}). Night ambient sound levels between 20 dBA and 30 dBA is expected in areas away from any activity with little insect or animal sounds and with little or no air movement.

Increased noise levels are directly linked with the various activities associated with the construction of the facility and related infrastructure, as well as the operational phase of the activity. Potential noise sources during the construction phase will originate from:

» Use of construction equipment that is likely to include excavator/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flat bed truck(s), pile drivers, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.
» Material supply where aggregate and cement will be transported from the closest centre to the development site, with the establishment of a small on-site concrete batching plant.
» Blasting may be required as part of the civil works to clear obstacles or to prepare foundations
» A significant source of noise during the construction phase is additional traffic on and off site. This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the wind turbine.
» Construction traffic is expected to be generated throughout the construction phase, however the volume and type of traffic will vary during the construction period.

Potential noise sources during the operational phase will originate from:

» **Wind turbine noise** can be associated with two types of noise source, namely aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources which are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment.
» **Transformer noise** which is the "hum" frequently associated with transformers/substations. However, this is a relative easy noise to mitigate with the use of acoustic shielding and/or placement of the transformer equipment.

» **Low frequency noise** from a wind turbine (i.e. typically below 200 Hz) can usually not be detected except very near the source. However, there are people more sensitive for these low frequency sounds. The annoyance is often connected with the periodic nature of the emitted sounds rather than the frequency of the acoustic energy.

The noise emissions into the environment from the various sources as defined by the project developer were calculated for the construction and operational phase in detail, using the sound propagation model described in SANS 10357 as well as ISO 9613-2. The developer highlighted that the Vestas V90 1.8/2.0 MW wind turbine could possibly be considered for use at the facility and therefore the modelling was based on the noise emission characteristics of the V90 1.8/2.0 MW turbine. However, the developer decided to make use of the bigger V90 3.0MW turbine after the noise modelling was already undertaken.

Considering the noise emission characteristics of the Vestas V90 1.8/2.0 MW versus that of the Vestas V90 3.0 MW, it should be noted that the larger Vestas V90 3.0 MW model could be as much as 1 dBA louder (considering uncertainties at 5 m/s wind speed) than the smaller machine, and as much as 2 dBA at higher wind speeds. The use of the bigger machine could therefore potentially increase noise levels between 1 and 2 dBA.

Considering a 1 – 2 dBA change in noise levels on the projected noise climate, the potential increase in noise levels is considered insignificant, and should not change the result of the existing Environmental Noise Impact Assessment. The original Environmental Noise Impact Assessment done for this project is still relevant, and the recommendations and management measures would still be applicable.

Refer to the noise impact assessment (Appendix L) for sound levels of and noise contours at various sensitive noise receptors which was determined for the V90 1.8/2.0 MW turbine. A letter from the relevant specialist stating the potential change in significance of noise impacts due to the use of the V90 3.0MW wind turbine is also included in Appendix L.

Impact table summarising the significance of impacts on Noise Levels

Numerous simultaneous construction activities that could impact on PSRs (without mitigation)

Extent	Regional – Change in ambient sound levels would extend further than 1,000 meters from activity (3)
Duration	Long term – Noisy activities in the vicinity of the receptor could last up to a month (4).
Magnitude	Low to very high (2 - 10)
Probability	Improbable (1) – Possible (2)
Significance	**Medium (34)**
Status	Negative
Reversibility	High
Irreplaceable loss of resources?	Not relevant
Can impacts be mitigated?	Yes.
Mitigation:	None
Cumulative impacts:	» This impact is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.
Residual Impacts:	» This impact will only disappear once construction activities cease.

The implementation of mitigation measures (Refer to section 8.1 in Appendix L) could result in a reduction of both the projected sound pressure levels and the probabilities that increased noises would impact on PSRs, reducing the significance of construction noises impacting on PSRs to a more acceptable low.

Nature: Numerous turbines operating simultaneously during a period when a quiet environment is desirable (without mitigation) There is a low risk that the projected ambient noise level could exceed the acceptable night time rating levels (when wind speeds are less than 6 m/s, else wind induced noise levels start to play a significant role). Changes in ambient sound levels are projected to be low excluding PSR01 (no dwelling, but added as the area might be used in future). The operation of the wind turbines will slightly add to the acoustical energy in the low frequencies. However there is already significant acoustical energy in the low frequencies due to the wind induced noise. The risk of low-frequency noise impacting on PSRs is considered low.	
Extent	Local – Impact will extend less than 1,000 meters from activity. (2)
Duration	Permanent – Facility will operate for a number of years (5)
Magnitude	Low (2)
Probability	Possible - (2)
Significance	**Low (18)**
Status	Negative
Reversibility	High
Irreplaceable loss of resources?	Not relevant
Can impacts be mitigated?	Yes, however it is not deemed necessary due to the low projected impact. A list of mitigation options is still presented

	that could further reduce the potential impact on the potentially sensitive receptors.
Mitigation:	None
Cumulative impacts:	» This impact is cumulative with existing ambient background noises.
Residual Impacts:	» This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.

It should be noted that while the Noise Impact Assessment determined the significance of the noise impact to be low, it does not mean that the facility would be inaudible, neither is it a guarantee that there will be no noise complaints due to the operation of the facility. The probability of a noise impact happening is sufficiently low, and if it happens, that the potential magnitude of the noise impact is low enough to consider the significance of the noise impact to be low. Refer to section to 8.2 in Appendix L for mitigation measures that could further reduce the risk of noise impacts during the operational phase.

Comparative Assessment of Power line Alternatives

No preference was made regarding the selection of the preferred power line routes for Substation 1 and 2. In terms of noise impacts both routes for Substation 1 and 2 will be similar.

Implications for Project Implementation

» The proposed project will have an impact of medium significance on PSR06 and PSR07 during construction and of low significance on PSR07 during the operational phase.
» While the potential noise impact was determined to be insignificant, the implementation of the proposed mitigation measures could further reduce the potential noise impact as well as potential noise risks to the absolute minimum.
» Should the layout (or type of wind turbines used) change significantly, it is recommended that the new layout be remodelled/reviewed in terms of the potential noise impact by an independent acoustics specialist.
» Quarterly monitoring noise monitoring at the potential sensitive receptors is recommended to be conducted by an acoustic consultant or approved noise inspection authority for the first year of operation. This monitoring is to take place over a period of 24 hours in 10 minute bins, with the resulting data co-ordinated with wind speeds as measured at a 10 meter height. These samples should be collected when the Wind Turbines are operational.
» Quarterly monitoring is recommended at PSR06 and PSR07 for the first year, as well as any other receptors that have complained to the developer regarding noise originating from the facility. Because PSR01 might be developed in the future, similar

sampling is recommended for that site. Annual feedback regarding noise monitoring should be presented to all stakeholders and other Interested and Affected parties in the area. Noise monitoring must be continued as long as noise complaints are registered.

» This report should also be made available to all potential sensitive receptors in the area, or the contents explained to them to ensure that they understand all the potential risks that the development of a wind energy facility may have on them and their families.

6.3.7 Assessment of Potential Social Impacts

Impacts on the social environment due to the renewable energy facility are expected to occur during both the construction and operation phases.

The potential negative impacts associated with the construction phase are typical of general construction related projects and are anticipated to respond to mitigation. These relate to the inflow of workers to the area, inflow of jobseekers, intrusion impacts (e.g. noise pollution, increased vehicle movement and so forth), as well as safety and security issues.

The main potential social benefits associated with the construction and operation of the proposed Karoo Renewable Energy Facility refers to the job opportunities, the creation of "green energy" and possible socio-economic spin-offs created through the process.

Even though the construction phase would create some job opportunities and the operational phase a very limited number of job opportunities, this aspect still receives a positive rating given the high unemployment levels and large young population profile found in the area. Employment of locals is thus imperative. Failure to do so would result in a negative attitude towards the proposed development and in worst cases could turn into social mobilisation against the project and the applicant.

Some potential negative impacts which may also occur during the operational phase include:

» Enjoyment of the landscape and "sense of place" would be negatively affected for those residents, landowners, tourists and/or bystanders who are either opposed to such facilities and/or those that strongly perceive wind and solar facilities as visually intrusive;
» Impact on tourism and the creation of potential tourist opportunities (this can also be regarded as a potential positive impact);
» The visual impacts;

» Some landowners might feel that their future, the future of sheep farming and the "sense of place" have been compromised by the proposed project. As the farming activities on the neighbouring farms are not anticipated to be negatively affected by the operations of the Karoo Renewable Energy Facility, and due to the limited number of landowners that expressed any concerns in this regard, this issue received a moderate rating.

The following series of tables provides a summary of the potential social impacts associated with the construction and operation of the proposed wind energy facility.

Impact table summarising the significance of Social Impacts during the Construction Phase (with and without mitigation)

Nature: Employment Creation The proposed wind energy facility project could provide limited construction jobs for the local population. A large part of the construction activities associated with the PV facility would however entail manual labour such as the erection of the fence, creation of fire breaks, cable laying, mount installation and the construction of the workshop area and so forth. More specialised skills, however would be required for the installation of the modules and electronics. The jobs associated with the Karoo Renewable Energy Facility would thus fall within the unskilled, semi-skilled, skilled and highly skilled positions.				
Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Regional (4)	Regional (4)	Regional (4)	Regional (4)
Duration	Short duration (2)	Short duration (2)	Very short duration (1)	Very short duration (1)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Highly probable (4)	Highly probable (4)	Definite (5)
Significance	**Medium (36)**	**Medium (48)**	**Medium (44)**	**Medium (55)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Positive impacts can be enhanced		Positive impacts can be enhanced	
Mitigation: » Although the majority of construction related work are usually undertaken by males, local females should also be considered for employment before outsourcing these positions to males from outside the study area				

- A broad-based approach should be followed to identify and involve relevant organisations which could assist the main contractor and project proponent in identifying people whose skills may correspond with the job specifications
- Semi-skilled and even unskilled labourers could be trained to assist with the construction of the solar panels and mounts
- The wind energy facility could possibly provide more jobs for locals should special training be given to some for the more skilled or specialist tasks
- Employment of local community members should be undertaken where possible. PReference should be given to community members from Victoria West, Hutchinson and Beaufort West
- The applicant should ensure an equitable process whereby locals and previously disadvantaged individuals (including women) are taken into account.
- The project proponent and contractors should create conditions that are conducive for the involvement of entrepreneurs, small businesses and SMME's during the construction process.
- Tender documentation should contain guidelines for the involvement of labour, entrepreneurs, businesses and SMME's from the local sector.
- A local Labour desk should be set-up (if not already established) in the beneficiary communities by the main contractor or project proponent to co-ordinate the process of involving local labour.
- Communication efforts with regards to job creation opportunities should facilityrain from creating unrealistic expectations

Cumulative impacts:

- The proposed project could further result in capacity building through on-site training and skills development opportunities
- Improvement in quality of life even if only for a short duration
- Possible economic downfall of individuals after the period of employment has lapsed as they have become used to a certain income level

Residual impacts:

- Capacity building and skills development of those involved in the construction phase of the project

Nature: Inflow Of Workers

Whilst the expected inflow of workers from outside the study area cannot be quantified at this stage, although it is not anticipated to be many individuals, experience has shown that an increase of people movement in an area usually creates the perception that criminal activities increase. This would probably be the perception among property owners in the study area irrespective of whether local people or outsiders are employed. Concerns relate to small livestock theft and damage to or theft of fences. Should locals be employed, it could, however, minimise the perceived and actual risk in this regard.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Site of development and surrounding area (2)	Site of development and surrounding area (2)	Site of development and surrounding area (2)	Site of development and surrounding area (2)
Duration	Short duration (2)	Short duration (2)	Very short duration	Very short duration

			(1)	(1)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	**Medium (40)**	**Medium (30)**	**Medium (36)**	**Low (27)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes No in terms of the spread of HIV/Aids		Yes No in terms of the spread of HIV/Aids	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	

Mitigation:

- Construction workers falling within the semi-skilled to unskilled category should be sourced from the local population where possible
- Construction workers should be supervised at all times
- No construction workers should remain on-site overnight
- Construction activities should be kept to normal working hours
- Workers should receive induction training on site to undertake the various repetitive tasks, especially those associated with the construction of the PV facility
- Property owners surrounding the construction areas should be informed of the construction schedules and activities
- Security on-site should be active prior to the construction period
- The construction site should be properly managed to avoid any littering and possible environmental pollution. Water and sanitation facilities should be up to standard
- Information distributed as part of the existing HIV/Aids awareness campaigns should again be focused on and communicated to the local workforce
- Unrealistic employment expectations should not be created
- The development of informal vending “stations” where food and small goods are sold should, if allowed, be properly managed, to avoid littering and possible environmental pollution. Workers should pReferably receive daily meals on site or should be responsible for their own food and drink requirements

Cumulative impacts:

- Increased safety and security risks for animals and people with possible increase in crime
- Health related impacts
- Short-term additional pressure on the provision of temporary services

Residual impacts:

- Long term consequences with regards to the provision of services and implementation of infrastructure should construction workers from outside the study area remain in the area on completion of the construction period

Nature: Influx Of Jobseekers

With the majority of construction projects, an influx of jobseekers is to some extent experienced. The size and profile of these jobseekers cannot be determined or controlled. The extent of the inflow is usually determined by some of the following factors:

» The proximity of the construction site to existing low-income or informal settlements;
» The unemployment levels of those residents in close proximity to the construction site or in the study area;
» The type of construction activity and the need for unskilled or semi-skilled workers;
» The length of the construction period;
» The scale of the construction activities;
» The existing presence of jobseekers who already came to the area in search of employment at other sources of possible employment;
» Whether recruiting of labourers is taking place at the construction site itself; and
» The confidence of the jobseekers with regards to actually securing employment.

An extensive influx of jobseekers to an area could result in negative social impacts such as illegal settlements with associated environmental pollution, social conflict between the jobseekers and locals to secure employment, conflict between informal vendors (also seen as jobseekers) for "new" business, misbehaviour of jobseekers (e.g. possible increase in alcohol use) possible increase in crime due to these jobseekers being unemployed, lack of sufficient accommodation and other infrastructure to cater for their needs, pressure on water and sanitation related facilities, and so forth.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Site of development and surrounding area (2)	Site of development and surrounding area (2)	Site of development and surrounding area (2)	Site of development and surrounding area (2)
Duration	Short term (2)	Very short term (1)	Short term (2)	Very short term (1)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	**Medium (40)**	**Low (27)**	**Medium (40)**	**Low (27)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	To some extent		To some extent	

Mitigation:

» The applicant, local leaders and the Ubuntu Local Municipality should jointly develop a strategy to

minimise the influx of jobseekers to the area.

» Maximise the use of local labour and contractors where possible by developing a strategy to involve local labour in the construction process.
» The recruitment process and the use of contractors should be clearly communicated to the local communities.
» The communication strategy of the applicant regarding the proposed project should ensure that unrealistic employment expectations are not created.
» The applicant could attend community meetings arranged within the various wards to discuss the employment and recruitment process to be followed
» Construction workers should be easily identifiable by wearing uniforms and even identity tags
» The development of informal vending "stations" where food and small goods are sold should, if allowed, be properly managed, to avoid littering and possible environmental pollution

Cumulative impacts:

» Conflict between so-called "outsiders" and locals
» Additional pressure on infrastructure and services during the construction period
» A possible in-migration of unemployed outsiders who remain in the study area after the project has been completed resulting in a permanent additional pressure on infrastructure and services

Residual impacts:

» Possible permanent settlement of job seekers in the area with associated cumulative impacts as indicated above

Nature: Accommodation Of Workforce

It is unlikely that the construction workforce would be accommodated in a construction camp on or near the construction site. From a social perspective the development of a construction camp is also not preferred due to the negative social impacts associated with such a camp (e.g. possible environmental pollution, social disturbances and negative impact on local social fabric, increased noise, need for additional services and infrastructure, littering and so forth). It is further anticipated that any increase in crime could be attributed by the locals to "outside" workers residing in a study area.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Site of development and surrounding area (2)	Site of development and surrounding area (2)	Site of development and surrounding area (2)	Site of development and surrounding area (2)
Duration	Short duration (2)	Short duration (2)	Very short term (1)	Very short term (1)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Probable (3)	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Medium (30)**	**Low (27)**	**Low (27)**
Status (positive or negative)	Negative (construction camp) Positive (hospitality industry)	Negative (construction camp) Positive	Negative (construction camp) Positive	Negative (construction camp) Positive

		(hospitality industry)	(hospitality industry)	(hospitality industry)
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation: » Local labour should be used as far as possible to eliminate the need for a construction camp » Workers should not be accommodated on site and existing accommodation facilities should be utilised as far as possible » Team members that would make use of Bed and Breakfast facilities should pReferably make use of the local facilities available in close proximity to the site such as those located on nearby farms. Alternatively, accommodation in Hutchinson, Victoria West and Beaufort West should be sought				
Cumulative impacts: » Possible increase in crime or perception of increase in crime due to criminals taking advantage of the construction workers being in the area » Possible economic spin-offs due to economic benefits for the local hospitality industry				
Residual impacts: » Economic benefits to local accommodation facilities and hospitality industry				

Nature: Impacts On Daily Living And Movement Patterns

Apart from the behaviour and presence of construction workers in the area , construction related activities could impact on the daily living and movement patterns of the local property owners and farm workers due to e.g. increased construction vehicle activity on the local gravel roads, upgrading of local roads, the movement of abnormal vehicles on local roads transporting wind turbines, increased noise and possible blasting noise, and construction of new access roads on site or upgrading of existing roads on site.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Short term (2)	Short term (2)	Very short term (1)	Very short term (1)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (27)**	**Medium (30)**	**Low (24)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of	Possible, if local roads are degraded and not maintained		Possible, if local roads are degraded and not maintained	

resources?		
Can impacts be mitigated?	Yes	Yes

Mitigation:

» Additional access roads at the construction sites should be kept to a minimum
» Access roads and entrances to the site should be carefully planned to limit any intrusion on the neighbouring property owners and road users
» Noise and dust pollution should be limited as far as possible
» Surrounding property owners should be notified if and when blasting would occur
» Gravel roads should be sprayed with water to limit dust creation if economically feasible and reasonable from an environmental perspective (water scarce area)
» Construction vehicles should adhere to the speed limits
» Construction vehicles and those transporting materials and goods should be inspected to ensure that these are in good working order and not overloaded
» The movement of abnormal loads should be communicated to the property owners in the study area and the necessary permits and authorisations should be obtained from the relevant government departments
» Limit unnecessary movement of abnormal loads as far as possible
» Source general construction material and goods locally where available to limit transportation of these over long distances

Cumulative impacts:

» Possible degradation of local roads with no funds available from Provincial or Local Government for maintenance of these roads
» Possible increase in risk of accidents due to movement of vehicles on local roads

Residual impacts:

» Permanent access roads on site

Nature: Impact On Farming Activities

During the construction phase some negative impacts on the resource use on the farms are anticipated due to the extent of the construction activities. Alternative grazing areas would have to be found for the sheep currently grazing on the areas to be used for the wind turbines and solar panels. Farming activities could furthermore be negatively impacted on by general intrusions and noise associated with the construction activities such as the increase in vehicular movement and possible blasting noise.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Site of development (1)	Site of development (1)	Site of development (1)	Site of development (1)
Duration	Medium term (3)	Short term (2)	Medium term (3)	Short term (2)
Magnitude	High (8)	Moderate (6)	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	**Medium (48)**	**Low (27)**	**Medium (48)**	**Low (27)**

Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	No		No	
Irreplaceable loss of resources?	Yes (footprint areas of wind turbines and solar panels)		Yes (footprint areas of wind turbines and solar panels)	
Can impacts be mitigated?	Possibly		Possibly	
Mitigation: » Construction activities should not interfere with the water sourcing project » Local labourers should be used during the construction phase to limit the inflow of outsiders to the area » The influx of jobseekers should be limited				
Cumulative impacts: » Possible loss of income should the farming with sheep discontinue				
Residual impacts: » Permanent loss of income » Permanent loss of grazing areas and sterilisation of the land for farming practices				

Nature: Local Procurement

At this stage it is not anticipated that local procurement would be achievable for the technology requirements associated with a project of this nature. It is highly likely that the wind turbines and solar panels would be imported from overseas. Local procurement would be more focused on the procurement of general construction materials and goods (e.g. steel and concrete) which would result in positive local economic spin-offs and benefits such as increased income, and expansion of other local economic sectors.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Regional (4)	Regional (4)	Regional (4)	Regional (4)
Duration	Very short term (1)	Short term (2)	Very short term (1)	Short term (2)
Magnitude	Low (4)	Moderate (6)	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)	Probable (3)	Probable (3)
Significance	**Low (27)**	**Medium (36)**	**Low (27)**	**Medium (36)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts	Positive impacts can be enhanced		Positive impacts can be enhanced	

be mitigated?		
Mitigation: » Local businesses, entrepreneurs and SMME's should be informed of and be provided the opportunity to be involved in the tender process » Investigation with regards to goods and materials to determine whether goods and materials can be sourced locally » Local sourcing should be undertaken if economically feasible to assist in providing more economic prospects and employment opportunities for the local people, even if only for a short duration		
Cumulative impacts: » Stimulation of and support to local businesses and local economy which could ensure that benefits accrue to the local communities		
Residual impacts: » Positive local economic stimulus		

Nature: Impact On Ubuntu Local Municipality

Should the project proponent *not* be responsible for the upgrading of the local roads, and the implementation of temporary service infrastructure to the site (such as electricity, water and sanitation which could possibly be required during the construction phase), the development of these would fall on the Ubuntu Local Municipality. If the funding for these temporary services has not been budgeted for, it is highly unlikely that funds for such development would be readily available. Such a situation could delay the construction phase. It is however anticipated that the project proponent would be responsible for the implementation of the required temporary services and the upgrading of the local roads. The impact is thus rated based on the worst case scenario for the Ubuntu Local Municipality.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Short term (2)	Short term (2)	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (27)**	**Medium (44)**	**Low (27)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation:				

» The project applicant should be responsible for the provision of temporary services and infrastructure to the site. If this would not be the case, then the Ubuntu Local Municipality should undertake a detailed audit of the temporary services and infrastructure requirements that would be required » Detailed planning and discussions with the Ubuntu Local Municipality in this regard should be undertaken to ensure integrated planning » A dedicated planning forum should attend to this issue to avoid any delays in the project commissioning
Cumulative impacts: **»** Financial impact on the Ubuntu Local Municipality **»** Possible delays of project implementation
Residual impacts: **»** Possible financial impacts on the Ubuntu Local Municipality

Nature: Traffic Related Impacts

Access to the farms under investigation can be obtained from the N1 and N12, as well as a secondary road, Referred herein as the Biesiespoort Road leading to the actual site itself. The R63 is to the north west of the proposed site. Some additional smaller "farm roads", which are normally only used by residents of the surrounding area to access their properties, link from these roads. Such a farm road exists on the eastern boundary of the farm Nobelsfontein 227. The road stretches from the Biesiespoort road across the farm Nobelsfontein linking with the railway line in the south and continues to the farm dwelling and outbuildings located on the farm Nobelsfontein. A service road, not frequently used, also runs parallel to the railway line.

The imported wind turbines would be transported via sea to possibly Cape Town harbour. The wind turbines would then be transported along the national, secondary and local access roads to the actual site. Due to the size of the wind turbines and the abnormal size of the vehicles that would be required, some of the secondary and local roads would have to be upgraded prior to the delivery of the turbines, which would include widening of corners and/or bridges. The developer would thus have to ensure that the necessary agreements with the relevant road departments are in place to allow them to undertake any upgrades and/or maintenance activities on the roads.

Additional construction vehicles that would make use of the national, secondary and local roads to access the construction site(s) would include cranes, trucks, excavators, graders and those heavy vehicles transporting the materials and equipment required for the PV plant and general construction activities. Even though the N12 is being upgraded, all of these types of vehicles would thus increase the risk of accidents on these roads and would put additional pressure on the capacity and road surface of the local gravel roads.

It was indicated that three turbines could be transported in land per week. As the proposed development is anticipated to consist of 150 wind turbines, this totals 50 weeks of transportation. Should less turbines be required (e.g. 113 turbines as indicated as part of the latest layout plans), the transportation time would also be reduced. Abnormal vehicles would have the most detrimental impact on the local roads' surface and capacity. Continuous pressure over a period of time could result in more rapid degradation of the local roads than would have occurred under normal

circumstances and customary traffic loads. It is however, anticipated that the general construction vehicles would be stored on site and movement of these vehicles between the construction site and source areas would be kept to the minimum.

Irrespective of the number of trucks, it is fair to state that the increase in heavy vehicles on the local roads would have a detrimental impact on the road conditions. The intensity of the impact would thus depend on the actual figures (numbers of trucks and frequency) which cannot be finalised at this stage. It should, however, be noted that it could be possible to transport the PV components via rail which would already mitigate the possible negative impacts in this regard.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Short term (2)	Very short duration (1)	Short term (2)	Very short duration (1)
Magnitude	Moderate (6)	Moderate (6)	Low (4)	Low (4)
Probability	Highly probable (4)	Probable (3)	Probable (3)	Probable (3)
Significance	**Medium (44)**	**Medium (30)**	**Low (27)**	**Low (24)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes to some extent		Yes to some extent	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	

Mitigation:

» All regulations and legislation pertaining to the use of provincial and local roads by abnormal vehicles to transport the wind turbines should be noted and adhered to
» The developer would thus have to ensure that the necessary agreements with the relevant road departments are in place to allow them to undertake any upgrades and/or maintenance activities on the roads
» Speeding of construction vehicles should be avoided at all costs
» The safety of the road users (vehicles and pedestrians) should be a priority
» Property owners of the surrounding farms should at all times have proper access to their properties
» Strict vehicle safety standards should be implemented and monitored
» The local gravel access roads frequently used by construction vehicles should regularly be graded by the project proponent to limit the degradation of the road surface
» The feasibility of transporting materials and equipment via rail to the Biesiespoort Station could be investigated, especially for the PV components.

Cumulative impacts:

» Possible erosion of the soil due to heavy vehicles and machinery

» Poor local road and surface conditions which are unlikely to be attended to by the provincial and/or local authorities
Residual impacts: » Poor local road and surface conditions which are unlikely to be attended to by the provincial and/or local authorities

Nature: Impact On Tourism

During the construction phase, the project could be to the benefit of the local guest houses as some members of the construction team could be accommodated at these establishments located in close proximity to the construction site. This aspect could create or maintain jobs for locals in the area thereby resulting in positive impacts even if only of a limited extent. As no major tourist routes pass the construction site, the negative visual impact experienced during the construction phase is not expected to have any negative impacts on the local tourism sector.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Short term (2)	Short term (2)	Very short duration (1)	Very short duration (1)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Highly probable (4)	Probable (3)	Highly probable (4)
Significance	**Medium (33)**	**Medium (44)**	**Medium (30)**	**Medium (40)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	

Mitigation:

» Members of the applicant's team, contractors, specialists and other construction team members should be encouraged to make use of the local accommodation facilities situated in close proximity to the construction site

Cumulative impacts:

» Possible further positive economic spin-offs and returns of members of the specialist teams to the area as tourists

» Exposure of the larger area to various individuals with possible future positive impacts on the tourism sector

Residual impacts:

» Positive economic benefits to local accommodation establishments

Nature: Impact Of Construction Of Substations And Power Lines

The main impacts usually associated with the construction of a power line and substation Refer to the intrusions and possible negative impacts on the social fabric due to the inflow of workers to the area, impacts on the land value and resource use, impacts on the property owners' daily living and movement patterns and so forth.

The existing Skietkuil/Biesiespoort substation is situated on the farm Nobelsfontein 227 on the eastern section of the site investigated for the proposed Karoo Renewable Energy Facility. Two additional substations are also proposed, which would be situated as follows:

» Substation 1 situated on the farm Nobelsfontein 227 just north of the Biesiespoort Road, east of the proposed laydown area and east of the existing Biesiespoort-Kromrivier 132 kV power line; and
» Substation 2 situated to the south of the Biesiespoort Road on the eastern corner of the farm Phaisantkraal 1.

Four options are currently available to link the facility with the existing electricity grid, namely:

» Substation 1 Option 1: where there would be an immediate turn in line to the Hutchinson-Biesiespoort 132 kV line;
» Substation 1 Option 2: where there would be a link to the existing Biesiespoort substation;
» Substation 2 Option 1: where there would be a turn in line to the Droërivier-Hydra 2 x 400 kV power line; and
» Substation 2 Option 2: where there would be a link between the substation 2 to the existing Victoria Substation located to the north-east of the study area.

From a social perspective the shortest power line routes on the affected farms would be preferred. The following options are the preferred options: Substation 1 Option 1, Substation 1 Option 2 and Substation 2 Option 1 would therefore be recommended above Substation 2 Option 2.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Site of development and surrounding area (2)	Local (3)	Site of development and surrounding area (2)
Duration	Short term (2)	Short term (2)	Very short duration (1)	Very short duration (1)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (16)**	**Medium (30)**	**Low (14)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of	No		No	

resources?		
Can impacts be mitigated?	Yes	Yes
Mitigation: » Mitigation measures noted under sections 6.1 to 6.5 of the Social Impact Assessment (Appendix M) also remain relevant in this regard » The construction of the power lines should be carefully considered. From a social perspective the shortest route would have the least negative social impacts. Substation 2 Option 2 should preferably not be implemented		
Cumulative impacts: » Possible negative impact on land value due to presence of substations and power lines, especially if Substation 2 Option 2 be implemented » Additional infrastructure with additional negative visual impact and subsequent impact on the sense of place		
Residual impacts: » Negative visual impact associated with a substation and power line » Sterilisation of land where substation is located and at tower footprints		

Nature: Health And Safety

An inflow of workers could, as a worst case scenario and irrespective of the size of the workforce, pose some security risks. Criminals could also use the opportunity due to "outsiders" being in the area to undertake their criminal activities. As the crime levels in the area are low, any criminal incidences in this regard would definitely be noted by the property owners, which in the worst case could result in attitude formation against the proposed project.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Medium term (3)	Short term (2)	Medium term (3)	Very short duration (1)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Probable (3)	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Medium (33)**	**Medium (36)**	**Medium (30)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes to some extent		Yes to some extent	
Mitigation:				

- Employing local community members could minimise the potential for criminal activity or perceived perception of an increase in criminal activity due to the presence of an outside workforce.
- Screening of workers that apply for work could be useful to lessen perceived negative perceptions about the outside workforce.
- Construction workers should be easily identifiable by wearing uniforms and even identity tags.
- Local community organisations and policing forums must be informed of the presence of the outside workforce.
- Care should be taken to avoid conflict between the local communities and the "outside" workforce
- The property owners surrounding the construction area should be involved during the construction process by communicating the construction schedule and movement of workers with these representatives.
- Property owners and their workers, together with the relevant community structures should be motivated to be involved in crime prevention and by reporting crimes.
- The construction site should be fenced

Cumulative impacts:

- Possible increase in crime levels with subsequent possible economic losses or in worst-case scenarios loss of lives of animals and individuals

Residual impacts:

- Possible increase in crime levels with subsequent possible economic losses or in worst-case scenarios loss of lives of animals and individuals

Nature: Visual Impact

The main visual impact associated with the construction phase would be the actual construction site, possible storage of equipment and construction vehicles (laydown area), as well as the disruption of the soil and vegetation.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Short term (2)	Short term (2)	Very short duration (1)	Very short duration (1)
Magnitude	Low (4)	Low (4)	Low (4)	Low (4)
Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (27)**	**Medium (32)**	**Low (24)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be	Yes		Yes	

mitigated?		
Mitigation: » Soils should be replaced and rehabilitated as soon as possible after construction » The construction site should be kept litter free » Overall site rehabilitation should occur as soon as the construction process allows » The recommendations made by the Visual Impact Assessment should be adhered to		
Cumulative impacts: » Cumulative visual impact as a result of infrastructure already present in the area		
Residual impacts: » None anticipated		

Impact table summarising the significance of Social Impacts during the Operational Phase (with and without mitigation)

Nature: Job Creation

The wind energy facility would employ approximately twenty (20) individuals during the operational life (SARGE, 2011). For the PV facility there would only be between five (5) to eight (8) positions required for the administration, maintenance (three to four individuals) and management activities (Pöyry, 2010). Additional employment could be created by the provision of ancillary services on-site such as the security personnel required. Maintenance would mainly involve the cleaning of the panels, general cleaning of the site, replacement of panels and/or other mechanical and infrastructural repairs. It is anticipated that maintenance of the turbines would be done twice a year, but for the PV facility this would be done on a daily basis. Maintenance of the substation would be the responsibility of Eskom. General maintenance of the local roads could furthermore result in some temporary jobs during the operational life of the facility.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (2)	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)	Probable (3)	Highly Probable (4)
Significance	**Medium (36)**	**Medium (48)**	**Medium (36)**	**Medium (48)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Positive impacts can be enhanced		Positive impacts can be enhanced	
Mitigation: » Contractors should capacitate locals where practical				

- The project proponent should consider training and capacity building programmes to lessen the skills disparity
- The skill requirements should be communicated to the local community leaders and community based organisations
- The Contractors and/or the applicant should make use of local recruitment agencies or other relevant community based organisations to obtain a list of jobseekers
- An equitable process whereby minorities and previously disadvantaged individuals (women) are taken into account, should be implemented

Cumulative impacts:

- Through the employment of locals other anticipated negative social impacts could be mitigated
- Improved quality of life of those employed
- Increased purchasing power of those employed through the project.
- Indirect benefits to businesses
- Stimulation of local economy

Residual impacts:

- Skilled and capacitated individuals

Nature: Impact On Daily Living And Movement Patterns

During the operational phase, general maintenance of the Karoo Renewable Energy Facility would include maintenance on the equipment (turbines, gearboxes etc.) and solar panels, clearing of alien vegetation between the turbines, road maintenance, firebreaks, general maintenance at the security gatehouse and so forth.

These maintenance activities are not expected to have negative impacts on the neighbouring farmers, apart from a limited increase in the movement of people to and from the site, as well as the presence of these employees on-site. It should furthermore be noted that all the employees would not be on site on a daily basis due to the remote monitoring and operational systems to be used for specifically the wind energy facility.

The main impact on daily living and movement patterns during the life of the facility Refers to the permanent visual impact of the solar energy and wind energy facilities, as well as the associated power line, which again impacts on the character of the area and thus on the sense of place as experienced by the residents and visitors.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (2)	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	**Medium (30)**	**Low (20)**	**Medium (30)**	**Low (20)**
Status (positive or negative)	Neutral	Neutral / Positive	Neutral	Neutral / Positive
Reversibility	Yes		Yes	

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Speeding on the local roads should be avoided for safety reasons and to limit dust creation » The local access road to the site should be regularly maintained to keep the local road conditions in a good quality state		
Cumulative impacts: » Possible intrusions due to additional traffic in the area		
Residual impacts: » None anticipated		

Nature: Safety And Security

When operational, the facility's site will be fenced with a multipurpose security gatehouse at the entrance to the site. Maintenance personnel would thus have to access the site through the security entrance. It is thus not anticipated that the proposed facility would increase any safety and security risks in the area, although unauthorised entry to the site should be avoided for general safety purposes. As the site would be fenced as indicated above, this would be highly unlikely to happen. The presence of permanent security personnel in the area could even limit other possible criminal activities.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (22)**	**Medium (33)**	**Low (22)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation: » The site should be properly fenced » Fire fighting and general emergency services should be available on site » Normal operational safety guidelines should be adhered to				

- Security personnel should be aware of the possibility of animal theft and poaching and should be able to identify possible criminal elements and/or criminal activities in this regard.
- Procedures and measures to prevent, and in worst cases, attend to fires should be developed in consultation with the surrounding property owners

Cumulative impacts:

- Possible increase in criminal activities due to people movement in the area, although unlikely
- Possible loss of livestock with subsequent economic losses to property owners

Residual impacts:

- Increased fire risks

Nature: Possible Impact On Tourism

The major routes used by tourists are the N1 and N12. The only tourist related facilities in the local area Refer to the accommodation facilities on privately owned farms in close proximity to the site under investigation. Some of the farms in the area also receive visitors for hunting purposes. As no well-known tourist attractions and facilities are thus situated in close proximity to the proposed site and tourists passing the site would be very limited, no negative impacts on the local tourism industry are foreseen.

It should also be noted that wind energy facilities and PV facilities are generally viewed in a positive light, mainly due to the clean technology used and overall positive impact on the environment. The presence of wind energy facilities and PV facilities are thus not believed to negatively impact on tourists' enjoyment of their holiday. It is furthermore highly likely that tourists would return to an area where these facilities are present if they had a pleasant overall holiday experience. Tourists could even be interested in visiting these facilities, especially if these facilities have associated educational centres. As South Africa has not seen many of such facilities of this scale, it is highly likely that local tourists interested in renewable energy would want to view these facilities.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Regional (3)	Regional (3)	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Medium (39)**	**Medium (33)**	**Medium (39)**
Status (positive or negative)	Potentially negative / Positive	Positive	Potentially negative / Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Positive impacts can be enhanced		Positive impacts can be enhanced	

Mitigation:

» The proposed facility should be included as an attraction in the Ubuntu Local Municipality's Tourism Strategy » The project proponent, representatives of the Ubuntu Local Municipality, tourism operators and property owners involved in the tourism sector should jointly investigate and promote the role which the Karoo Renewable Energy facility could play with regards to the local tourism industry
Cumulative impacts: » Possible increased visitors to the area with positive financial impacts on the local tourism sector
Residual impacts: » Positive impact on the local tourism industry

Nature: Local Procurement

The design and manufacturing of the equipment used at a wind energy facility requires highly skilled resources and inputs and the services of professionals experienced with the operation and maintenance of wind turbines would thus be critical for the success of the project. It is not likely that there would be local manufacturers that would be able to fulfil this demand and it is consequently anticipated that the infrastructure and equipment would be imported internationally. The same would be applicable to the infrastructure and equipment required for the PV facility.

Apart from the highly specialised technical components it is expected that some local procurement of goods, materials and services could occur which would result in positive economic spin-offs. These opportunities for local service providers to render services to the Karoo Renewable Energy Facility could include maintenance of the guardhouse, gardening at the guardhouse, cleaning services, security services and maintenance or replacement of general equipment.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Regional (3)	Regional (3)	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)	Low (4)	Moderate (6)
Probability	Improbable (2)	Probable (3)	Improbable (2)	Probable (3)
Significance	**Low (22)**	**Medium (39)**	**Low (22)**	**Medium (39)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Positive impacts can be enhanced		Positive impacts can be enhanced	

Mitigation:

» Local sourcing of materials and general services to assist in providing more economic and employment opportunities for the local people

Cumulative impacts:

» Stimulation of and support to local businesses and local economy which could ensure that benefits accrue to the local communities
Residual impacts:
» Same as above

Nature: Local Economic Contribution

The Karoo Renewable Energy Facility's total capital expenditure totals approximately R4 billion where the wind energy facility would total approximately R2.6 billion and the PV solar facility R1.4 billion (SARGE, 2011). The proposed Karoo Renewable Energy facility is thus expected to result in increased local economic activity and local employment through the creation of additional employment opportunities.

	Wind Energy Facility		**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Regional (3)	Regional (3)	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	High (8)	Moderate (6)	High (8)
Probability	Probable (3)	Highly probable (4)	Probable (3)	Highly probable (4)
Significance	**Medium (39)**	**Medium (60)**	**Medium (39)**	**Medium (60)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Positive impacts can be enhanced		Positive impacts can be enhanced	

Mitigation:

- The economic contribution of the project should aim to economically assist the local community through secondary spin-offs as far as possible and by economically assisting with community based projects and initiatives
- The applicant could strengthen community partnership through strategic funding of community projects and initiatives

Cumulative impacts:

- Positive trickle down economic spin-offs
- Increased economic activity in the region

Residual impacts:

- Same as above

Nature: Social Development And Social Services Support

Social development and social services support is not a direct impact of the proposed project as such,

but would only materialise if the applicant commits to social upliftment and development due to their presence in the area. An important positive role that SARGE thus could fulfil as part of their social responsibility towards the local communities is to assist in addressing community development needs. This would ensure the upliftment of the local communities. The project proponent could investigate the possibility of supporting some community projects already being undertaken in the area.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Regional (3)	Regional (3)	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	High (8)	Moderate (6)	High (8)
Probability	Probable (3)	Highly probable (4)	Probable (3)	Highly probable (4)
Significance	**Medium (39)**	**Medium (60)**	**Medium (39)**	**Medium (60)**
Status (positive or negative)	Positive	Positive	Positive	Positive
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Positive impacts can be enhanced		Positive impacts can be enhanced	

Mitigation:

- Involvement in upliftment programmes could be done according to the needs identified as part of the IDP of the Ubuntu Local Municipality
- Capacity building and skills training should form part of the social development support provided to local communities
- Individual tailor made training programmes for full time employees should be embarked upon in association with accredited training facilities to ensure long term benefits to those involved
- In cases for the middle to lower skilled jobs, where the relevant skills do not exist, training should be provided to willing local community members to enable them to fill the positions
- The Skills Development Levy should be established once the project is commissioned to ensure that the benefits of the implementation thereof reach the local communities from the start of the project
- Bursary candidates should be identified and selected based on a stringent screening process
- The project applicant should create conditions that are conducive for the involvement of entrepreneurs, small businesses and SMME's during the operational phase for rendering ancillary services to the proposed facility

Cumulative impacts:

- Social development and upliftment as a result of the proposed project

Residual impacts:

- Social development and upliftment as a result of the proposed project
- Improved livelihood of those benefiting from the capacity building and skills training

Nature: Impact On Farming Activities

The wind energy facility and PV facility would thus allow sheep to continue grazing on site between the panels (possibly underneath as well due to its height), between the turbines and within the power line servitude area which would result in some agricultural practices continuing on site. No watering points would also be negatively affected by the proposed facility. The only land that would thus be sterilised would be the areas actually used for the turbine structures, the footprint of the solar mounts, access roads, fire breaks and associated buildings and sub-station buildings. Care, should still be taken to not create uneconomical sub-units due the areas being divided by the infrastructure thereby impacting on the actual portions that could be used for grazing purposes.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (26)**	**Medium (39)**	**Low (26)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	No		No	
Irreplaceable loss of resources?	To a limited extent		To a limited extent	
Can impacts be mitigated?	To some extent		To some extent	

Mitigation:

- Reduce any negative impacts on farming activities by keeping fencing within the site to a minimum and designing fencing to maximise efficiency of stock movements
- Limit the development on new access roads on site as far as possible

Cumulative impacts:

- Possible economic losses due to downscaling of sheep farming

Residual impacts:

- Same as above

Nature: Land Value

The proposed Karoo Renewable Energy facility could negatively impact on the property values in the surrounding area during the short term, as the facility could be seen as not an established part of the existing landscape, thereby influencing the sense of place, and due to the uncertainty associated with the development of such a facility. Possibly after the construction phase and commissioning of the facility, when experience has shown that the proposed facility has no or little impact on the surrounding landowners and the activities undertaken on their properties, the impact on the property prices could return to normal.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (3)	Local (3)	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)	Short term (2)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (26)**	**Medium (33)**	**Low (26)**
Status (positive or negative)	Negative	Possibly negative to Neutral	Negative	Possibly negative to Neutral
Reversibility	No		No	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	
Mitigation: » The Visual, Noise and Heritage Impact Assessment recommendations should be implemented to limit any potential negative impacts on the sense of place » Equipment should be maintained and serviced on a regular basis » The facility should be managed according to international best practice				
Cumulative impacts: » Impacts on sense of place » Possible indirect economic impact of select property owners				
Residual impacts: » Very limited possible long-term impact on the property values				

Nature: Health Related Impacts

As the operations at the proposed Karoo Renewable Energy facility would not result in any air pollution, the subsequent health impacts on communities in close proximity or sensitive receptors are deemed insignificant. Additional waste would however be generated by the employees on site. This limited impact is expected to be mitigated through the proper design of the facilities on site.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Regional (3)	Local (2)	Regional (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)	Minor (2)	Minor (2)
Probability	Improbable (1)	Probable (3)	Improbable (1)	Probable (3)
Significance	**Low (8)**	**Low (27)**	**Low (8)**	**Low (27)**
Status (positive or negative)	Positive	Positive	Positive	Positive

Nature: Health Related Impacts

As the operations at the proposed Karoo Renewable Energy facility would not result in any air pollution, the subsequent health impacts on communities in close proximity or sensitive receptors are deemed insignificant. Additional waste would however be generated by the employees on site. This limited impact is expected to be mitigated through the proper design of the facilities on site.

Wind Energy Facility		**PV Facility**
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Positive impacts can be enhanced	Positive impacts can be enhanced

Mitigation:

- Marketing of the "green" technology to be used can assist in awareness creation about the benefits of renewable energy.
- Engineering aspects and the design of the facility should ensure no environmental pollution. Proper waste, water and sanitation infrastructure and facilities must thus be installed

Cumulative impacts:

- Wider awareness of "green" technology

Residual impacts:

- Same as above

Nature: Visual Impact And Sense Of Place

Even though the area is rural in character, there is some limited existing disturbance by infrastructure such as roads, transmission lines, telephone poles, the railway line, the existing substation, scattered homesteads and so forth. The proposed facility is thus expected to add to the existing negative visual impact of these types of infrastructure on the open relatively undisturbed rural landscape and therefore on the sense of place.

The number of receptors could also play a significant role in the intensity and significance of the visual impact. The area surrounding the affected farms is not densely populated, homesteads are scattered throughout the area and the site under discussion is not situated directly along major tourist routes. The permanent visual impact would thus be limited to a small minority of residents and road users (e.g. those making use of the Biesiespoort Road). Even though one would then deal with "less" concerns and an impact of limited extent based on the population figures, the impact could have a more marked effect on these residents' quiet, undisturbed rural lifestyle, their quality of life and their sense of place. Based on the limited inputs received during the public participation process it can be concluded that the change in the landscape character has been accepted by the majority of residents in the area.

In this regard it should also be noted that the impact of the turbines, substations and PV panels on the visual environment would differ based on the receptors' perception of such facilities. Some people could view the turbines and panels as having a significant negative impact on the beauty of the landscape, while others could view them in a positive light and even use the presence of the

facility as part of the area's marketing efforts.				
Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (2)	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)	Moderate (6)	Moderate (6)
Probability	Definite (5)	Highly probable (4)	Highly probable (4)	Probable (3)
Significance	**Medium (60)**	**Medium (48)**	**Medium (48)**	**Medium (36)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	No		No	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	To a very limited extent		To a very limited extent	

Mitigation:

- The design and specific positioning of the panels and turbines should aim to minimise the possible negative visual impact of the facility on the surrounding property owners
- The panel mounts should have the lowest height practically possible
- The natural landscape could possibly be used to conceal some of the panels and turbines. The visual impact is absorbed somewhat, by the topography (hills and mountains) in the medium distance
- It should be ensured that there is no reflection from the panels.
- The design of the security buildings should blend in with surrounding environment
- Lighting issues should receive the attention it deserves to avoid any light pollution at night
- The design of the blades should limit any possible "shadow flicker"
- The mitigation measures of the Visual Impact Assessment should be strictly implemented

Cumulative impacts:

- Possible negative impacts on the land value as a result of the negative impact on the sense of place

Residual impacts:

- Change in rural character and quality of the natural environment

Nature: Noise Impact

Noise generating sources, apart from the wind turbines could relate to the number of workers that would be on site on a daily basis, vehicle movement on the local roads and on-site movement, as well as maintenance activities. This, however, would be of a very limited extent. The Biesiespoort Substation (already present on the farm Nobelsfontein) and power line (corona noise) could be perceived as additional sources of noise pollution. Homesteads in the area however are limited and the closest sensitive receptors are some distance away from the project site. These noise

disturbances would only be temporary and would only occur at certain times during specific weather conditions.

From a social perspective it is thus concluded that the increased noise would occur from time to time, it could be of an intrusive nature for those in close proximity to the facilities (thus those on site near the wind turbines, near the substation and underneath the power line), but not socially disruptive. It would thus not interfere with the quality of the daily activities of nearby residents and would not negatively influence their health. In addition it should be noted that improved engineering principles with regards to the wind turbines could also limit the noise increase.

Wind Energy Facility			**PV Facility**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (2)	Local (2)	Local (2)
Duration	Long term (4)	Short duration (2)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)	Probable (3)	Improbable (1)
Significance	**Medium (36)**	**Low (24)**	**Low (24)**	**Low (8)**
Status (positive or negative)	Negative	Negative	Possibly negative	Neutral
Reversibility	Yes		Yes	
Irreplaceable loss of resources?	No		No	
Can impacts be mitigated?	Yes		Yes	

Mitigation:

- Mechanical noise should be kept to a minimum by means of insulation at the gearbox and the generator of the various wind turbines
- The engineering design of the turbines should thus ensure the least noise as possible
- The mitigation measures of the Noise Impact Assessment should be strictly implemented

Cumulative impacts:

- None anticipated

Residual impacts:

- Possible increase in noise pollution

Comparative Assessment of Power line Alternatives

In terms of potential social impacts of the alternative power line options, the shortest route on the affected farms would be preferred. Substation 1 Option 1, Substation 1 Option 2 and Substation 2 Option 1 would therefore be recommended above Substation 2 Option 2.

Implications for Project Implementation

» The project applicant should put in place a policy of preferentially sourcing local labour for construction and maintenance activities. This aspect should be included and stipulated in the tender documentation to ensure that locals receive real economic benefits.
» Capacity building and skills training among employees are critical and would be highly beneficial to those involved, especially if they receive portable skills to enable them to also find work elsewhere and in other similar environments.
» Local residents, with the focus on the surrounding landowners, should receive accurate information with regards to the project status, timeframes for construction and other relevant information about issues that could influence their daily living and movement patterns such as details with regards to the increase of traffic volumes and possible traffic / road disruptions.
» The construction site should be fenced to eliminate any unauthorised entry to the site. Fencing should remain once the facility is operational.
» Contractors and their employees should make use of the existing accommodation facilities within the area or in the nearest towns such as Victoria West and Beaufort West. No contractors should thus be residing on site in contractors' camps or any informal type of accommodation facilities.
» Local access roads to the site and access roads on site should be upgraded in cases where these roads have not been designed to accommodate the abnormal vehicles. This should also be agreed with the relevant roads authorities.

6.4. Summary of All Impacts

As indicated in Chapter 3, the significance weightings for potential impacts have been rated as follows:

» **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
» **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
» **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

As a summary of the potential impacts identified and assessed through the EIA process, the following table provides a summary of the impact rating.

Nature	Without mitigation	With mitigation
Potential impacts on Ecology		

Loss or fragmentation of indigenous natural vegetation	Low - Medium	Low - Medium
Loss of habitat for threatened animals	Low	Low
Damage to wetlands/watercourses	Medium - High	Low - Medium
Establishment and spread of declared weeds and alien invader plants	Medium	Low
Potential impacts on Avifauna		
Disturbance - noise, movement and temporary occupation of habitat during the construction process. Likely to impact all birds in the area to some extent, but sensitive, sedentary and/or habitat specific species will most adversely affected.	Medium	Medium
Habitat loss - destruction of habitat for priority species, either temporary – resulting from construction activities peripheral to the built area, or permanent - the area occupied by the completed development.	Medium - High	Medium
Disturbance - noise and movement generated by operating turbines and maintenance activities is sufficient to disturb priority species, causing displacement from the area, adjustments to commute routes with energetic costs, or otherwise affecting nesting success or foraging efficiency.	Medium-High	Medium
Mortality - collision of priority species with the wind turbine blades lines, or electrocution of the same on new power infrastructure.	Medium - High	Medium
Potential impacts on Geology, Soil, and Erosion Potential		
Soil degradation - may occur directly through excavation activities, removal of soil for roads and structures, loosening, mixing, wetting, compaction of in situ soil during earthworks.	Medium	Medium
Soil degradation and pollution – through using contaminants during the construction phase (e.g. fuel, oil, cement). Loosening, mixing, wetting, compacting of in situ soil during earthworks.	Low	Low
Soil degradation - through water or wind related erosion.	Medium	Low
Soil degradation – through siltation of waterways and dams downstream from site.	Medium	Low
Dust pollution from construction site affecting areas surrounding site.	Medium	Low

Potential impacts on Heritage Sites and Palaeontology		
Impacts to palaeontological material	Medium	Low
Impacts on archaeological material – which could involve displacement or destruction of material at turbine and solar array locations and in the paths of power lines and access roads.	Medium	Low
Potential Visual Impacts		
Potential visual impact on users of arterial and secondary roads in close proximity of the proposed facility.	High	High
Potential visual impact on residents of towns, farms and homesteads in close proximity of the proposed facility.	High	High
Potential visual impact on sensitive visual receptors within the region.	Medium	Medium
Potential visual impact on the sense of place and scenic features within the region.	Low - Medium	N/A
Potential visual impact on tourist routes and tourist potential within the region.	Low	N/A
Potential visual impact of construction on visual receptors in close proximity to the facility.	Medium	Low
Potential visual impact of lighting at night on observers in close proximity to the facility.	Medium	Low
Potential visual impact of shadow flicker on visual receptors in close proximity to the facility	Low	Low
Potential visual impact of access roads located within the proposed wind energy facility footprint.	Medium	Medium
Potential visual impact of ancillary infrastructure located within the proposed renewable energy facility footprint.	Low	Low
Potential visual impact of the power line.	Low	Low
Potential Noise Impacts		
Numerous simultaneous construction activities that could impact on potential sensitive receptors.	Medium	Low
Numerous turbines operating simultaneously during a period when a quiet environment is desirable.	Low	Low
Potential Social Impacts (Construction)		
Creation of employment	Medium	Medium

Potential inflow of construction workers	Medium	Low - Medium
Influx of jobseekers	Medium	Low
Accommodation of workforce	Low - Medium	Low - Medium
Impacts on daily living and movement patterns	Medium	Low
Impact on farming activities	Medium	Low
Local procurement	Low (Positive)	Medium (Positive)
Impact on Ubuntu Local Municipality	Medium	Low
Traffic Related Impact	Low - Medium	Low - Medium
Impact on tourism	Medium	Medium
Impact of construction of substations and power line	Medium	Low
Health and Safety	Medium	Medium
Visual Impact	Medium	Low
Potential Social Impacts (Operation)		
Creation of employment	Medium	Medium
Impacts on daily living and movement patterns	Medium	Low
Safety and security	Medium	Low
Impact on tourism	Medium	Medium
Local procurement	Low (positive)	Medium (positive)
Local Economic Contribution	Medium	Medium
Social Development and Social Services Support	Medium	Medium
Impact on farming activities	Medium	Low
Land Value	Medium	Low
Health related impacts	Low	Low
Visual impact and sense of place	Medium	Medium
Noise impact	Medium - Low	Low

6.5. Comparative Assessment of Alternatives

The findings of the specialist studies regarding pReference of the power line alternatives is summarised in the table below.

	Preferred Power line Route
Ecology	All except Substation 2 Option 2
Avifauna	Substation 1 Option 1, and Substation 2 Option 1
Geology	Substation 1 Option 1, and Substation 2 Option 1
Heritage and Palaeontology	Substation 1 Option 1, and Substation 2 Option 1

Visual	Substation 1 Option 1, and Substation 2 Option 1
Noise	No preference
Social	Substation 1 Option 1, and Substation 2 Option 1

Therefore the preferred routes for the power lines for both **Substation 1 and 2**, is **Option 1**. The route meets the acceptance level for environmental impacts. SARGE will ensure that impacts are minimised to an acceptable level. This can be managed through the implementation of an Environmental Management Plan.

6.6. Assessment of Potential Cumulative Impacts

A cumulative impact, in relation to an activity, Refers to the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse undertaking in the area[13].

» Cumulative *ecological impacts* – cumulative impacts on ecology relate largely to the impacts at a regional level rather than at a site-specific level. Impacts on a plant/animal species or vegetation/habitat type at the site could have an impact on the conservation status of these species at a regional level. Therefore, it is important to consider the broader impact within the region rather than at the site specific level. This could be particularly important if identified Red List or protected species are impacted by this and other proposed developments in the region.

» Cumulative *avifauna impacts* - collision rates may appear relatively low in many instances, however cumulative effects over time, especially when applied to large, long lived, slow reproducing and/or threatened species (many of which are collision-prone), may be of considerable conservation significance. Furthermore, when viewed in isolation, one renewable energy facility may pose only a limited threat to the avifauna of the region. However, in combination they may result in the formation of significant barriers to energy-efficient travel between resource areas for regionally important bird populations, and/or significant levels of mortality in these populations in collisions with what may become repeated arrays of renewable energy facility components spread across foraging areas and/or flight paths of priority species.

» Cumulative *geology, soil and erosion potential impacts* - although the impact of soil removal for the proposed activity has only a moderate significance, the cumulative impact of soil removal and earthworks in the area is considered low due to the localised and scattered nature of the171proposed activity and the undeveloped nature of the area.

[13] Definition as provided by DEA in the EIA Regulations.

» Cumulative impacts *on heritage and fossil resources* – Increased pressure on heritage and palaeontological resources through the destruction of these resources.

» Cumulative *noise impacts* - the impact of construction and operation activities that could affect potential sensitive receptors is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.

» Cumulative *visual impacts* - The construction of the turbines and PV plant together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of other proposed renewable energy facilities located in the proximity of the site.

» Cumulative *social impacts* - The proposed establishment of multiple renewable energy172facilities in the area will have a significant impact on the landscape and the areas rural sense of172place and character. This impact will be exacerbated by the172consecutive visibility (e.g. the effect172of seeing172two or more renewable energy facilities along a single journey, e.g. road or walking172trail) of the sites, specifically for motorist's travelling along the N12, which is an important tourist route. Another possible cumulative impact of the proposed facility is the degradation of local roads due to an increase in traffic volumes.

Cumulative effects have been considered within the detailed specialist studies, where applicable (Refer to Appendices F – M).

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 7

SARGE (Pty) Ltd proposes to establish a commercial renewable energy facility which will comprise a combination of a wind energy facility component and a photovoltaic (PV) solar facility component, as well as the associated infrastructure on a site near Victoria West within the Northern and Western Cape Province. A study area of approximately 202 km^2 is being considered as the broader study area for the construction of the proposed facility.

The wind energy facility component is proposed to ultimately accommodate up to **150 wind turbines**, appropriately spaced to make use of the wind resource on the site. A total generating capacity of up to 450 MW is proposed for the wind energy component, while the photovoltaic (PV) solar component will have a generating capacity of up to 50 MW. The project would be developed in a phased approach. The proposed renewable energy facility will be comprised of the following associated infrastructure:

» Up to 150[14] wind turbines with a generating capacity of up to 450MW;
» Each turbine will be a **steel tower** (between 80m and 125m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of between 90m and 100 m (i.e. each blade ranging from 45 to 55m in length);
» An array of **photovoltaic (PV) panels** occupying an area of approximately 97 ha (including access roads) with a generating capacity of up to 50MW;
» Two (2) **132 kV substations** with high-voltage (HV) yard footprints of approximately 100m x 100m;
» **Foundations** to support both the turbine towers as well as the PV panels;
» **Cabling** between the project components, to be lain underground where practical;
» Two (2) new **overhead 132 kV power lines -**
» ***From Substation 1:***
  - Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1km length of power line) or alternatively
  - Substation 1 Option 2: To connect to Eskom's existing Biesiespoort Substation (up to 2.5 km length of power line).
» ***From Substation 2:***
  - Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line) or alternatively
  - Substation 2 Option 2: To connect to Eskom's existing Victoria Substation (up to 12 km length of power line).

[14] The current layout comprises 113 wind turbines as a result of the design process thus far which has taken environmental and technical constraints into consideration. The EIA application however remains for a facility of up to 150 wind turbines.

» **Internal access roads** (5 m wide and ~82.15 km long) linking the wind turbines and PV component with the other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new internal access roads; and
» **Small office and/or workshop building** for maintenance and storage purposes.

The EIA for the proposed facility has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998)[15]. The EIA Phase aimed to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed alternatives put forward as part of the project.
» Assess potentially significant impacts (direct, indirect, and cumulative, where required) associated with the proposed facility.
» Comparatively assess identified technically feasible alternatives put forward as part of the project.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

7.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - M provide a detailed assessment of the environmental impacts on the social and biophysical environment of the proposed project. This chapter concludes the EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the renewable energy facility, including two on-site substations and the associated 132 kV power lines, and all other associated infrastructure. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental consultants during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project. In summary, the following conclusions were drawn from each of the specialist studies undertaken:

» Impacts on **individuals of threatened animal species** (the Riverine Rabbit) are of **low** significance prior to mitigation due to the fact that that potentially suitable habitat is present in the north-eastern part of the site. No individuals of the species

[15] Note that these EIA Regulations were current at the time of submitting the Application for Authorisation and therefore this process has been completed in terms of these Regulations.

were found on site and landowners on site have indicated that no previous sitings have taken place on site. It is, nevertheless, possible for the species to occur. The proposed facility is likely to have a **high to low** local and regional negative impact on the **flora/vegetation (and ecology)** on the site prior to mitigation (including impacts on indigenous natural vegetation, individuals of threatened animal species, establishment and spread of declared weeds and alien invader plants and impacts on wetlands). This impact can be reduced to **moderate to low** after the implementation of recommended mitigation measures. The primary negative impacts are the result of direct impacts, including loss of habitat within indigenous natural vegetation in development footprints, and direct, long-term loss of natural vegetation in areas that will be disturbed by heavy construction machinery, laydown areas, etc. during the construction phase.

» The proposed facility could have a significant, long-term impact of **moderate to high** significance on selected **avifauna** species resident to the surrounding area. The taxa likely to be most affected include large raptors (Verreaux's and Martial Eagles) nesting on existing transmission power line towers on the Karoo flats, or else on the cliffs of Gys Roosberg, the Horseshoe and some outlying ridge lines, and using these topographic features for slope soaring. Another possible impact of the facility will be displacement effects on, and (in particular) collision mortality of Ludwig's Bustards and Blue Cranes. These priority species may be disturbed by the construction of the renewable energy facility, and/or lose foraging habitat (in terms of the area covered by the construction footprint and by displacement from areas with operating turbines and PV panels), and/or sustain mortalities in collisions with the turbine blades, or by collision with, or electrocution on the new power infrastructure. These effects may be reduced to **acceptable and sustainable levels** by adherence to a proposed mitigation scheme. A comprehensive programme to fully monitor the actual impacts of the facility on the broader avifauna of the area is recommended and outlined, from pre-construction into the operational phase of the project. Full clarity on the likely environmental impact of this facility can only be reached once pre-construction monitoring has been completed.

» The findings of the **geology, soils and erosion potential** study have indicated that the proposed development will have an impact of **moderate to low** significance on the geological environment and these impacts can be largely reduced to an **adequately low** level with the implementation of appropriate mitigation.

» Both the Phase 1 Archaeological Impact Assessment and the Palaeontological Desktop study concluded that the study area is of **moderate** cultural and palaeontological sensitivity. The possible impacts can be reduced to an **adequately low** level with the implementation of appropriate mitigation.

» The placement of the facility and its associated infrastructure will have a **visual impact** on the natural scenic resources and rural character of this region. Potential visual impacts are of **high significance** in terms of the potential visual impact on users of arterial and secondary roads in close proximity (**~5km radius**) of the proposed facility. The impact on sensitive visual receptors in the vicinity of the development will be of **moderate to low significance**. The visual impact of the core facility (mainly the wind turbines) is not readily mitigated due to the size of the structures in the landscape. Within the greater region, the potential visual impact on sensitive visual receptors, and on the sense of place of tourist routes and destinations, will be of **moderate to low** significance. The various ancillary infrastructure is expected to result in visual impacts of **low** significance. This anticipated visual impact is not, however, considered to be a fatal flaw from a visual perspective, considering the relatively low incidence of visual receptors in the region and the contained area of potential high visual exposure.

» The **noise impact** on specific receptors in the area, during both the construction and operational phases is potentially of **moderate to low significance** on two of the identified noise receptors (PSR6 and PSR7- refer to Figure 6.11 for the location of these receptors). With the implementation of recommended mitigation measures this can be reduced to a **low significance.**

» The findings of the **social impact** assessment undertaken indicate that the development will create limited employment and business opportunities for locals during both the construction and operational phase of the project. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a **positive social benefit** for society as a whole. However, the visual impacts associated with a facility of this nature will impact on the current sense of place and landscape character. This impact will be for the entire operational lifespan (approximately 25 years) of the facility. All of the potential negative impacts can be effectively mitigated through the recommended mitigation measures.

From the results of the facility layout determination, it is apparent that the permanently affected/utilised areas within the site/farm boundaries is only approximately 1.436 km^2 in extent. This amount to 0.8 % of the total 202 km^2 originally earmarked for development, and is broken down in the table below.

Facility component –permanent	Approximate extent (in m^2)
150[16] turbine footprints (i.e. each 15 m x 15 m)	33 750 (for 150 turbines)[17]

[16] The current turbine layout has 113 turbines as a result of the design process thus far which has taken environmental and technical constraints into consideration. However, the EIA application remains for a facility of up to 150 turbines.

Solar array	970 000
Permanent access roads[18] underlain with 33 kV cabling where possible (5 m wide and 82.15 km long)	410 775
Substation footprint (100 m x 100 m) x2	20 000
Small office and/or workshop building (40 m x 20 m)	800
TOTAL (m^2)	**1 435 325 m^2** (of a total area of 202 km^2) **~ 0.8 % of site**

The permanent area lost to the proposed renewable energy facility (assuming 150 turbines and an area of 97 ha for the solar array) will therefore amount to ~0.8% of the total 202 km^2 of the broader site[19].

Temporarily affected areas comprise laydown areas for turbines (i.e. each with a minimum footprint of 50 m x 25 m), temporary access roads (5m wide and 5.6 km long, over and above permanent roads constructed) as well as a general construction laydown area of 66 ha in extent. The 33 kV cabling to connect the turbines and the solar array to the on-site substations will make use of the permanent access roads to be constructed on site. A trench of approximately 1 m deep will be excavated in which the cabling will be laid; thereafter the area will be rehabilitated.

Areas of temporary disturbance during construction amount to 0.43% of the total 202 km^2 originally earmarked for development, and is broken down in the table below.

Facility component –temporary	**Approximate extent (in m^2)**
Laydown areas for turbines (i.e. each 50 m x 25 m)	187 500 (for 150 turbines)[20]
Temporary access roads[21] (5 m wide and 5.6 km long)	28 000
General construction laydown area	660 000
TOTAL (m^2)	**875 500 m^2** (of a total area of 202 km^2) **~ 0.43 % of site[22]**

Environmental specifications for the management of potential impacts are detailed within the draft EMP (included within Appendix N).

[17] The area would be reduced to 25 425m^2 for 113 turbines.

[18] Assuming a width of 5m and a length of 82.155 km.

[19] The permanent area lost to the proposed renewable energy facility (assuming 150 turbines and an area of 97 ha for the solar array) amounts to ~0.8 % of the total 202 km^2 of the broader site.

[20] The area would be reduced to 141 250m^2 for 113 turbines.

[21] Assuming a width of 5 m and a length of 5.6 km.

[22] The temporary area of disturbance (assuming 150 turbines) amounts to ~0.43% of the total 202 km^2 of the broader site.

Power line Option 1 for both Substation 1 and 2 has been nominated as the preferred power line alternative by the specialist findings. Option 1 for both substations meet the acceptance level for all identified environmental impacts, and will ensure that impacts are minimised to an acceptable level which can be managed through the implementation of an Environmental Management Plan (EMP).

The table below provides an overall summary of the significance of impacts for different infrastructure components of the proposed facility.

Table 7.1: Overall summary of the significance of impacts for different infrastructure components

Impact	PV plant	Wind turbines	Ancillary Infrastructure (incl roads, laydown areas, substations and power lines)
1. Ecology	Low - Medium	Low - Medium	High
2. Avifauna	Medium	Medium - High	Medium - High
3. Geology	Low	Medium	Medium
4. Heritage	Medium	Medium	Medium
5. Palaeontology	Low	Medium	Medium
6. Visual	Low	High	Low
7. Noise	Low - Medium	Low - Medium	Low - Medium
8. Social	Low - Medium	Low - Medium	Low - Medium

7.2 Site Sensitivity

Areas of high ecological, avifaunal and visual sensitivity as well as areas of medium heritage sensitivity have been identified within the proposed development site. These include the following, and are demarcated on Figure 7.1:

» The only ecological impact of potentially high significance is that of the internal access roads on drainage lines. Due to the linear nature of access roads and the number of drainage lines across the site, there is the potential for a high number of drainage line crossings. If these are crossed in such a way as to significantly affect hydrological processes, then the impact will be of high significance. Mitigation measures can, however, reduce the significance to moderate.

» High sensitivity avifaunal areas have been identified during the avifaunal assessment and are deemed 'no-go' areas (Figure 6.3). These include cliff lines or elevated ridges as well as Verreaux's Eagle and Martial Eagle nest sites. These high sensitivity areas should be the focus of a pre-construction monitoring programme.

» Rock paintings, rock engravings, stone artefacts, stone walling as well as human remains were encountered on the broader site, although not all features are within the development footprint. A medium sensitivity has been ascribed to these heritage features.

» Elevated terrain is present within the boundaries of the study site. These steep slope faces have an inherent scenic quality, rendering them visually sensitive.

» Sensitive noise receptors and inhabited homesteads.

The following recommendations/mitigation measures are made to reduce impacts on these sensitive areas, or provide additional information/data that can lead to reduction or control of impacts in these areas:

» Internal access roads must be situated to avoid drainage lines, as far as possible. Stormwater and runoff water must be controlled and erosion must be inhibited. Erosion control features must be placed at crossings of drainage lines. No structures must be placed within any drainage channel.

» Development should be excluded from the following sensitive avifaunal areas:
- Within 500 m of any cliff lines or elevated ridges within the development area to reduce collision risk, primarily for slope soaring raptors.
- Within 1500 m of any known or suspected Verreaux's Eagle nest sites (Figure 6.3) to reduce disturbance and collision risk for this species.
- Within 2500 m of any known or suspected Martial Eagle nest sites (Figure 6.3) to reduce disturbance and collision risk for this species.

» Heritage and palaeontological resources encountered on-site should be ideally avoided, or a permit obtain for their disturbance:
- Exposed human remains must be reported to the South African Heritage Resources Agency (SAHRA) so that they may appoint the relevant archaeologist/s to remove the exposed human remains. This must happen regardless, even though the site falls outside of the development footprint.
- No construction activities may take place within 100m of the documented rock shelters containing rock paintings and boulders containing rock engravings.
- The ridges and rocky outcrops surrounding the locations of the turbines and solar panels must be investigated prior to construction to establish whether undocumented rock shelters contain rock paintings and rocky outcrops contain boulders with rock engravings. If any are encountered, no construction activities may take place within 100m of these.
- No construction activities may take place within 100m of the documented stone-wall structures.

- If it is inevitable that construction activities must take place within 100m of any documented and undocumented rock shelters containing paintings, rocky outcrops with boulders containing rock engravings and stone-wall structures, then a perimeter fence must erected to protect the sensitive area from any possible negative impact.
- It is possible that in situ archaeological sites/remains, and human remains may be uncovered during construction. Therefore, a professional archaeologist should be appointed during the vegetation removal and construction phases of the development.
- Effective mitigation of palaeontological heritage for this project is only feasible once the positions of individual structures and access roads have been finalised. Pre-excavation surveying of selected sites and access roads would only be necessary where development will take place directly on potential fossil-bearing strata.

» In the medium to long distance, the visual impact of the wind turbines may be absorbed where these are viewed against the backdrop of mountainous topography. This is only relevant, however, where the turbines do not break the skyline created by the mountainous terrain beyond. To mitigate the visual impact of the facility, the following should be considered:
- The 3 turbines located in a particularly elevated position (i.e. on top of a landform more than 140m above the surrounding area) and 5 turbines located on slopes in excess of 18 degrees should ideally be repositioned to lower lying areas and more moderate slopes (refer to Figure 7.2).
- Certain visual receptors are/will be subject to views of other electricity transmission infrastructure relating to the following:
  * The Droerivier-Hydra 1, 2 and 3 transmission power lines which cross the N1.
  * The Eskom 400kV Victoria Substation located approximately 3 km to the northwest of the N1, and approximately 12 km from the study site.
  * The authorised and soon to be constructed Eskom 765kV Gamma Substation (and associated power lines) to the north west of the N1, and to the north east of the study site.

» Quarterly **noise monitoring** at the potential sensitive receptors is recommended to be conducted by an acoustic consultant or approved noise inspection authority for the first year of operation. This monitoring is to take place over a period of 24 hours in 10 minute bins, with the resulting data co-ordinated with wind speeds as measured at a 10 m height. These samples should be collected when the wind turbines are operational. Quarterly monitoring is recommended at PSR06 and PSR07 for the first year, as well as any other receptors that have complained to the developer regarding noise originating from the facility. Because PSR01 might be developed in the future, similar sampling is recommended for that site.

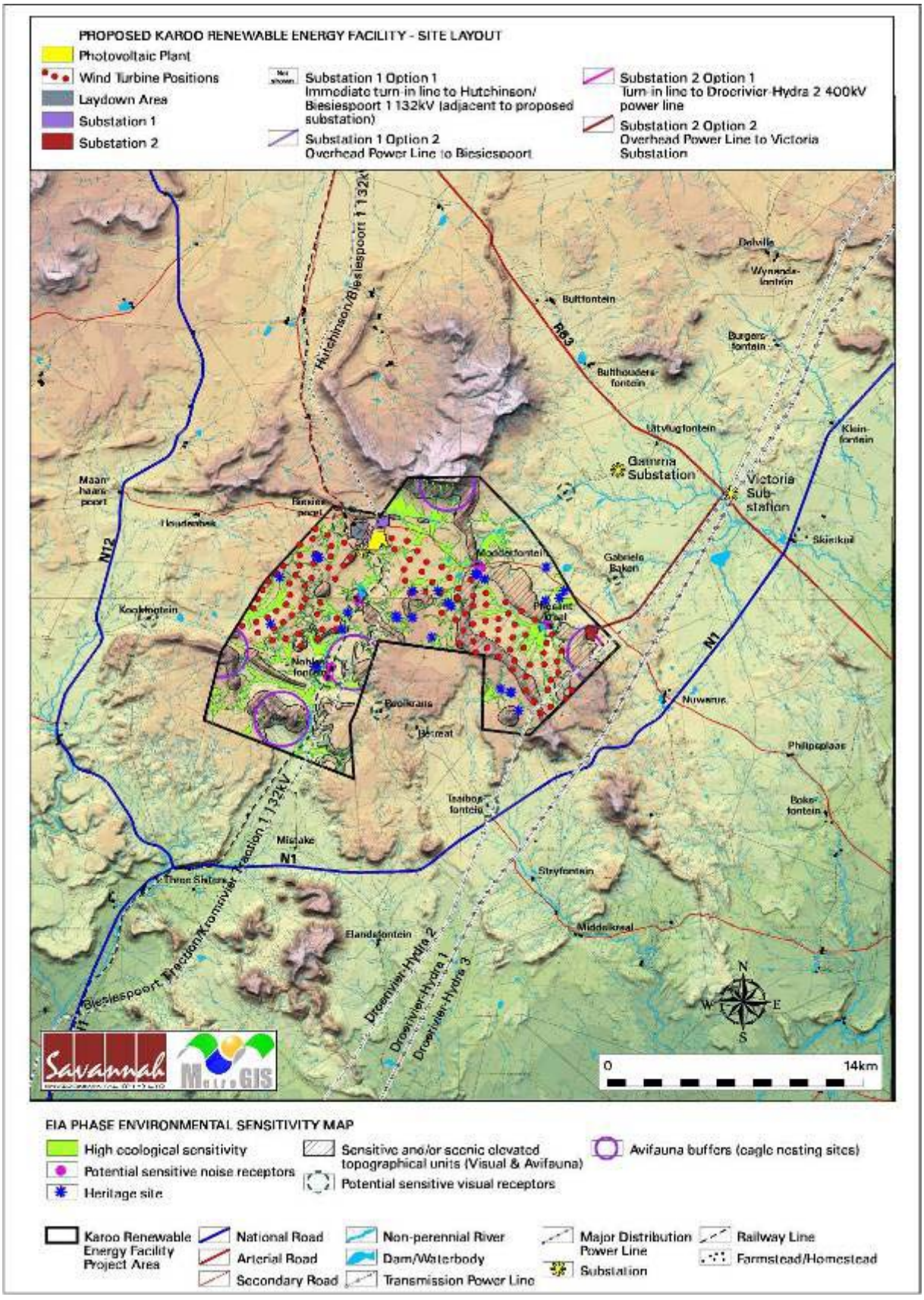

Figure 7.2: Combined Sensitivity Map for the Karoo Renewable Energy Facility site showing areas of high ecological, avifauna, heritage and visual sites, and sensitive noise receptors

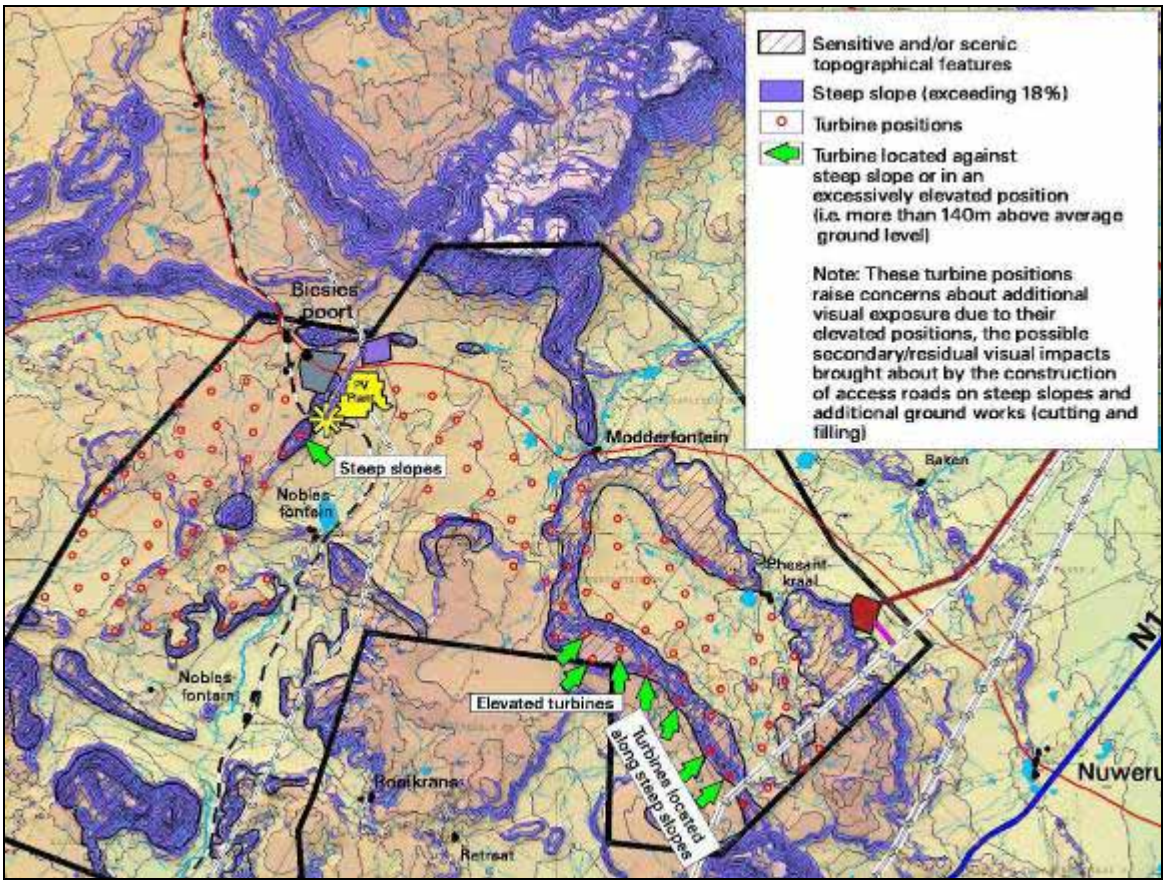

Figure 7.2: Map indicating turbine positions of concern from a visual perspective – i.e. the 3 turbines located in a particularly elevated position and the 5 turbines located on slopes in excess of 18° should ideally be repositioned to lower lying areas and more moderate slopes

7.3. Overall Conclusion (Impact Statement)

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. The South African Government has set a 10-year cumulative target for renewable energy of 10 000 GWh renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. This amounts to approximately 4% (1667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

The technical viability of implementing a renewable energy facility near Victoria West in the Northern and Western Cape Province has been established by SARGE. The positive implications of establishing a renewable energy facility on the demarcated site include:

» The project would assist the South African government in reaching their set targets for renewable energy.

» The potential to harness and utilise good renewable energy resources would be realised.
» The National electricity grid would benefit from the additional generated power.
» Promotion of clean, renewable energy in South Africa.
» Positive impacts on the tourism economy of the area.
» Creation of local employment and business opportunities for the area.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures.
» Implementation of the recommended mitigation, monitoring and management measures in the draft Environmental Management Plan (EMP) can reduce the significance of these impacts of high significance to moderate or low significance ratings.
» The areas of high sensitivity which have been classified as exclusion or 'no-go' areas are those which could impact on nesting sites of Verreaux's Eagle and Martial Eagle. Compliance with the recommendations pertaining to these exclusion areas (i.e. the mitigation for the identified areas) will address those avifaunal impacts identified as being of high significance.
» Provided that the recommended mitigation and management measures are implemented, there is **no single environmental fatal flaw** that should prevent the proposed project from proceeding.
» With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.
» In terms of the proposed power lines to be constructed, **Option 1** is preferred in both cases for **Substation 1 and 2** from an environmental perspective.

7.4. Overall Recommendations

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the wind energy facility, PV solar facility and associated substations and power lines, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Karoo Renewable Energy Facility and associated infrastructure is environmentally acceptable, and can be mitigated to an acceptable level (provided the appropriate mitigation measures are implemented). This mitigation includes the relocation of turbines located in areas of sensitive and/or scenic elevated topographical units to lower lying areas and more moderate slopes in order to reduce the potential for high visual impacts. The visual

impact associated with the wind component of the proposed facility is the primary impact which cannot be significantly mitigated - however the impact of high significance is restricted to within a distance of 5 km of the site.

The following infrastructure should be included within an authorisation issued for the project:

» Up to 150 wind turbines with a generating capacity of up to 450MW;
» An array of **photovoltaic (PV) panels** occupying an area of approximately 97 ha (including access roads) with a generating capacity of up to 50MW;
» Two (2) **132 kV substations** with high-voltage (HV) yard footprints of approximately 100m x 100m each. One substation will be located towards the northern section of the site and the second substation towards the south eastern corner of the site.
» **Foundations** to support both the turbine towers as well as the PV panels;
» **Cabling (33kV)** between the project components, to be lain underground where practical;
» **Two (2) new overhead 132 kV power lines -**
  - Substation 1 Option 1: To turn-in directly to the existing Hutchinson/Biesiespoort-1 132kV line (up to 1km length of power line);
  - Substation 2 Option 1: To turn-in directly to the existing Droerivier/Hydra-2 400kV line (up to 1.5 km length of power line)
» **Internal access roads** (5 m wide and ~82.15 km long) linking the wind turbines and PV component with the other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines will necessitate the construction of a number of new internal access roads; and
» **Small office and/or workshop building** (40m x 20m) for maintenance and storage purposes.

The following conditions should be included within an authorisation issued for the project:

» All mitigation measures detailed within this report and all practical mitigation measures detailed within the specialist reports contained within Appendices F - M must be implemented.
» The draft Environmental Management Plan (EMP) as contained within Appendix N of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed renewable energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMP for all life cycle phases of the proposed project is considered key in achieving the appropriate environmental management standards

as detailed for this project. This document should be considered as a dynamic document and must be updated as required throughout the life cycle of the facility.

» No facility components should be placed in demarcated high ecological, avifaunal and visual sensitivity areas (refer to Figure 7.1).

» All exclusion areas in terms of avifauna should be demarcated on-site, and no disturbance during the construction phase should be allowed in these demarcated areas. These include areas within:
  - 500 m of any cliff lines or elevated ridges within the development area to reduce collision risk, primarily for slope soaring raptors.
  - 1500 m of any known or suspected Verreaux's Eagle nest sites to reduce disturbance and collision risk for this species.
  - 2500 m of any known or suspected Martial Eagle nest sites to reduce disturbance and collision risk for this species.

» The above avifaunal exclusion areas could affect the location of Substation 2 in the south-east. Substation 2 should be repositioned so as to avoid a nesting site of a Verreaux's Eagle.

» The monitoring protocols for avifauna, as required by Appendix G of this report, should be implemented.

» During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.

» Internal access roads should be planned with due cognisance of the topography. Roads should be laid out along the contour wherever possible, and should never traverse slopes at 90 degrees. Construction of roads should be undertaken with adequate drainage structures in place to forego potential erosion problems.

» All construction areas, specifically trenches, road servitudes and cut and fill slopes should be appropriately rehabilitated after construction. This rehabilitation must also be monitored and maintained during operation.

» No development must take place within 100m of the rock shelters containing paintings, rocky outcrops with boulders containing rock engravings and stone-wall structures. If it is, however, inevitable that construction activities must take place within 100m of the heritage material, a perimeter fence must be erected to protect the sensitive area from any possible negative impact.

» Despite not been affected by the development, the exposed human remains must be reported to the South African Heritage Resources Agency (SAHRA) so that they may appoint the relevant archaeologist/s to remove the exposed human remains.

» If at any stage during the construction phase any semblance of a fossil were to be observed, it would be vital to recover the fossil and report the occurrence to the relevant authority.

» The three turbines located in particularly elevated positions (i.e. on top of a landform more than 140m above the surrounding area) and the five turbines located on slopes in excess of 18 degrees should be repositioned through the final micro-siting to lower lying areas and more moderate slopes.

- A lighting engineer should be consulted to assist in the planning and placement of light fixtures for the turbines, the PV plant and the ancillary infrastructure in order to reduce visual impacts associated with glare and light trespass.
- Turbines located within 500 m of any inhabited settlement, homestead or public road should be relocated to beyond this distance in order to negate the potential impact of shadow flicker.
- When working near (within 500 m) to a potential sensitive receptor(s), the number of simultaneous construction activities must be limited to the minimum.
- Quarterly noise monitoring at the identified potential sensitive noise receptors is recommended to be conducted by an acoustic consultant or approved noise inspection authority for the first year of operation.
- Should the layout (or type of wind turbines used) change significantly during the final design, it is recommended that the revised layout be remodelled/reviewed in terms of:
  - the potential noise impact by an independent acoustics specialist;
  - the potential ecological impact, should areas within the defined high sensitivity areas be impacted, by an independent ecologist.
- In order to enhance the local employment and business opportunities, mitigation/enhancement measures listed in the Social Impact Assessment should be implemented.
- A comprehensive stormwater management plan should be compiled for those portions of the site which will be altered through the introduction of extensive hard/compressed surfaces.
- Applications for all other relevant and required permits required to be obtained by SARGE must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to any riparian vegetation or wetlands.
- Following the final design phase of the facility, a final layout must be submitted to DEA for review and acceptance.

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