ENVIRONMENTAL IMPACT ASSESSMENT PROCESS
FINAL EIA REPORT

PROPOSED HAPPY VALEY WIND ENERGY FACILITY ON A SITE NEAR HUMANSDORP

(DEA Ref No: 12/12/20/1861)
(NEAS Ref No: DEAT/EIA/12309/2011)

FINAL EIA REPORT

September 2011

Prepared for:

Renewable Energy Investments South Africa (Pty) Ltd
PO Box 197
Simondium
7670

REISA
Renewable Energy Investments South Africa

Prepared by:

Savannah Environmental Pty Ltd

UNIT 606, 1410 EGLIN OFFICE PARK
14 EGLIN ROAD, SUNNINGHILL, GAUTENG
PO BOX 148, SUNNINGHILL, 2157
TEL: +27 (0)11 234 6621
FAX: +27 (0)86 684 0547
E-MAIL: INFO@SAVANNAHSA.COM
WWW.SAVANNAHSA.COM

Savannah
ENVIRONMENTAL (PTY) LTD

PROJECT DETAILS

DEA Reference No.	:	12/12/20/1861
NEAS Reference No.	:	DEAT/EIA/12309/2011
Title	:	Environmental Impact Assessment Process Final EIA Report: Proposed Happy Valley Wind Energy Facility & Associated Infrastructure near Humansdorp, Eastern Cape Province
Authors	:	Savannah Environmental (Pty) Ltd John von Mayer & Karen Jodas
Sub-consultants	:	MetroGIS David Hoare Consulting Avisense Consulting Animalia Consulting Agricultural Research Council (ARC): Institute for Soil, Climate and Water Albany Museum M2 Environmental Connections Tony Barbour Sustainable Futures
Client	:	Renewable Energy Investments South Africa (Pty) Ltd
Report Status	:	Final EIA Report for authority review

When used as a reference this report should be cited as: Savannah Environmental (2011) Final EIA Report: Proposed Happy Valley Wind Energy Facility and Associated Infrastructure near Humansdorp, Eastern Cape Province

PURPOSE OF THE EIA REPORT

Renewable Energy Investments South Africa (Pty) Ltd (REISA) is proposing to establish a commercial wind energy facility and associated infrastructure on a site located within Kouga Municipality in the Eastern Cape Province. The facility will be referred to in this report as the Happy Valley Wind Energy Facility near Humansdorp. REISA has appointed Savannah Environmental, as independent environmental consultants, to undertake the EIA. The EIA process is being undertaken in accordance with the requirements of the National Environmental Management Act (NEMA; Act No. 107 of 1998).

This EIA Scoping Report represents the outcome of the EIA Phase of the EIA process and contains the following sections:

Chapter 1 provides background to the proposed Happy Valley Wind Energy Facility project and the environmental impact assessment
Chapter 2 describes the activities associated with the project (project scope). This chapter also describes wind energy as a power option and provides insight to technologies for wind turbines
Chapter 3 outlines the regulatory and legal context of the EIA study
Chapter 4 outlines the process which was followed during the EIA Phase of the project, including the consultation program that was undertaken
Chapter 5 describes the existing biophysical and socio-economic environment
Chapter 6 describes the assessment of environmental impacts associated with the proposed wind energy facility
Chapter 7 presents the conclusions of the impact assessment as well as an impact statement
Chapter 8 contains a list references for the EIA report and specialist reports

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

The release of a draft EIA Report provided stakeholders with an opportunity to verify that the issues they have raised to date have been captured and adequately considered within the study. The Final EIA Report now incorporates all issues and responses prior to submission to the National Department of Environmental Affairs (DEA), the decision-making authority for the project.

PUBLIC REVIEW OF THE DRAFT EIA REPORT

The Draft EIA Report was made available for public review from 05 August 2011 – 04 September 2011 at the following locations:

» www.savannahSA.com
» Humansdorp Library

The report was also available on:

» www.savannahSA.com

SUMMARY

Background and Project Overview

Renewable Energy Investments South Africa (Pty) Ltd (REISA) is proposing the establishment of a commercial wind energy facility and associated infrastructure which will be referred to as the Happy Valley Wind Energy Facility. The wind energy facility is proposed to be established on an identified site which is located approximately 9 km north-west of Humansdorp in the Eastern Cape, within the Kouga Local Municipality.

The nature and extent of the proposed facility, as well as potential environmental impacts associated with the construction of a facility of this nature is explored in more detail in this EIA Report.

The wind energy facility is proposed on Portion 1 and Remaining Extent of Farm 810.

The proposed facility will have a **generating capacity of up to 40 MW** and will be comprised of the following infrastructure:

» A cluster of up to **20 wind turbines**[1] to be constructed over an area of ~ **12 km²** in extent
» Each turbine will be a **steel tower** (of up to 80m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of up to 100 m (i.e. each blade up to 50 m in length)
» **Concrete foundations** (16m x 16m x 2,5m) to support the turbine towers
» Underground electrical distribution **cabling** between the turbines
» An on-site substation (up to 35m x 22m) with an associated transformer
» A new overhead power line (up to 132kV) to connect to Eskom's existing Melkhout substation;
» **Internal access roads** (3m wide) to each wind turbine within the facility
» **Upgrade** to existing **site access** infrastructure
» Small office and/or workshop building (20m x 10m) for maintenance purposes.

Environmental Impact Assessment

» Overall the proposed wind energy facility is likely to have a medium - high local and regional negative impact on the ecology on site, prior to mitigation. This could be reduced to medium - low after mitigation. The primary negative impacts are the result of both direct and indirect factors. Direct impacts

[1] The layout assessed in this EIA report (Figure 2.1) indicates a total of 13 wind turbines proposed for the site, however the application remains for up to twenty wind turbines.

include loss of 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. A number of impacts associated with this project are due to the fact that some of the infrastructure is proposed to be positioned within a part of the landscape that is currently in a relatively pristine condition, and within vegetation that, although not considered a high conservation priority nationally (Kouga Grassy Sandstone Fynbos is classified as Least Threatened), is considered to potentially have high biodiversity value. This portion of the sitecontributes valuable ecosystem goods and services to the surrounding landscape, primarily with respect to being a water catchment area. A portion of the proposed turbines are positioned near the summit of the highest part of the mountain ridgeline which dominates the landscape. This will result in a high degree of fragmentation of a currently undisturbed landscape. The introduction of infrastructure in these areas will compromise the ecological integrity of this area and, potentially, of immediately surrounding areas.

» The primary concern for the proposed facility in terms of avifauna will be that of collision of birds with the turbines and earth wires of the power line. This impact on avifauna is potentially of medium - high significance, but could be reduced to a medium - low significance with the implementation of mitigation measures. 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.

» The findings of the geology and soils study indicate the most important impacts on geology and soils include soil degradation (including erosion). The significance of the main direct impacts that have been identified is considered low to moderate due to the localised and limited extent of the proposed activity and the anticipated geology which appears to be generally favourable towards the proposed layout. An assessment of the potential geotechnical constraints on the project indicates no insurmountable problems which have may have an impact on the design and construction processes. Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary degradation of soil. Special attention to be given to roads that cross drainage lines and roads on steep slopes (to prevent unnecessary cutting and filling operations).

» The results of the heritage survey suggest that the impacts associated with turbine and other infrastructure footprints would have a negligible impact on the archaeological material in the study

area. This impact is potentially of moderate significance but can be reduced to low significance with the implementation of mitigation and monitoring measures. There is a remote chance that trace or invertebrate body fossils may well be found in the development phase during excavation, road building or trenching. Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

» It is envisaged that the structures would be easily and comfortably visible to observers (i.e. travelling along roads, residing at homesteads or visiting the region), especially within a 5 to 10 km radius (i.e. at short to medium distances) of the facility and would constitute a high visual prominence, potentially resulting in a high visual impact. In terms of visual exposure, it is not considered "best practise" from a visual impact point of view to place wind turbines (due to their scale) on scenic and/or elevated topographical units (i.e. hills, mountains, etc.). However, it is acknowledged that the facility is not considered to be fatally flawed (completely unacceptable).

» The potential for noise impact on surrounding areas (outside of the development footprint) is of low significance. The potential impact on sensitive receptors (e.g. homesteads) within the proposed wind energy facility footprint is potentially of medium significance on one of the identified sensitive receptors, but this will be dependent on final turbine placement and mitigation measures applied in order to reduce potential noise impacts on any receptors to a low significance. Care must be taken to ensure that the operations at the wind energy facility do not unduly cause annoyance or otherwise interfere with the quality of life of the receptors.

» The majority of the potential negative impacts on the social environment as a result of the construction and operation of the wind energy facility are expected to be of moderate to low significance, with implementation of the recommended mitigation measures. A number of positive impacts have been identified, which could be further enhanced if managed effectively.

No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of high significance requiring mitigation have been highlighted. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Plan (EMP) included within Appendix O. The most significant environmental impacts associated with the proposed project, as identified through the EIA, include:

» Ecological impacts associated with the construction and operation of the facility (most specifically the

access roads to the turbine positions), specifically damage to wetlands and drainage lines, impacts due to changes in run-off and drainage patterns, loss of vegetation and the spread of alien plant species.

» Visual impacts on the natural scenic resources of the region imposed by the components of the facility (most specifically the turbines).

» Local site-specific impacts as a result of physical disturbance/modification to the site with the establishment of the facility.

» Impacts associated with the access roads, substation and power line.

» Impacts on the social environment

From the specialist investigations undertaken for the proposed wind energy facility site, several environmentally sensitive areas were identified with regard to potential ecological impacts. The only effective way to reduce impacts on natural vegetation is to modify the position of infrastructure to avoid the pristine mountain areas. Impacts associated with turbines 1, 8, 9, 10, 11, 12 and 13 must be very carefully controlled in order to minimize impacts on habitat within the mountain area where there are steep slopes and undisturbed vegetation.

The access roads, rather than the turbine footprints potentially have the most significant impact (owing to approximately 10km of access road being required). The useof existing tracks on the site must be prioritised. This would reduce the need of new road to ~8 km. The number of internal access roads needs to be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road.

on the site, which could disturb resident birds during the construction phase. During operation of the facility, the threat of collision of avifauna with the turbine blades is the most significant impact. However, the real extent of this potential risk is not currently well understood within the South African context.

The proposed development will possibly affect populations of regionally or nationally threatened (and impact susceptible) birds (mainly raptors and large terrestrial species) likely to occur within or close to the proposed turbines. The facility will probably have a detrimental impact on these birds, particularly during its operational phase, unless commitment is made to mitigating these effects. Careful and responsible implementation of the required mitigation measures should reduce construction and operational phase impacts to 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 African avifauna. The impacts of this development must be viewed in the context of the potential cumulative effects generated by at least five other wind energy project proposed for the same general area.

It is also considered essential that the bird interactions which do take place with the establishment of the facility are fully documented. To this end, the initiation of a comprehensive pre-and-post commissioning monitoring programme, and a longer-term scheme for surveying bird movements in relation to the wind energy facility and fully documenting all collision (or electrocution with power line infrastructure/substation) casualties, is considered critical. Such a monitoring programme will also inform and refine any post-construction mitigation of impacts which might ultimately be required.

In order to reduce/avoid impacts on sensitive areas, it is recommended that:

» Impacts associated with turbines 1, 8, 9, 10, 11, 12 and 13 must be very carefully controlled in order to minimise impacts on habitat within the mountain area where there are steep slopes and undisturbed vegetation.
» As far as possible, wind turbines and associated laydown areas and access roads which could potentially impact on sensitive areas should be shifted in order to avoid these areas of high sensitivity (i.e. best practice is impact avoidance). Where this is not technically feasible or viable, alternative mitigation measures as detailed in this report must be implemented.
» 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 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 much as possible.
» Any steep slopes are therefore considered to have elevated sensitivity from an ecological perspective. This applies to most of the mountain ridge that constitutes the main topographic feature on site.
» The number of internal access roads must be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road.

» A comprehensive search for threatened and near-threatened plant populations must be undertaken within the footprint of the proposed infrastructure prior to construction. This walk-through survey should take place during an appropriate season to maximise the likelihood of detecting these plants. If any plants are found, localised modifications in the position of infrastructure must be made to avoid such populations and a suitable buffer zone around them.
» Natural drainage lines should be considered no-go areas to reduce potential erosion impacts.
» A comprehensive programme to fully monitor the actual impacts of the facility on the broader avifauna of the area be implemented to cover the pre-construction environment as well as the operational phase of the project (Appendix H and Appendix O).
» The workshop area, any interim construction facilities and temporary laydown areas should located away from any identified sensitive areas.
» The developer must consider the various mitigation options as suggested in the noise EIA assessment (Appendix M) to reduce the significance of the potential noise impact on any sensitive receptors to an impact of lower significance.

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 ~4% (1667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

Through pre-feasibility assessments and research, the viability of establishing a wind energy facility on a site north-west of Humansdorp has been established by Renewable Energy Investments South Africa (REISA). The positive implications of establishing a wind energy facility on the demarcated site within the Eastern Cape include:

» The project would assist the South African government in reaching their set targets for renewable energy.
» The potential to harness and utilise good wind energy resources at an inland site would be realised.
» The National electricity grid in the Eastern Cape 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 there are no environmental fatal flaws that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation and management measures are implemented, and given due consideration during the process of finalising the wind energy facility layout.

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.

The proposed substation position and power line corridors are considered to be acceptable from an environmental perspective. The proposed power line should follow the alignment Alternative 1 in order to minimise potential visual and ecological impacts.

The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

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 facility and associated substation and distribution power line, 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 Happy Valley Wind Energy Facility on a site near Humansdorp is not fatally flawed.

1. The visual impact associated with the facility is the primary impact which cannot be significantly mitigated. However the impact of high significance is restricted to within a distance of 5 - 10 km of the site. In terms of visual exposure, the facility a small facility, further reducing the potential visual impact. From a technical perspective, its location makes it highly desirable in terms of the overall efficiency of the plant.
2. The primary concerns related to this proposed project are due to impacts caused by the linear infrastructure, specifically the internal access roads, and not to the turbines and/or substation. However correct placement of infrastructure and the application of mitigation measures listed in this EIA report will reduce any associated potential ecological impacts to acceptable levels.

The following infrastructure would be included within an authorisation issued for the project:

» Construction of the Wind Energy Facility with up to 20 wind turbine units, and all associated infrastructure (access roads to site, internal access roads, workshop building)
» Construction of a single substation on the site at the position proposed in Figure 7.1.
» Overhead power line (of up to 132kV) linking the wind energy facility to the Eskom electricity distribution network via the existing Melkhout Substation as proposed in Figure 7.1 to follow the proposed Alternative 1 route.

The following conditions would be required to be included within an authorisation issued for the project:

» Mitigation measures detailed within this report and the specialist reports contained within Appendices F to N be implemented.
» The draft Environmental Management Plan (EMP) as contained within Appendix O of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed wind 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 to be key in achieving the appropriate environmental management standards as detailed for this project.
» Natural drainage lines should be considered no-go areas to reduce potential erosion impacts.
» Disturbed areas should be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
» During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum. The wind turbines and access road infrastructure should be positioned on the northern slope of the ridgeline to reduce impacts on sensitive ecological areas on the southern slope.
» A comprehensive stormwater management plan should be compiled for the substation footprints prior to construction.
» Mitigate secondary visual impacts associated with the construction of roads through the use of existing roads wherever possible. Where new roads are required, these should be planned taking 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 properly, with adequate drainage structures in place to forego potential erosion problems. Roads should be positioned behind (i.e. on the north side) of the crest of the ridge wherever possible. Access

roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.

» A monitoring program should be initiated in order to collect data on the numbers of birds affected by the wind energy facility.

» The developer should consider the various mitigation options as proposed in the noise assessment to reduce the significance of the potential noise impact on any sensitive receptors.

» Applications for all other relevant and required permits required to be obtained by REISA and 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.

TABLE OF CONTENTS

APPENDICES

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.

Article 3.1 (*sensu* Ramsar Convention on Wetlands): "Contracting Parties "shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory"".(Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (see http://www.ramsar.org/)

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 turbine's 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 of time 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 a wind turbine's 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 as a result of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

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

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

Natural properties of an ecosystem (*sensu* Convention on Wetlands): Defined in Handbook 1 as the "…physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them". (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (see http://www.ramsar.org/)

Ramsar Convention on Wetlands: "The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". As of March 2004, 138 nations have joined the Convention as Contracting Parties, and more than 1300 wetlands around the world, covering almost 120 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (refer http://www.ramsar.org/). South Africa is a Contracting Party to the Convention.

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).

Regional Methodology: The Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) have developed a guideline document entitled *Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape - Towards a Regional Methodology for Wind Energy Site Selection* (Western Cape Provincial Government, May 2006). The methodology proposed within this guideline document is intended to be a regional level planning tool to guide planners and decision-makers with regards to appropriate areas for wind energy development (on the basis of planning, environmental, infrastructural and landscape parameters).

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.

Sustainable Utilisation (*sensu* Convention on Wetlands): Defined in Handbook 1 as the "human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations". (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (refer http://www.ramsar.org/).

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.

Wise Use (*sensu* Convention on Wetlands): Defined in Handbook 1 (citing the third meeting of the Conference of Contracting Parties (Regina, Canada, 27 May to 5 June 1987) as "the wise use of wetlands is their sustainable utilisation for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem".(Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (see http://www.ramsar.org/)

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
DEDEA	Eastern Cape Department of Economic Development and Environmental Affairs
DEAT	National Department of Environmental Affairs and Tourism
DEA	National Department of Environmental Affairs
DME	Department of Minerals and Energy
DOT	Department of Transport
DWAF	Department of Water Affairs and Forestry
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographical Information Systems
GG	Government Gazette
GN	Government Notice
GWh	Giga Watt Hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IEP	Integrated Energy Planning
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)
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework
SIA	Social Impact Assessment
ZVI	Zone of visual influence

INTRODUCTION CHAPTER 1

Renewable Energy Investments South Africa (Pty) Ltd ("REISA") is proposing the establishment of a commercial wind energy facility and associated infrastructure which will be referred to as the Happy Valley Wind Energy Facility. The wind energy facility is proposed to be established on an identified site which is located approximately 9 km north-west of Humansdorp in the Eastern Cape, within the Kouga Local Municipality (Figure 1).

The nature and extent of this facility, as well as potential environmental impacts associated with the construction of a facility of this nature is assessed in more detail in this Final Environmental Impact Assessment (EIA) Report.

1.1. The Need for the Proposed Project

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and the on-going exploitation of resources. Grid connected renewable energy is currently the fastest growing sector in the global energy market. Installed global wind capacity was in the order of 195GW by the end of 2010, with total world installed capacity having doubled since 2004. Targets for the promotion of renewable energy now exist in more than 58 countries, of which 13 are developing countries. The South African Government has recognised the country's high level of renewable energy potential and presently has in place targets of 10 000 GWh of renewable energy by 2013 (to be produced mainly from biomass, wind, solar and small-scale hydro). This is amounts to ~4% (1 667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

To contribute towards this target and towards socio-economic and environmentally sustainable growth, and kick start and stimulate the renewable energy industry in South Africa, the need to establish an appropriate market mechanism was identified, and Government is considering the introduction of Feed-in Tariffs (FIT). FIT 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 (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.

Renewable energy is recognised internationally as a major contributor in protecting our climate, nature, and the environment as well as providing a wide range of environmental, economic and social benefits that will contribute towards long-term global sustainability.

It is considered viable that long-term benefits for the community and/or society in general can be realised should this site prove to be acceptable from a technical and environmental perspective for the potential establishment of a wind energy facility. In the event of the facility being developed, it will contribute to and strengthen the existing electricity grid for the area. In addition, the proposed project will aid in achieving the goal of a 30% share of all new power generation being derived from independent power producers (IPPs).

Currently, the Province has limited power generation and power in the Eastern Cape is predominately generated by coal power stations situated in the provinces of Limpopo and Mpumalanga and transmitted over a 1000 km via transmission power lines. A project of this nature will create needed energy generation capability in the region.

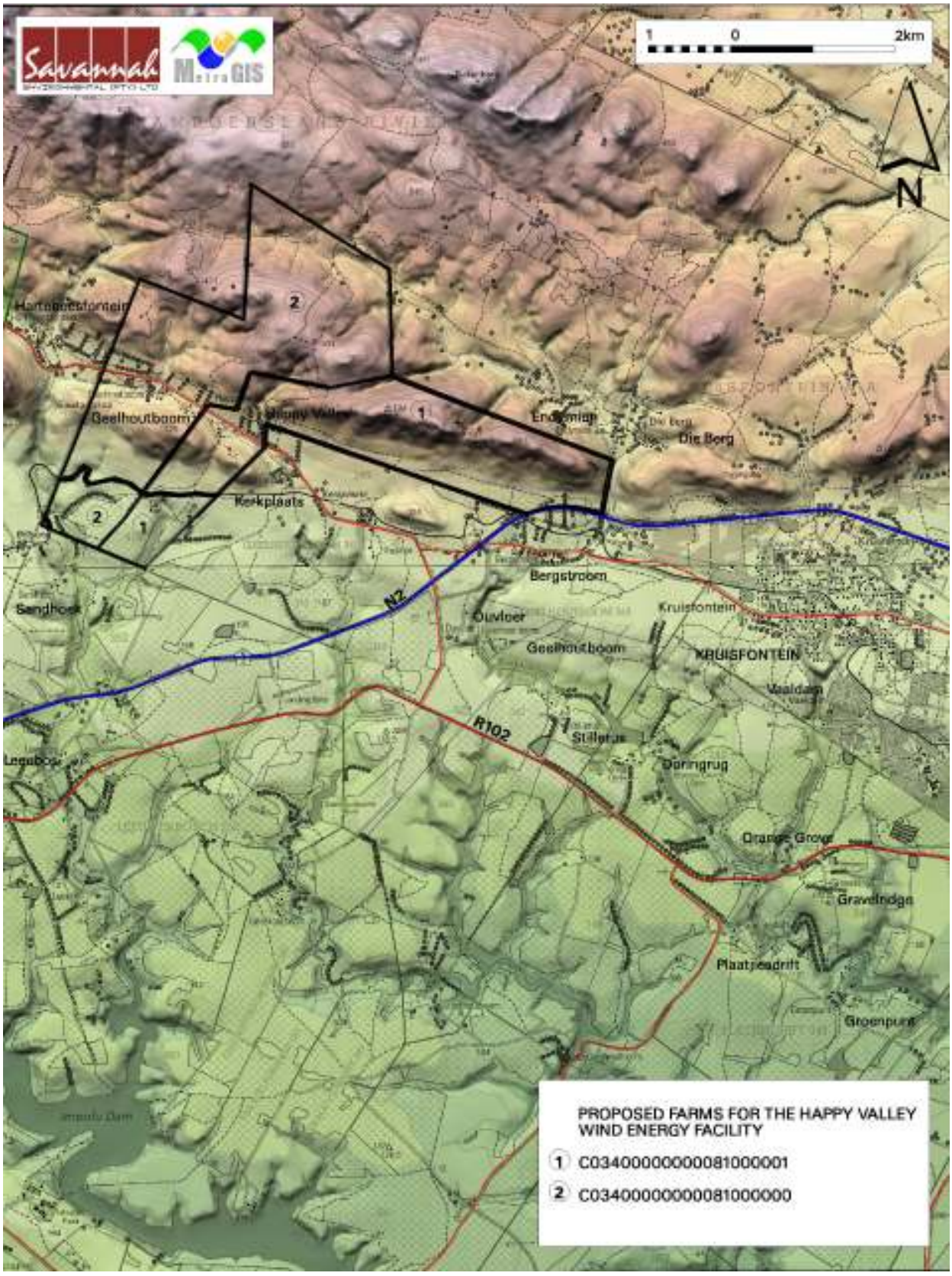

Figure 1.1: Locality map showing the proposed site for the establishment of the Happy Valley Wind Energy Facility

1.2. Rationale for the Proposed Happy Valley Wind Energy Facility

South Africa's electricity supply remains heavily dominated by coal-based power generation and has an extremely low market share of renewable energy generation. To date, South Africa has failed to exploit the diverse gains which the renewable energy industry offers, and the country's significant renewable energy potential remains largely untapped.

1.2.1. Renewable Generation Targets

Renewable energy is internationally recognised as a major contributor in protecting our climate, our natural resources and the environment as well as providing a wide range of environmental, economic and social benefits that will contribute towards long-term global sustainability. This is a rapidly growing international sector whose overall capacity increased to 280 GW in 2008, a 75% increase from 160 GW in 2004, excluding large hydropower.

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, there is a need to develop supplementary, environmentally friendly and sustainable sources of energy. 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 amount 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 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)).

1.2.2. Sustainable Growth and Feed-in-Tariffs

Feed-in Tariffs (FIT) are essentially guaranteed prices for electricity supply as opposed to conventional consumer tariffs. They have been set to promote socio-economic and environmentally sustainable growth. The basic economic principle underpinning the FIT is the establishment of a tariff that covers the cost of generation plus a "reasonable profit" to entice Independent Power Producers (IPP) to invest in generation projects. This is quite similar to the concept of cost recovery used in utility rate regulation based on the costs of capital. Renewable Feed-in Tariffs (REFIT) 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 the conditions under which electricity may be supplied by licence.

1.2.3. Project-related Benefits

The long-term benefits for communities and/or society in general can be realised should the site near Humansdorp prove acceptable (from a technical and environmental perspective) for the establishment of the proposed wind energy facility. Power generated at the facility will assist in strengthening the national electricity grid, and will contribute towards achieving the goal of a 30% share of all new power generation being derived from IPPs.

From national, regional and local perspectives, investment in renewable energy initiatives, such as the proposed wind energy facility, is supported. It is important that policy is enacted at the national level to encourage renewable energy development as South Africa is a signatory to the Kyoto Protocol[2].

1.3. Project Overview

The proposed site lies approximately 9 km north-west of Humansdorp in the Eastern Cape within the Kouga Local Municipality, located within the Cacadu District Municipality. The larger site covers an area of approximately 12 km^2.

[2] The Kyoto Protocol calls for developed countries to reduce their green house gas emissions during the commitment period (2008 - 2012) by 5.2 % compared to 1990 levels. Developing countries, like South Africa, do not have a limit on their emissions.

The facility infrastructure, which will be appropriately placed on the larger site, will include the following:

» Up to **20 wind turbines** to be placed within an area of ~ **12 km^2** in extent
» Each turbine will be a **steel tower** (of up to 80m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of up to 100 m (i.e. each blade up to 50 m in length)
» **Concrete foundations** to support the turbine towers
» Underground electrical distribution **cabling** between the turbines
» An on-site substation with an associated transformer
» A new overhead power line (up to 132 kV) to connect to Eskom's existing Melkhout substation ~12 km east of the site;
» **Internal access roads** to each wind turbine within the facility
» **Main access road leading to the site**
» Small office and/or workshop building for maintenance purposes

The overarching objective for the wind energy facility planning process is to maximise electricity production through **exposure to the wind resource**, while minimising infrastructure, operational and maintenance costs, as well as **social and environmental impacts**. These issues have now been considered within **site-specific studies** and assessments through the EIA process in order to delineate areas of sensitivity within the broader site and ultimately inform the placement of the wind turbines and associated infrastructure on a site.

As the performance of the turbines is determined by disturbances to the wind resource, turbines must be appropriately spaced within the facility to minimise the potential for reduced turbine efficiency. A preliminary design for the layout of the wind turbine infrastructure is considered within this EIA report. The exact positioning or detailed layout of the components of this proposed wind energy facility will be developed by taking cognisance of environmental sensitivities and mitigation measures identified through the EIA process. A final layout of the turbines within the facility would be prepared prior to construction.

The scope of the proposed project, including details of all elements of the project (for the construction, operation and decommissioning phases) is discussed in more detail in Chapter 2.

1.4. Requirement for an Environmental Impact Assessment Process

In order to assess local level environmental and planning issues in sufficient detail, site-specific studies and assessments are required to be undertaken through the EIA process in order to delineate areas of sensitivity within the

broader site and ultimately inform the placement of the wind turbines and associated infrastructure on a site.

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

NEMA is the national legislation that provides for the authorisation of "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these activities must be considered, investigated, assessed and reported on to the competent authority who has been charged by NEMA with the responsibility of granting environmental authorisations. As this is a proposed electricity generation project and thereby considered to be of national importance, the National Department of Environmental Affairs (DEA) is the competent authority and the Eastern Cape Department of Economic Development and Environmental Affairs (DEDEA) will act as a commenting authority. An application for authorisation was accepted by DEA under application reference number **12/12/20/1861**. *Note: This EIA process is being conducted in accordance EIA Regulations that were current at the time of application for authorisation (i.e. the EIA Regulations of April 2006).*

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. REISA (Pty) Ltd appointed Savannah Environmental to conduct the independent Environmental Impact Assessment process for the proposed wind energy facility.

An EIA is also an effective planning and decision-making tool for the project proponent. It allows the environmental consequences resulting from a technical facility during its establishment and its operation to be identified and appropriately managed. It provides the opportunity for the developer to be forewarned of potential environmental issues, and allows for resolution of the issue(s) reported on in the Scoping and EIA reports as well as dialogue with affected parties.

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 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)	*1(m)*	*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 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 April 2006)	*15*	*The construction of a road that is wider than 4 m or that has a reserve wider than 6 m, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 m long.*
Government Notice R386 (21	*16(b)*	*The transformation of undeveloped, vacant or derelict land to residential mixed, retail, commercial, industrial*

April 2006)		*or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1 hectare.*

1.5. Objectives of the Environmental Impact Assessment Process

The Scoping Phase of the EIA is the process of identifying potential issues associated with the proposed project, and defining the extent of studies required within the EIA Phase. This was achieved through an evaluation of the proposed project in order to identify and describe potential environmental impacts. The Scoping Phase included input from the project proponent, specialists with experience in the study area as well as in EIAs for similar projects, as well as a public consultation process with key stakeholders that included both government authorities and interested and affected parties (I&APs). The Scoping phase was concluded in December 2010.

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

The release of the draft EIA Report provided stakeholders with an opportunity to verify the issues they have raised through the EIA process have been captured and adequately considered. The final EIA Report now incorporates all issues and responses raised during the public review of the draft EIA Report prior to submission to DEA.

This EIA Report consists of the following sections:

Chapter 1 provides background to the proposed Happy Valley Wind Energy Facility project and the environmental impact assessment
Chapter 2 describes the activities associated with the project (project scope). This chapter also describes wind energy as a power option and provides insight to technologies for wind turbines
Chapter 3 outlines the regulatory and legal context of the EIA study
Chapter 4 outlines the process which was followed during the EIA Phase of the project, including the consultation program that was undertaken
Chapter 5 describes the existing biophysical and socio-economic environment
Chapter 6 describes the assessment of environmental impacts associated with the proposed wind energy facility

Chapter 7 presents the conclusions of the impact assessment as well as an impact statement
Chapter 8 contains a list references for the EIA report and specialist reports

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

Savannah Environmental was contracted by REISA as an independent consultant to undertake an EIA for the proposed project, as required by the NEMA EIA Regulations. Neither Savannah Environmental, nor any of its specialist sub-consultants on this project are subsidiaries of or affiliated to REISA. Furthermore, Savannah Environmental does not have any interests in secondary developments that may arise out of the authorisation of the proposed project.

Savannah Environmental is a specialist environmental consulting company providing a holistic environmental management service, including environmental assessment and planning to ensure compliance and evaluate the risk of development; and the development and implementation of environmental management tools. Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team.

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

Savannah Environmental has gained extensive knowledge and experience on potential environmental impacts associated with electricity generation projects through their involvement in related EIA processes. Savannah Environmental has completed several EIA processes for wind energy facilities in various parts of the country including the reporting for the Eskom Holdings Limited wind energy facility on the West Coast at Skaapvlei, the Umoya Energy Hopefield Wind Energy Facility in the Western Cape, Moyeng's proposed Suurplaat Wind Energy Facility in the Northern and Western Cape as well as their proposed West Coast One Wind Energy Facility in the Western Cape, Rainmaker Energy's Dorper and AB's Wind Energy Facilities in the Eastern Cape and the African Clean Energy Developments Wind Energy Facility near Cookhouse in the Eastern Cape, amongst others. Savannah Environmental has therefore developed a valuable understanding of impacts associated with such facilities. In addition, Savannah Environmental has

successfully managed and undertaken EIA processes for other power generation projects for throughout South Africa. Curricula vitae for the Savannah Environmental project team consultants are included in Appendix A.

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

OVERVIEW OF THE PROPOSED PROJECT CHAPTER 2

This chapter provides an overview of the proposed Happy Valley Wind Energy Facility. The project scope includes the planning/design; construction; operation and decommissioning activities. This chapter also explores site and technology alternatives as well as a "do nothing" option. Lastly, it explores wind energy facilities as a means for power generation.

The facility is proposed on the following farm portions (refer to Figure 2.1):

» Portion 1 of Farm 810
» Remaining extent of Farm 810

The proposed site lies approximately 9 km north-west of Humansdorp in the Eastern Cape within the Kouga Local Municipality, located within the Cacadu District Municipality. The larger site covers an area of approximately 12 km^2. The facility infrastructure, which will be appropriately placed on the larger site, will include the following:

» A cluster of up to **20 wind turbines**[3] to be constructed over an area of ~ **12 km^2** in extent
» Each turbine will be a **steel tower** (of up to 80m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of up to 100 m (i.e. each blade up to 50 m in length)
» **Concrete foundations** (16m x 16m x 2,5m) to support the turbine towers
» Underground electrical distribution **cabling** between the turbines
» An on-site substation (up to 35m x 22m) with an associated transformer
» A new overhead power line (up to 132kV) to connect to Eskom's existing Melkhout substation;
» **Internal access roads** (3m wide) to each wind turbine within the facility
» **Upgrade** to existing **site access** infrastructure
» Small office and/or workshop building (20m x 10m) for maintenance purposes

Initially, the original Draft Scoping Report (Savannah Environmental, July 2010) only considered Portion 1 of Farm 810, however the site extent has since been revised to also include the Remaining Extent of Farm 810, a portion to the northwest of portion 1 of Farm 810, in order to allow for greater installed capacity. This additional farm portion covers an area of approximately 5 km^2, which brings the total footprint of the site to approximately 12 km^2. The revised

[3] The layout assessed in this EIA report (Figure 2.1) indicates a total of 13 wind turbines proposed for the site, however the application remains for up to twenty wind turbines.

Draft Scoping Report (Savannah Environmental, December 2010) considered these changes to the project scope. In April 2011 acceptance was provided by the National Department of Environmental affairs to continue with the EIA phase of the project.

This chapter provides details regarding the scope of the proposed Happy Valley Wind Energy Facility near Humansdorp. This chapter also explores wind energy as a power generation technology, as well as the alternative options with regards to the proposed wind energy facility development, including the "do nothing" option.

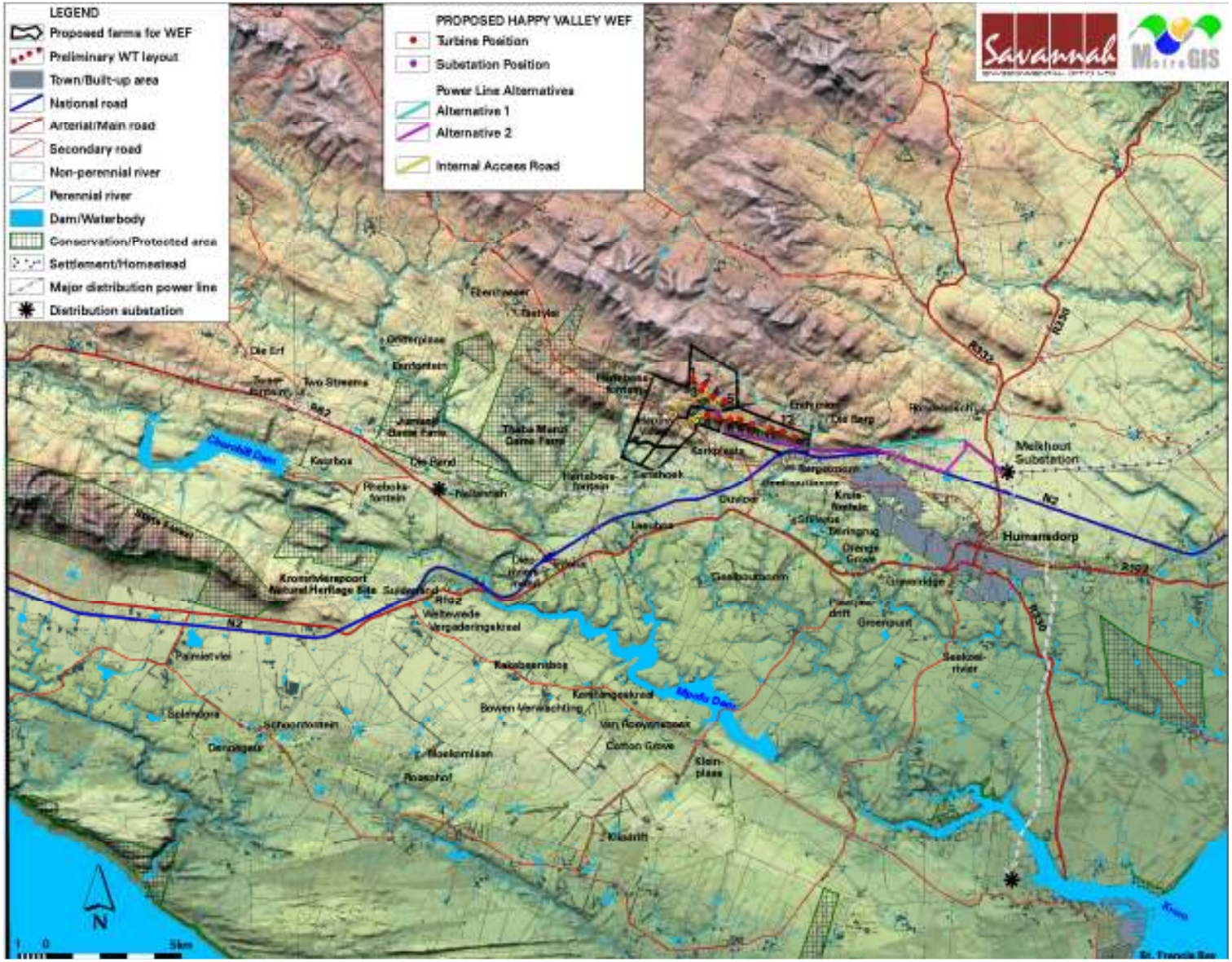

Figure 2.1: Locality map showing the broader study area, as well as the properties included in the development site, as well as a provisional wind turbine layout, power line corridors and proposed substation location within the development footprint

2.1. Rationale for Site Alternative

The site for the proposed Happy Valley Wind Energy Facility has been identified by REISA as a highly desirable site. The characteristics which make it a preferred site include:

» **Wind resource:** the estimated average wind speeds for the site are considered excellent for wind generation. This has been confirmed from monitored data collected at the site from two existing 80 m high wind monitoring masts. These monitoring masts have been recording wind and atmospheric data since 30 August 2010. The higher wind speed allows fewer wind turbines to be installed on the site in order to generate a significant amount of power. The facility thus has the potential to generate more power than a similarly sized facility in a different area.
» **Topography:** the proposed site will allow for the avoidance of shielding of the wind resource as it is situated on elevated terrain which is directly exposed to the wind resource.
» **Extent of site:** the proposed site which covers an area of approximately 12 km^2 will allow for the installation of the entire facility including associated infrastructure in one central location as the extent of the site is larger than the development footprint required for the facility.
» **Power transmission and grid connection considerations:** an overhead power line is proposed to connect the facility to Eskom's existing Melkhout Substation. The Melkhout Substation is situated in close proximity to the site (~12 km east) thus reducing the length of new power line infrastructure that would be required as part of the project.
» **Site access**: the site can be accessed via the N2 national road to Port Elizabeth. Good access to the general area will assist in the transportation of the turbine components to the site from the Port Elizabeth harbours.
» **Local labour and economic stimulus:** the site is located in close proximity to the towns of Humansdorp, Kareedouw and Kruisfontein. These towns will act as a ready source of local labour during construction of the proposed facility.

Site selection draws on macro-level assessment of broad constraints, but also requires that micro-siting issues are considered in order to determine whether the project can constitute a potentially viable site.

From the site identification process undertaken by REISA, as well as the analysis of monitored wind data at the site, REISA considers the site to be a highly preferred site for the development of a wind energy facility. The suitability of the site is intended to be verified through monitored data to be recorded at a height of 60 - 80 m (two wind monitoring masts are currently installed on the site). Wind monitoring includes the following activities:

» Atmospheric studies (resource scale studies)
» Installation of wind monitoring mast/s on the site
» Correlation of atmospheric data to the wind mast monitored data
» Collection of up to 12 to 48 months of data in order to consider and confirm long-term trends.

2.1.1. Site-specific Layout Design Alternatives

Through the process of determining constraining factors, the layout of the wind turbines and infrastructure was planned. The overall aim is to maximise electricity production through exposure to the wind resource, while minimising infrastructure, operation and maintenance costs, and social and environmental impacts. The site was selected through a detailed process of identification of sites based on a combination of attributes that are required for a suitable, viable and sustainable wind energy facility.

Specialist software is available to assist developers in selecting the optimum position for each turbine. This turbine micro-siting information was provided to inform the specialist impact assessments. Due to the relatively small size of the site several restrictions also played a role in determining the preliminary locations of wind turbines. Complex terrain introduces wind flow effects such as turbulence that may not be acceptable for turbine siting. Terrain alignment with respect to the wind rose also needs to be assessed in order to ensure that workable turbine spacing can be effected.

A new overhead **power line** (of up to 132 KV) will be constructed to connect the on-site substation to the electricity distribution grid via Eskom's existing Melkhout substation. Routes for the power line will be assessed, surveyed and pegged prior to construction. Two **alternative corridors** are proposed for the proposed power line (refer to Figure 2.1). Alternative 1 is approximately 11 km in length. Alternative 1 exits the site in an easterly direction before reaching the N2 national road after ~6 km and then heading away from the N2 in a northeast direction for ~3 km. The line would then travel in a straight line southeast for 2 km towards the Melkhout substation. Alternative 2 is approximately 12 km in length. It follows an identical route but after 6 km (where Alternative 1 heads northeast away from the N2) Alternative 2 continues straight alongside the N2 for ~2.5 km before heading north where it again joins the Alternative 1 route before heading southeast towards Melkhout substation (refer to Figure 2.1). The sensitivity of the proposed routes for the power lines and proposed substation position are assessed through this EIA report.

2.1.2. The 'do-nothing' Alternative

The 'do-nothing' alternative is the option of not constructing the Happy Valley Wind Energy Facility. Should this alternative be selected there will be no potential environmental impacts.

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 for future generations:** Actions to reduce our disproportionate carbon footprint can play an important part in ensuring our role in preventing dangerous anthropogenic climate change; thereby securing the natural foundations of life for generations to come.

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 contribution to final energy consumption by 2013. The target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro. DME'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)).

The primary rationale for the proposed Happy Valley Wind Energy Facility is to add new generation capacity from renewable energy to the national electricity mix and to aid in achieving the goal of a 42% share of all new installed generating capacity (new build) being derived from renewable energy forms, as targeted by the Department of Energy (DoE) (Integrated Resource Plan 2010 – 2030). In terms of the Integrated Resource Plan (IRP), approximately 28.8% of the renewable energy mix is planned to be generated from wind technologies over the next twenty years. This is, however, dependent on the assumed learning rates and associated cost reductions for renewable options.

In the event of the project being developed, it will contribute to the local electricity grid, as well as to the target for renewable energy as detailed in the IRP. In addition, the implementation of the proposed project will provide both

economic stimulus to the local economy through the construction process and employment for the operational phase of the facility.

Through research, the viability of the Happy Valley wind energy facility has been established. The 'do nothing' alternative will not assist the South African government in reaching their set targets for renewable energy. In addition, the Eastern Cape power supply will not benefit from the additional generated power being evacuated directly into the Province's grid.

Currently the site proposed for the Happy Valley Wind Energy Facility is not being used for any farming activities. Mr. Mayer, an adjacent farm owner, indicated that he did not feel that the proposed facility would impact on his current dairy farming operations. This opinion seems to be shared by the other surrounding landowners.

The 'do nothing' option would mean that no environmental impacts would occur on site as a result of the construction or operation of the wind energy facility, as it maintains the current status quo and the site would continue to go unused. However the 'do nothing' option would represent a lost opportunity for South Africa to supplement is current energy needs with clean, renewable energy. Given South Africa's position as one of the highest per capita producer of carbon emissions in the world, this would represent a High negative social cost. This is, therefore, not a preferred alternative and not assessed in further detail.

2.2. Technology Alternatives

Wind energy as a power generation technology can be regarded as one of the most cost-effective energy sources for power generation in this area of South Africa, and has further advantages by offsetting carbon and air pollution, as well requiring negligible water usage during operation.

REISA will be considering various wind turbine technologies in order to maximise the capacity of the site. The turbines being considered will each have a capacity of up to 3 MW, with an overall facility capacity of up to 40 MW.

The technology provider has not yet been confirmed; this will be decided upon following further wind analysis and a detailed tender process. REISA will consider various wind turbine designs and finalise the layout in order to maximise the capacity of the site. The turbines being considered for use at this wind energy facility are proposed to be between 2MW and 3MW in capacity. The turbines will have a hub height of up to 80 m, and a rotor diameter of up to 90 m (each blade will be up to 45 m in length). The turbines under consideration at present are the Vestas V90 3.0MW or the V90 2.0MW. Also the Re Power MM82 is being considered.

2.3. Wind Energy as a Power Generation Technology

Wind power is the conversion of wind energy into a useful form, such as electricity, using wind turbines. The use of wind for electricity generation is a non-consumptive use of a natural resource, and produces an insignificant quantity of greenhouse gases in its lifecycle. Wind power consumes no fuel for continuing operation, and has no emissions directly related to electricity production.

Wind energy is one of the fastest growing electricity generating technologies and features in energy plans worldwide. Use of wind for electricity generation is essentially a non-consumptive use of a natural resource, and produces an insignificant quantity of greenhouse gases in its life cycle. Wind power consumes no fuel for continuing operation, and has no emissions directly related to electricity production. Operation does not produce carbon dioxide, sulfur dioxide, mercury, particulates, or any other type of air pollution, as do fossil fuel power sources. A wind energy facility also qualifies as a Clean Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies) as it meets all international requirements in this regard.

Environmental pollution and the emission of CO_2 from the combustion of fossil fuels constitute a threat to the environment. The use of fossil fuels is reportedly responsible for ~70% of greenhouse gas emissions worldwide. The climate change challenge needs to include a shift in the way that energy is generated and consumed. Worldwide, many solutions and approaches are being developed to reduce emissions. However, it is important to acknowledge that the more cost effective solution in the short-term is not necessarily the least expensive long-term solution. This holds true not only for direct project cost, but also indirect project cost such as impacts on the environment. Renewable energy is considered a 'clean source of energy' with the potential to contribute greatly to a more ecologically, socially and economically sustainable future. The challenge now is ensuring wind energy projects are able to meet all economic, social and environmental sustainability criteria.

Wind energy has the attractive attribute that the fuel is free. The economics of a wind energy project crucially 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, as the wind resource is a critical factor to the success of the installation.

Wind speed is the rate at which air flows past a point above the earth's surface. Average annual wind speed is a critical siting criterion, since this determines the cost of generating electricity. With a doubling of average wind speed, the power

in the wind increases by a factor of 8, so even small changes in wind speed can produce large changes in the economic performance of a wind energy facility (for example, an increase of average wind speed from 22 km/hr to 36 km/hr (6 m/s to 10 m/s) increases the amount of energy produced by over 130%). 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 to 17 m/s). Wind speed can be highly variable and is also affected by a number of factors, including surface roughness of the terrain.

Wind power is a measure of the energy available in the wind.

Wind direction at a site is important to understand, but it is not critical in site selection as wind turbine blades automatically turn to face into the predominant wind direction at any point in time.

South Africa can be considered as having a moderate wind resource as compared to Northern Europe (Scandinavia), Great Britain and Ireland, New Zealand and Tasmania. Typical annual wind speeds range from 15 km/hr to 25 km/hr (4 m/s to 7 m/s) around South Africa's southern, eastern and western coastlines (with more wind typically along the coastline). This relates to an expected annual energy utilisation factor of between 15% and 30%, the value depending on the specific site selected. It is commonly accepted that wind speeds of 25 km/hr to 30 km/hr (7 m/s to 8 m/s) or greater are required for a wind energy facility to be economically viable in Europe.

The wind speed measurements taken at a particular site are affected by the local topography (extending to a few tens of kilometres from the mast) or surface roughness. This is why local on-site monitored wind speed data is so important for detailed wind energy facility design. The effect of height variation/relief in the terrain is seen as a speeding-up/slowing-down of the wind due to the topography. Elevation in the topography exerts a profound influence on the flow of air, and results in turbulence within the air stream, and this also has to be taken into account in the placement of turbines.

The placement of a wind energy facility and the actual individual turbines must, therefore, consider technical factors such as the 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) and the effect of adjacent turbines on wind flow and speed – specific spacing is required between turbines in order to reduce the effects of wake turbulence.

Typically wind turbines need to be spaced approximately 2 to 3xD apart, and 5 to 10xD where a turbine is behind another (where 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 typical 2 MW capacity turbine whose rotor is approximately 90 m in diameter, each turbine would be separated by approximately 180 m to 300 m. The erection of turbines in parallel rows one behind another would require a distance between rows of 500 m to 700 m to avoid wake effects from one turbine onto another. Once a viable footprint for the establishment of the wind energy facility has been determined (through the consideration of both technical and environmental criteria), the micro-siting of the turbines on the site will be determined using industry standard software systems, which will automatically consider the spacing requirements.

2.4. Wind turbines

Wind turbines, like windmills, are mounted on a tower to capture the most energy. The kinetic energy of wind is used to turn a wind turbine to generate electricity. At 30 m or more aboveground, they can take advantage of the faster and less turbulent wind. 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**. Generally a wind turbine consists of **three rotor blades** and a **nacelle** 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.

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. Typically, 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 and 17 m/s).

The wind energy facility proposed would accommodate up to 244 wind turbines. As the performance of the turbines is determined by disturbances to the wind resource, they must be appropriately spaced within the facility. Turbines would, therefore, be positioned within an area of approximately 132 km^2.

Other infrastructure associated with the facility includes internal service roads, access roads, power lines and up to four substations (placed within the facility). The construction phase of the wind energy facility is dependent on the number of turbines erected and is estimated at one week per turbine. The lifespan of the facility is approximated at 20 to 30 years.

2.4.1. Main Components of a Wind Turbine

The turbine consists of the following major components:

» The rotor

» The nacelle
» The tower
» The foundation unit

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.

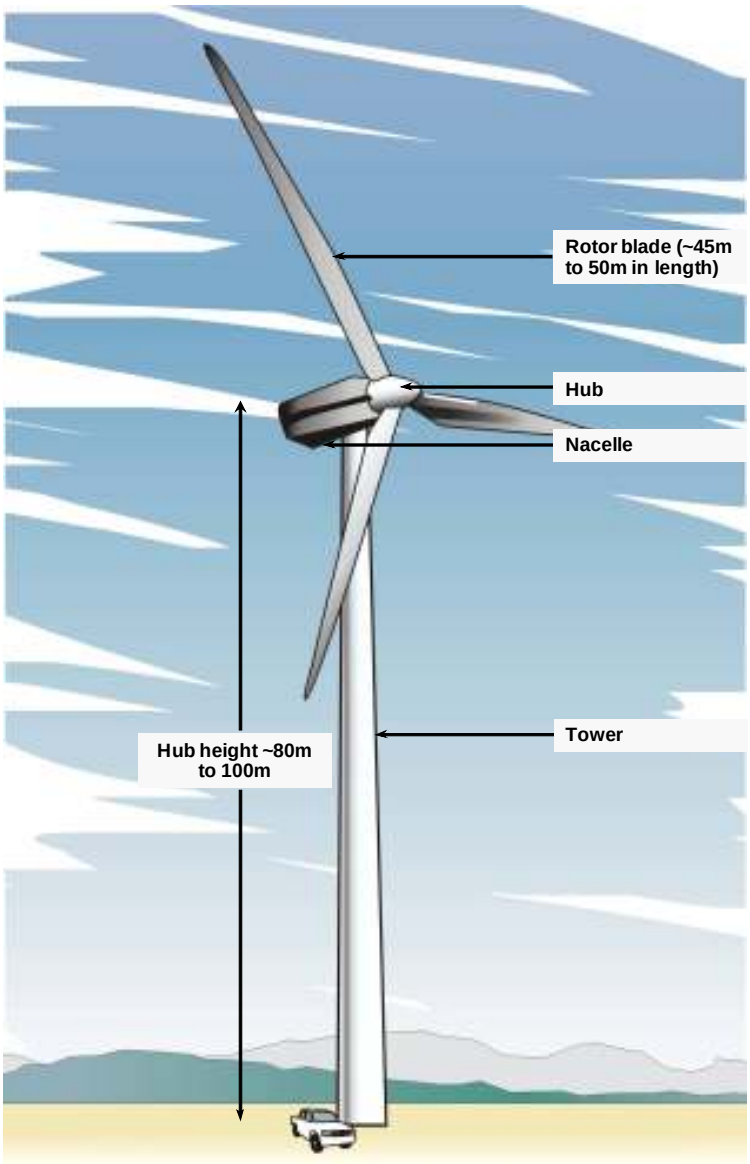

Figure 2.5: Illustration of the main components of a wind turbine.

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. The tower will be between up to 90 m 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.

2.4.2. Operating Characteristics of a Wind Turbine

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.

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.

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 entirely stop. In practice, the collection efficiency of a rotor is not as high as 59%. A more 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% and 30% of the original energy available in the wind (between 20% to 25% being typical for modern systems).

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.**

2.5. Project Construction Phase

The construction phase of the wind energy facility is dependent on the number of turbines to be erected, but can be estimated at one week per turbine. The lifespan of the facility is approximated at 20 to 30 years. In order to construct

the proposed wind energy facility and associated infrastructure, a series of activities will need to be undertaken.

Information provided by the developer indicated that the 244 turbines will be erected in 3 phases. The first phase will involve the establishment of 100MW of generating capacity, or approximately 60 turbines. The second phase will involve the establishment of an additional 200MW (+-120 turbines). The third phase will involve the establishment of the final 100MW of generating capacity (+-60 turbines).

The following construction activities have been considered to form part of the project scope:

» Construct Turbines
» Construct Substation
» Establishment of Ancillary Infrastructure
» Connection of Wind Turbines to the Substation
» Connect Substation to Power Grid
» Undertake Site Remediation
» Establishment of Laydown Areas on Site
» Transport of Components and Equipment to Site
» Construct Foundation
» Undertake Site Preparation
» Establishment of Access Roads to the Site
» Conduct Surveys

These are discussed in further detail below.

2.5.1. 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 turbine micro-siting footprint, survey of access roads, survey of substation site and survey of power line servitudes.

2.5.2. Establishment of Access Roads to the Site

The site is located in the vicinity of the N2 and existing farm road which will allow for site access. Within the site itself, access will be required from the existing farm road to the turbine 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. Although the informal farm road is unlikely to have been subjected to vehicle loading of the same magnitude and intensity to that expected during construction of the wind 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. Access roads to the region must be assessed and complex terrain may typically bring with it access constraints due to limited road infrastructure and constricted turning circles. Special haul roads may need to be constructed to and within the site to accommodate abnormally loaded vehicle access and circulation. The internal service road alignment will be informed by the final micro-siting/positioning of the wind turbines. 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. The width of the internal access roads will be 4.5 m wide. These will be rehabilitated and reduced to 3 m during operation of the facility.

REISA have drawn up a preliminary plan for the network of access roads to be constructed on the site (Figure 2.6). REISA carried out an aerial survey to ensure that the access road routes were planned to ensure least amount of disturbance to the environment during construction of the roads.

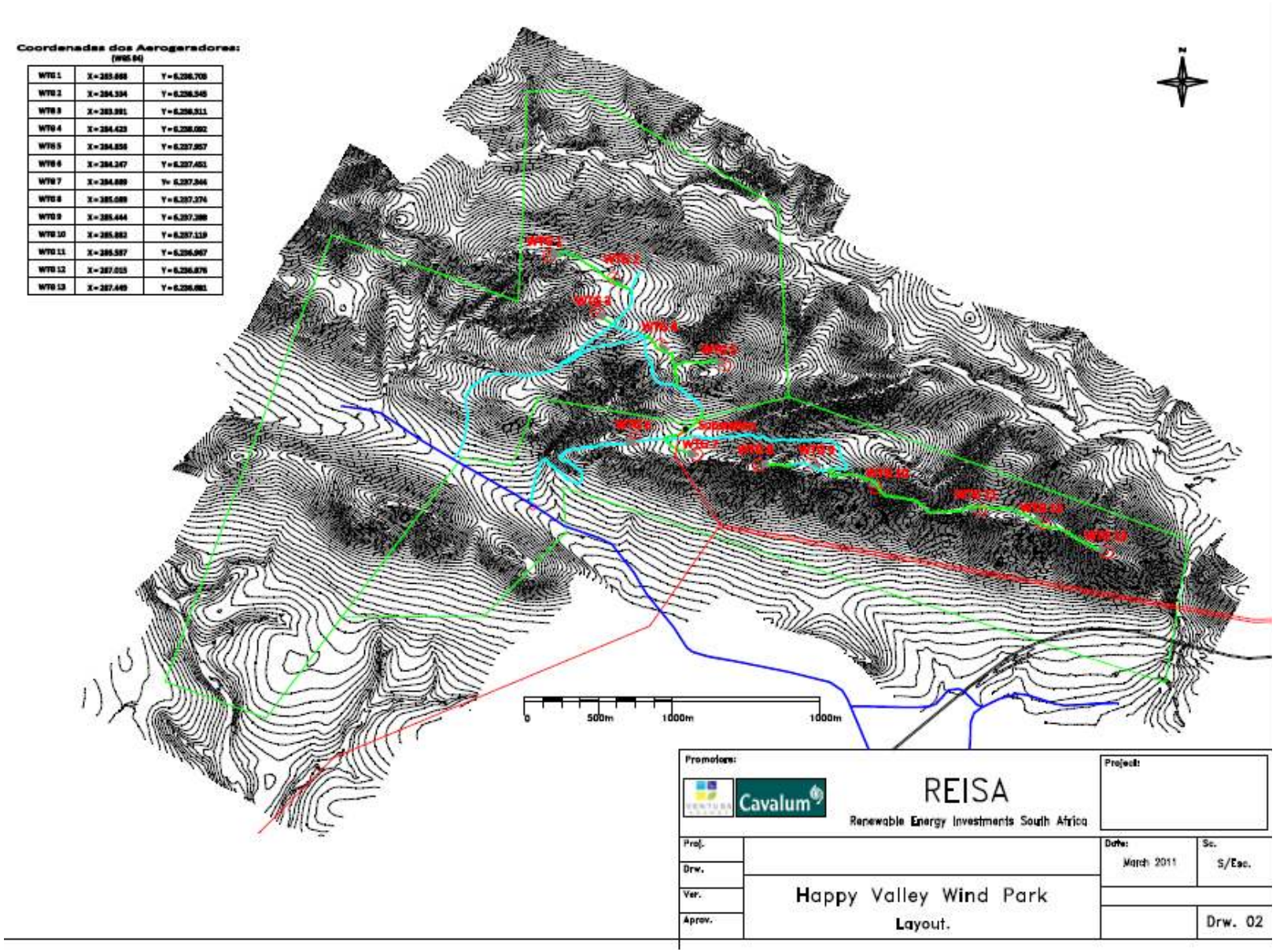

Figure 2.6. Preliminary access road layout for the proposed Happy Valley Wind Energy Facility.

The blue lines indicate existing access roads on site that will be required to be upgraded. Green lines indicate the new access that will be required to be constructed. As far as possible, existing access roads to the site would be utilised, and upgraded where required.

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. At this stage it is assumed that a nominal access track make-up in the order of 500 mm thick will be required for the track construction although an increased depth of up-fill will be required in some areas to overcome localised variations in ground level.

2.5.3. Undertake Site Preparation

Site preparation activities will include clearance of vegetation at the footprint of each turbine, 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.

2.5.4. Construct Foundation

Concrete foundations will be constructed at each turbine location. Foundation holes will be mechanically excavated to a depth of approximately 2 m to 3 m. The reinforced concrete foundation of approximately 16 m x 16 m x 2.5 m will be poured and support a mounting ring. The foundation will then be left up to a week to cure.

A portable concrete batch plant would possibly be required to supply concrete onsite. The site would include an in-ground water recycling/first flush pit to prevent dirty water escaping onto the site, and would be fully remediated after the construction phase. As an alternative, concrete could be brought to site as ready-mix.

The tower would be seated in a reinforced concrete footing and would require removal of rock and subsoil at the base of each turbine. Various designs of footing are under consideration, based around a gravity footing (where subsoil geology is less stable) and a rock-bolted footing (where subsoil geology provides good bedrock). A combination of these footing designs may be used on the site depending on the geology at each turbine location.

Sands and aggregate would be sourced from turbine foundation excavations, where possible, or from existing approved sand and gravel pits within the region.

2.5.5. Transport of Components and Equipment to 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. The individual components are defined as abnormal loads in terms of Road Traffic Act (Act No 29 of 1989)[4] 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 substations (including transformers) as well as the power lines (including towers and cabling) will also be transported to site as required.

It is also necessary to have a delivery laydown area for the various components adjacent to the laydown areas. In most cases it is expected that the access road could be used as this delivery area.

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.

The equipment will be transported to the site using appropriate National and Provincial roads, and the dedicated access/haul road to the site itself.

2.5.6. Establishment of Laydown Areas on Site

Laydown areas will need to be established at each turbine position for the storage of wind turbine components. The laydown area will need to accommodate the cranes required in tower/turbine assembly. Laydown and storage areas will be required to be established for the normal civil engineering construction equipment which will be required on site.

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

A hardstand area, typically 25 m x 50 m at the base of each tower, will be required at each position where the main lifting crane may be required to be assembled for tower erection. This area would be required to be compacted and levelled to accommodate the assembly crane.

A single, larger temporary laydown area will also be required for temporary storage during construction.

2.5.7. Construct Turbine

A large lifting crane will be brought on site. It will lift the tower sections into place, and lift the nacelle into position onto the top of the assembled tower. The rotor (i.e. the blades of the turbine) is typically assembled on the ground, and 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.

2.5.8. Construct Substation

The turbines will be connected to the substation via underground cabling. The position of the substation will be informed by the final micro-siting/positioning of the wind turbines. The layout of the turbines has determined the optimum position for the construction of the substations (Figure 2.1).

The construction of the substations would require a survey of the sites; site clearing and levelling and construction of an access road to substation sites (where required); construction of substation terrace and foundations; 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.

2.5.9. Establishment of Ancillary Infrastructure

The laydown area next to the turbines can be used as far as possible however a workshop as well as a contractor's equipment camp may also be required to be constructed at the bottom areas of the site, prior to accessing the uppermost levels where turbines will be constructed. 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.

2.5.10. Connection of Wind Turbines to the Substations

Each wind turbine will be connected to the substation via underground electrical cables (where possible) The installation of these cables will require the excavation of trenches of approximately 1 m deep within which they can then be laid. The underground cables will be planned to follow the internal access roads, where possible.

2.5.11. Connect Substations to Power Grid

A new overhead power line (of up to 132 kV) will be constructed to connect the on-site substation to the electricity distribution grid via Eskom's existing Melkhout substation. Routes for the power line will be assessed, surveyed and pegged prior to construction. Two alternative corridors are proposed for the proposed power line (refer to Figure 2.1). **Alternative 1** is approximately 11 km in length. Alternative 1 exits the site in an easterly direction before reaching the N2 national road after ~6 km and then heading away from the N2 in a northeast direction for ~3 km. The line would then travel in a straight line southeast for 2 km towards the Melkhout substation. **Alternative 2** is approximately 12 km in length. It follows an identical route but after 6 km (where Alternative 1 heads northeast away from the N2) Alternative 2 continues straight alongside the N2 for ~2.5 km before heading north where it again joins the Alternative 1 route before heading southeast towards Melkhout substation (refer to Figure 2.1). The sensitivity of the proposed routes for the power lines and proposed substation position are assessed through this EIA report.

2.5.12. Undertake Site Remediation

As construction is completed in an area, and as all construction equipment is removed from the site, the site 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. Hardstand areas would be left in situ after construction to provide for on-going maintenance and repairs if necessary. Access tracks would also be left in situ, however their width would be reduced to approximately 3 m after construction is completed.

2.6. Project Operation Phase

It is not known at this stage exactly how many people will be responsible for monitoring and maintenance of the facility. It is likely that no permanent staff will be required on site for any extended period of time.

Each turbine within the wind energy facility will be operational except under circumstances of mechanical breakdown, extreme weather conditions or maintenance activities. The wind turbine will be subject to periodic maintenance and inspection. Periodic oil changes will be required. Any waste products (e.g. oil) will be disposed of in accordance with relevant waste management legislation.

2.7. Project Decommissioning Phase

The wind turbine infrastructure is expected to have a lifespan of approximately 20 - 30 years and said infrastructure would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the facility's infrastructure 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.

2.7.1. Site Preparation

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

2.7.2. Disassemble and Replace Existing Turbine

A large crane will be brought on site. It will be used to disassemble the turbine and tower sections. These components will be reused, recycled or disposed of in accordance with regulatory requirements. All parts of the turbine would be considered reusable or recyclable except for the blades.

REGULATORY AND LEGAL CONTEXT CHAPTER 3

3.1. Policy and Planning Context

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 hierarchy of policy and planning documentation that support the development of renewable energy projects such as 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 development of the proposed solar energy facility.

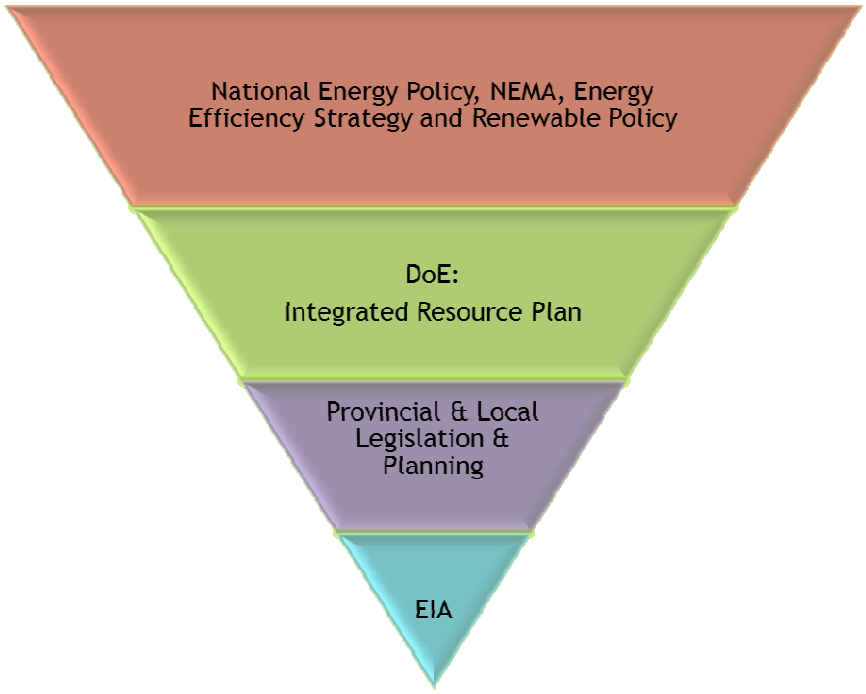

Figure 3.1: Hierarchy of electricity policy and planning documents

3.1.1. White Paper on the Energy Policy 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 then 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 solar energy 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 - 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.

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) in 2003 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 draft IEP recognised that South Africa is likely to be reliant on coal for at least the next 20 years as the predominant source of energy. However, the potential and a need to diversify energy supply through increased use of natural gas and new and renewable energies were recognised.

3.1.4 Final Integrated Resource Plan, 2010 - 2030

The Energy Act of 2008 obligates the Minister of Energy to develop and publish an integrated resource plan for energy. Therefore, the Department of Energy (DoE), together with the National Energy Regulator of South Africa (NERSA) has compiled the Integrated Resource Plan (IRP) for the period 2010 to 2030. The objective of the IRP is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure for South Africa over the next twenty years. The IRP is intended to:

» Improve the long term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development;
» Ascertain South Africa's capacity investment needs for the medium term business planning environment;
» Consider environmental and other externality impacts and the effect of renewable energy technologies;
» Provide the framework for Ministerial determination of new generation capacity (inclusive of the required feasibility studies)

The objective of the IRP is to evaluate the security of supply, and determine the least-cost supply option by considering various demand side management and supply-side options. The IRP also aims to provide information on the opportunities for investment into new power generating projects.

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 updated on 29 January 2010. The Department of Energy released the Final IRP in March 2011, which was accepted by Parliament at the end of March. This Policy-Adjusted IRP is recommended for adoption by Cabinet and subsequent promulgation as the final IRP. In addition to all existing and committed power plants (including 10 GW committed coal), the plan includes 9.6 GW of nuclear; 6.3 GW of coal; 17.8 GW of renewables (including 8,4GW solar); and 8.9 GW of other generation sources.

3.1.5 Electricity Regulation Act, 2006

Renewable Energy Feed-in Tariffs (REFIT) have been set by NERSA. This has been done to contribute towards the renewable energy target set by the government, to contribute towards socio-economic and environmentally

sustainable growth, and to stimulate the renewable energy industry in South Africa. The establishment of the REFIT in South Africa provides the opportunity for an increased contribution by the renewable energy sector by promoting competitiveness 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 (i.e. National, Provincial, and Local). The main regulatory agencies at a national level include:

» *Department of Energy (DoE)* - the DoE is the controlling authority in terms of the Electricity Act (Act No. 41 of 1987), and is responsible for policy relating to energy including renewable energy. Solar energy is considered under the White Paper for Renewable Energy and the DoE undertakes research in this regard.
» *National Energy Regulator of South Africa (NERSA)* - this body is responsible for regulating all aspects of the electricity sector, and will ultimately issue generation licenses for renewable energy developments.
» *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 has been made the competent authority responsible for granting the relevant environmental authorisations for all renewable energy projects which are regarded of national importance.
» *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 Limited (SANRAL):* this department is responsible for all national road routes.

The main regulatory agencies at a provincial level include:

» *Eastern Cape Department of Economic Development and Environmental Affairs (DEDEA)* - this department is responsible for environmental policy and

is the provincial authority in terms of NEMA and the EIA Regulations. The DEDEA is the commenting authority for this project.

» *Eastern Cape Department of Transport and Public Works* - this department is responsible for provincial roads in the province and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *Eastern Cape Department of Agriculture and Rural Development* - this department's involvement relates specifically to sustainable management of the agricultural resources in the Eastern Cape.

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. 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. The main regulatory agencies at a local level include:

» *The Kouga Local Municipality* – this municipality is one of the principal regulatory authorities responsible for planning, land use, and environmental management.
» *The Cacadu District Municipality* – like the local municipality, this department is also a regulatory authority responsible for planning, land use, and environmental management.

3.3. Applicable Legislation and Guidelines

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 (GNR R545, GNR 546 in Government Gazette 33306 of 18 June 2010)
» Guidelines published in terms of the NEMA EIA Regulations, in particular:
  * Companion to the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations of 2010 (Draft Guideline; DEA, 2010)
  * Public Participation in the EIA Process (DEA, 2010)
  * Integrated Environmental Management Information Series (published by DEA)
» International guidelines – the Equator Principles and the International Finance Corporation and World Bank Environmental, Health, and Safety Guidelines for Wind Energy (2007)

Several other acts, standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in the EIA Report. A review of legislative requirements applicable to the proposed project is provided in the table that follows.

Table 3.1: Relevant legislative and permitting requirements applicable to the project

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 S24(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 – lead authority. EC DEDEA - commenting authority.	This EIA report is to be submitted to the DEA and Provincial Environmental Department in support of the application for authorisation.
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.	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.

	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.		
Legislation	**Applicable Requirements**	**Relevant Authority**	**Compliance requirements**
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 55 *(c)* making other changes to the particulars on the list.	National Department of Environmental Affairs (DEA)	The volumes of waste generated during construction and operation of the facility will not be large enough to require a waste license.
Environment Conservation Act (Act No 73 of 1989)	National Noise Control Regulations (GN R154 dated 10 January 1992).	National Department of Environmental Affairs EC DEDEA - commenting authority. Local conservation authorities Local Municipality	There is no requirement for a noise permit in terms of the legislation. A Noise Impact Assessment is required to be undertaken in accordance with SANS 10328 – this has been undertaken as part of the EIA process (refer to Appendix M). There are noise level limits which must be adhered to. 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)	Water uses must be licensed unless such water use falls into one of the categories listed in S22 of the Act or falls under the general authorisation.	Department of Water Affairs	As no water use (as defined in terms of S21 of the NWA) will be associated with the proposed project, no water use permits or licenses are required to be applied for or obtained.
National Water Act (Act No 36 of 1998)	In terms of S19, 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 NWA)	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.
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	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

	accordance with the provisions of the Act. Requirements for Environmental Management Programmes and Environmental Management Plans are set out in S39 of the Act.		required to be obtained.
Atmospheric Pollution Prevention Act (Act No 45 of 1965)	In terms of S27, the Minister may declare certain areas dust control areas. (The project study area has not been declared a dust control area). Part V of Act regulates pollution generated by vehicle fumes.	National Department of Environmental Affairs	Although there is no legal obligation relating to the activities to be undertaken it is suggested that best practice means should be used to prevent dust generation from the roads and excavations during construction.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	S18, S19 and S20 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)	S38 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	South African Heritage Resources Agency (SAHRA) – 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.

	development or barrier exceeding 300 m in length; » any development or other activity which will change the character of a 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 S38. In such cases only those components not addressed by the EIA should be covered by the heritage component.		S4 of the NHRA provides that within 14 days of receipt of notification the relevant Heritage Resources Authority must notify the proponent to submit an 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, gathering, uprooting, damaging or destroying). Schedule 3 lists endangered flora and Schedule 4 lists protected flora. Articles 26 to 47 regulates the use of wild animals.	Provincial Department of Environmental Affairs (Eastern Cape DEDEA)	Compliance requirements
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	In terms of S57, the Minister of 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.	National Department of Environmental Affairs	As the applicant will not carry on any restricted activity, as is defined in Section 1 of the Act, no permit is required to be obtained in this regard. Specialist flora and fauna studies are required to be undertaken as part of the EIA process. These studies have been undertaken as part of the previously EIAs undertaken for the power station site. 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 as a result of the proposed development.
Conservation of	Regulation 15 of GNR1048 provides for the	National Department of	While no permitting or licensing

Agricultural Resources Act (Act No 43 of 1983)	declaration of weeds and invader plants, and these are set out in Table 3 of GNR1048. Weeds are described as Category 1 plants, while invader plants are described as Category 2 and Category 3 plants. 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.	Agriculture, Forestry and Fisheries (DAFF),	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 Fire Act (Act 101 of 1998)	In terms of Section 21 the applicant would be obliged to burn firebreaks to ensure that should a veldfire 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.	Department of Water Affairs	While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project.
Aviation Act (Act No 74 of 1962) 13th amendment of the Civil Aviation Regulations (CARS) 1997	Any structure exceeding 45m above ground level or structures where the top of the structure exceeds 150m above the mean ground level, the mean ground level	Civil Aviation Authority (CAA)	While no permitting of licence requirements arise from the legislation, this act will find application during the operational

	considered to be the lowest point in a 3km radius around such structure. Structures lower than 45m, 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.		phase of the project. 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 by reason 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, modification, disposal or dumping of such substances and products.	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.

	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 effect on road pavements, bridges and culverts.	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 22m. » Depending on the trailer configuration and height when loaded, some of the power station components may not

	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.		meet specified dimensional limitations (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.	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 in the province.	National Department of Agriculture, Forestry and Fisheries (DAFF), 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 authorisation for the proposed project.
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 (DEA)	No permitting or licensing requirements.
Promotion of Administrative Justice Act	» In terms of S3 the government is required to act lawfully and take	National Department of Environmental Affairs (DEA)	No permitting or licensing requirements.

(Act No 3 of 2000)	procedurally fair, reasonable and rational decisions » Interested and affected parties have right to be heard		

APPROACH TO UNDERTAKING THE ENVIRONMENTAL IMPACTASSESSMENT PHASE 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 plan (EMP)) to the competent authority for decision-making. The EIA process is illustrated below:

The EIA Phase for the proposed Happy Valley Wind Energy 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). The environmental studies for this proposed project were undertaken in two phases, in accordance with the EIA Regulations. This chapter serves to outline the EIA process that was followed.

4.1. Phase 1: Scoping Study

The Scoping Report aimed at detailing the nature and extent of the proposed Happy Valley Wind Energy Facility, identifying potential issues associated with the proposed 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).

An original Final Scoping Report for the facility was submitted to the Department of Environmental Affairs on 26 August 2010 (following a 30 day review period in July 2010). The Scoping Report was then revised (as per the revised application submitted to DEA on 18 November 2010) to include an additional property to the

site development footprint. In accordance with the EIA Regulations, the revised Draft Scoping Report was made available for review and comment by Interested and Affected Parties (I&APs) and stakeholders. Notification of the availability of this report was provided through letters to registered parties and through advertising in local and regional newspapers (The Herald and the Kouga Express Newspapers on 18 November 2010). The review period for the Revised Draft scoping report was from 16 November 2010 – 15 December 2010.

The revised Final Scoping Report was accepted by the DEA, as the competent authority. In terms of this acceptance, an Environmental Impact Assessment was required to be undertaken for the proposed project in line with the Plan of Study for EIA as outlined in the Scoping Report.

4.2. Phase 2: Environmental Impact Assessment

Through the Scoping Study, a number of issues requiring further study for all components of the project were highlighted. These issues have been assessed in detail within the EIA phase of the process.

The EIA Phase aims 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 wind energy facility.
» 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, 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 a Draft EIA Report in accordance with the requirements of the Regulation 32 Government Notice No R385 of 2006.
» Preparation of a Final EIA Report for submission to DEA.

These tasks are discussed in detail below.

4.3.1. Authority Consultation

The National DEA is the competent authority for this application. A record of all authority consultation undertaken prior to the commencement of the EIA Phase is included within the Scoping Report and EIA report. Consultation with the regulating authorities (i.e. DEA and DEDEA) has continued throughout the EIA process. On-going consultation included the following:

» Submission of a Final Scoping Report (August 2010) following a 30-day public review period (and consideration of stakeholder comments received).
» Submission of a revised Final Scoping Report (December 2010) following a 30-day public review period (and consideration of stakeholder comments received).
» Discussions with DEA and DEDEA in order to clarify the findings of the Scoping Report and the issues identified for consideration in the EIA process.
» Provision of an opportunity for DEA and DEDEA representatives to visit and inspect the proposed site.

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.

» A consultation meeting with the DEA and DEDEA in order to discuss the findings and conclusions of the EIA Report.
» Consultation with Organs of State that may have jurisdiction over the project:
  * Department of Economic Development and Environmental Affairs
  * Department of Energy
  * Department of Agriculture, Forestry and Fisheries
  * Department of Water Affairs
  * South African Heritage Resources Agency (SAHRA)
  * Conservation Authorities
  * Department of Transport and Public Works
  * South African National Roads Agency
  * Department of Land Affairs
  * Eastern Cape Department of Agriculture and Rural Development
  * Civil Aviation Authority
  * Cacadu District Municipality
  * Kouga Local Municipality

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 B.

4.3.2. Public Involvement and Consultation: EIA Phase

The aim of the public participation process was 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 and incorporated into the EIA process.

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). Adjacent landowners were identified and informed of the project (refer to landowner map in Appendix C). 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 were provided for I&APs issues to be recorded and verified through the EIA phase, including:

» Focus group meetings (stakeholders invited to attend)
» Public meeting (advertised in the local press: Herald and Kouga Express)
» Written, faxed or e-mail correspondence

Records of all consultation undertaken are included within Appendix E.

4.3.4. Identification and Recording of Issues and Concerns

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.

4.3.5. 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:

» Potential impacts on agricultural potential

Issues which require further investigation within the EIA phase, as well as the specialists involved in the assessment of these impacts are indicated in the table below.

Area of Expertise	Specialist	Refer Appendix
Ecology: flora, fauna and wetlands	David Hoare of David Hoare Consulting cc	Appendix F
Avifauna	Andrew Jenkins of Avisense Consulting cc	Appendix G
Bats	Werner Marais of Animalia Consulting	Appendix H
Visual	Lourens du Plessis of MetroGIS	Appendix I
Heritage	Dr Johan Binneman of Eastern Cape	Appendix J

	Heritage Consultants	
Geology and soils	Iain Paton of Outeniqua Geotechnical Services	Appendix K
Palaeontology	W.J. de Klerk of the Albany Museum	Appendix L
Noise	Morne de Jager of MENCO (M2 Environmental Connections cc)	Appendix M
Social Impact	Tony Barbour (Environmental Consultant and Researcher)	Appendix N
Public involvement process	Shawn Johnston of Sustainable Futures	-

Specialist studies considered direct and indirect environmental impacts associated with the development of all components of the wind energy facility. 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 either 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 REISA 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 O.

4.3.6. Assumptions and Limitations

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

» All information provided by REISA and I&APs to the Environmental Team was correct and valid at the time it was provided.
» It is assumed that the development site identified by REISA represents a technically suitable site for the establishment of a wind energy facility.
» Studies assume that any potential impacts on the environment associated with the proposed development will be avoided, mitigated or offset.
» This report and its investigations are project-specific, and consequently the environmental team did not evaluate any other power generation alternatives.

4.3.7. Public Review of Draft EIA Report and Feedback Meeting

This Draft EIA report was made available for public review from **05 August 2011 to 04 September August 2011** at the following locations:

» www.savannahSA.com
» Humansdorp Library

All registered I&APs were notified of the availability of the report and public meeting by letter. Adverts were also placed in the Kouga Express (04 August 2011) and The Herald (03 August 2011).

In order to facilitate comments on the draft EIA report and provide feedback of the findings of the studies undertaken and receive comments to address in the draft EIA report, a public feedback meeting was held during the review period of the Draft EIA Report. All interested and affected parties were invited to attend the **public feedback meeting** (held on: **17 August 2011** at **18:30** at the **Humansdorp Boutique Hotel Conference Centre**).

4.3.8. Final Environmental Impact Assessment (EIA) Report

The final stage in the EIA Phase entails the capturing of responses from I&APs on the Draft EIA Report in order to refine this report. It is this final report upon which the decision-making environmental Authorities make a decision regarding the proposed project. This is the **current** project phase.

DESCRIPTION OF THE AFFECTED ENVIRONMENT CHAPTER 5

This section of the EIA Report provides a description of the environment that may be affected by the proposed Happy Valley Wind Energy Facility near Humansdorp in the Eastern 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 - N.

5.1 Location of the Study Area

The proposed project site is located within the Kouga Local Municipality (EC108) approximately 7 km northwest of the town of Humansdorp, 23 km northeast of the municipal administrative centre of Jeffrey's Bay and approximately 95km east of the Nelson Mandela Bay Metropolitan Area (Port Elizabeth). The Kouga Local Municipality is one of 10 municipalities that fall within the greater Cacadu District Municipality (DC10). The majority of the area occupied by the proposed project is located in Ward 4 of the Kouga Local Municipality. However, a small portion of the proposed Wind Energy Facility development also falls within Ward 1. Ward 4 and 1 together constitute ~50% (1 205 km2) of the total area of the Municipality (2 419 km^2).

The municipality is approximately 2 419 km² in size (~4% of the greater Cacadu District Municipality) and bordered in the in the north by the Sundays River and Baviaans Local Municipalities, in the east by the Nelson Mandela Bay Metropolitan area (Port Elizabeth), in the south by the Indian Ocean and in the west by the Kou-Kamma Local Municipality.

The study area is located directly to the north of the N2 that links Port Elizabeth to George / Knysna. This road runs from east to west past the south-eastern corner of the study site. Access to the site is via Kruisfontein through Humansdorp. The site is therefore well-connected to a major route in this region. There is a road from Kruisfontein into the mountains north of the site that crosses the western part of the site. There are also limited local access roads on site.

The Eskom Melkhout Substation is located approximately 5 km east of the site, close to Humansdorp.

The main economical activity in the area is described as mixed agriculture/farming land uses that include irrigated agriculture and cattle farming.

Figure 5.1: Map indicating the extent of the Kouga Local Municipality Area and the location of the study area

The site itself is characterised by undulating agricultural land located to the north of the N2. The local farmers and their families have been stock farming (beef and dairy cattle and sheep) for between 15 and 300 years.

The study area predominantly includes rural agricultural land with Kruisfontein and Humansdorp being the largest towns or urban developments in close proximity to the proposed development area. The main economical activity is described as mixed agriculture/farming land uses that include irrigated agriculture and cattle farming.

5.2 Climate

The study area has warm summers and mild winters. The average daily minima for the coldest months are above freezing. There are an average of three days of frost per year. The proximity of the coast ameliorates all climate extremes, but the site is in the first range of low mountains inland of the coast and is therefore affected by the proximity of these mountains.

A weak bimodal pattern of rainfall exists in the study area with a slightly higher proportion of spring and autumn rainfall. Rainfall may, however, fall at any time of the year. The mean annual rainfall in the study area is estimated to be approximately 650 mm (Dent et al. 1989). In grasslands, all areas with less than 400 mm are considered to be arid grasslands. The study area can therefore be considered to be relatively moist.

5.3 Regional Setting

The study site is located on the southernmost ridge of the Cape Fold mountains South of the mountains are plains that stretch southwards to the coast-line. The ridge dominates the study area, running in an east-west direction through the site.

The study area is moderately to steeply sloping. The elevation across the site varies from 240 m (at the lowest point on the site) to 547 m above sea level. The site slopes towards the coast, but there are elevated areas running through the central part of the site parallel to the coast.

There are a number of small streams dissecting the landscape, all draining into the Seekoei River and flowing towards the coastline.

The region has a rural character with a number of individual farming homesteads/dwellings occurring within the study area. The natural vegetation types, primarily to the north of the study area, are described as shrubland with thicket and bushland occurring within the valleys and steeper areas. Large tracts of land south of the N2 national road (where the slope permits) have been transformed through agriculture and cattle farming, and are described as pastures, grazing land and agricultural fields.

The ThabaManzi Game Farm and Lodge, is located within the study area to the west of the proposed development site (refer to Figure 5.2).

Three prominent rivers (the Leeubos, Geelhoutboom and Seekoei Rivers) traverse the study area and form distinct drainage channels south of the proposed development site. The Impofu Dam is located to the south-west of the study area.

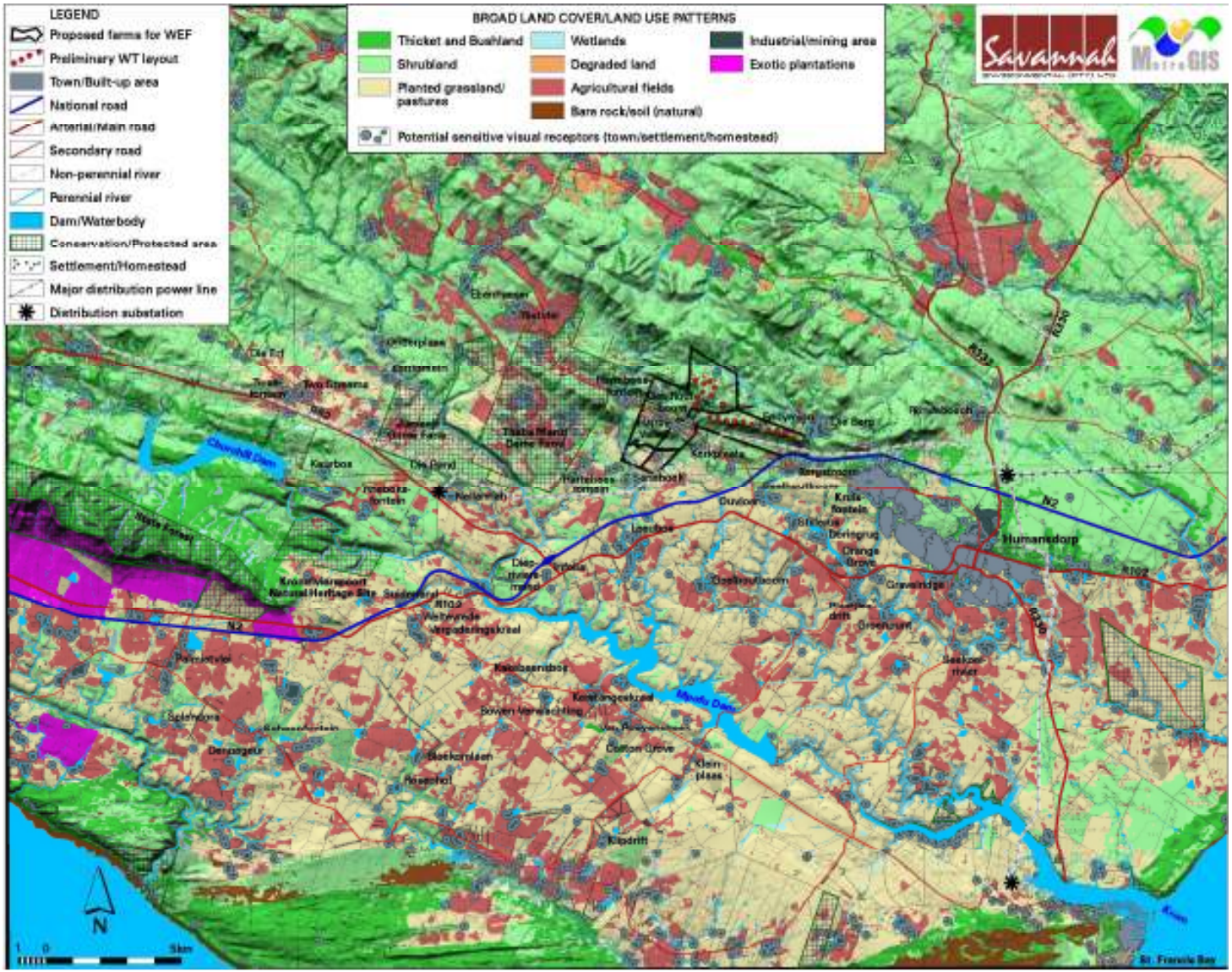

Figure 5.2. Land Cover / Land Use map of the broader study area**.**

5.4 Social Characteristics of the Study Area

5.4.1 Demographic Profile

The population the Kouga Municipality is estimated at 73 274 (Community Survey, 2007) with an annual growth rate of ~2.4% per annum (Kouga Local Municipality IDP, 2007-2012). The population constitutes approximately 18% of the greater Cacadu District. The population density within the Municipality is estimated at 30.3 people/km (Community Survey, 2007). The majority of the population (~75%) lives in the urban nodes while ~25% live in rural villages or homesteads (Kouga Local Municipality IDP, 2007-2012).

The age profile of the population reveals that approximately 66% of the population falls within the economically active age bracket of 15 to 65 years of age. The dependency ratio is, however, is 0.5 which means that every 2 working individual supports approximately 1 non-working/unemployed individual.

Just under half of the population is classified as Coloured (47.7%) followed by Black African (33.4%) and White (18.7). These demographics are reflected in the dominant languages within the Municipality, with 64.9% of the population Afrikaans speaking, 29% isiXhosa speaking and 4.9% English speaking.

The level of education within the Municipality is relatively high. Just over 10% of the population (~ 1 in 10) has no schooling, while over 20% have a Std 10/Grade 12 certificate. Approximately 6% of those with a Grade 12 qualification go on to obtain an education at University/Technikon level.

5.4.2 Economic Profile

The largest employer in Ward 4 of the Kouga Local Municipality is the agricultural sector which accounts for ~43% of the formal employment in the area. This sector is followed by the Construction, Wholesale and Retail sector, the Finance, Real Estate and Community Services sectors, which employ ~11%,~9% and ~8% of the employed population within the Ward respectively. Approximately 14% are categorised as "Other or not adequately defined." Ward 1's sectoral employment profile shows that just under a quarter (~26%) of formal employment is provided by the agricultural sector followed by the Wholesale and Retail sector (~17%), the Construction sector (~12%) and the Community Services sector (~10%).

The findings of a review of the relevant policy documents pertaining to the energy sector indicate that wind energy and the establishment of wind energy facilities are supported at national, provincial and local levels.

5.5. Biophysical Characteristics of the Study Area and Surrounds

5.5.1 Geography and Terrain

The dominant topographical unit or terrain type of the study area is described as moderately undulating plains and hills to the south of the study area with low mountains to the north. The study site is located on a number of hills (or low mountains) that are on average about 200m high, with the highest point 547.2m above sea level. The N2 national road traverses at the base of this hill at an elevation of approximately 260m above sea level. Figure 5.3 provides a shaded relief map of the broader study area.

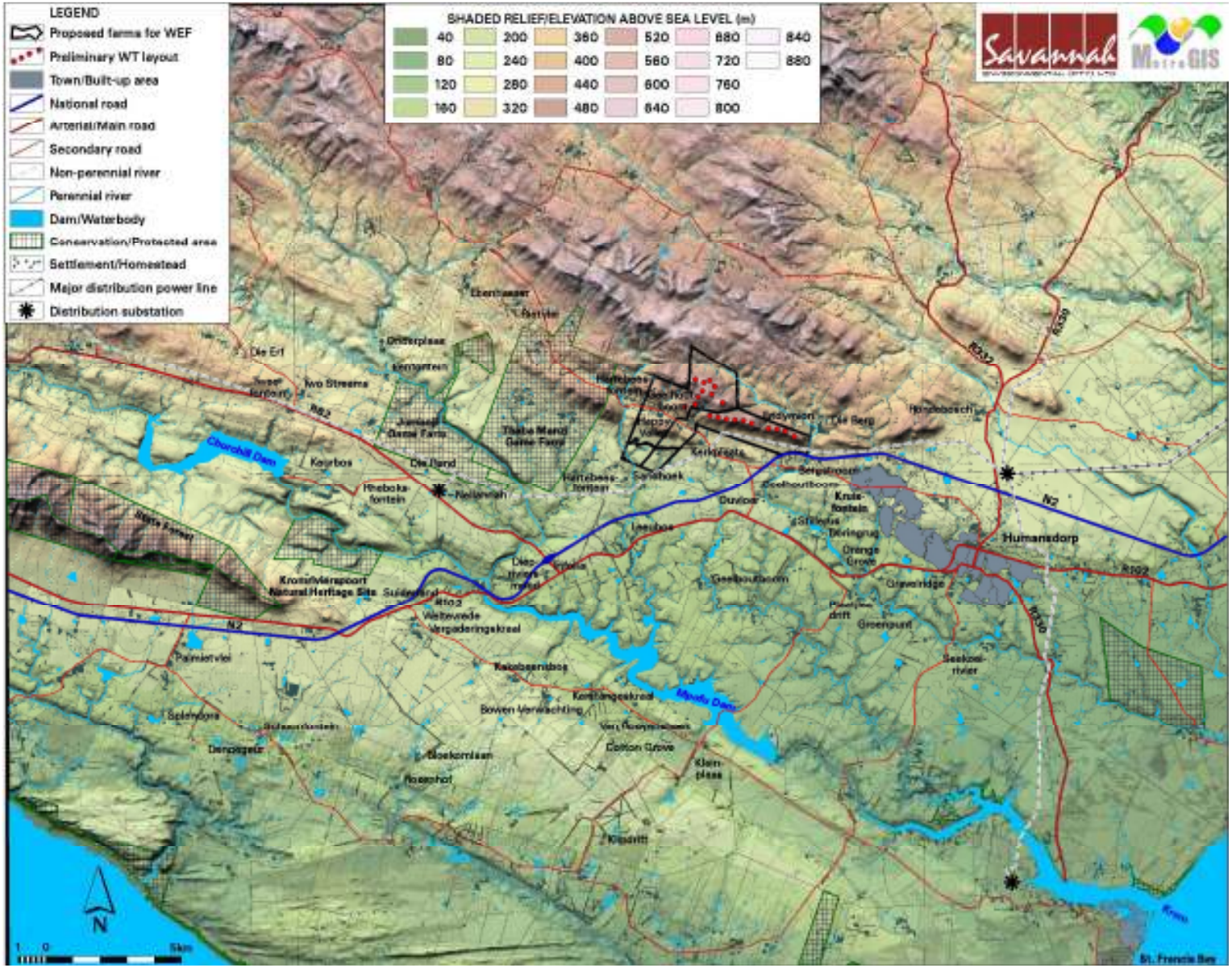

Figure 5.3. Shaded relief map (indicating topography and elevation above sea level) of the broader study area.

5.5.2 Geology and Soil

The study area is underlain by sedimentary rocks of the Table Mountain Group of the Cape Supergroup. The steep slopes and northern mountainous region is formed by the basal hard quartzites of the Peninsula Formation. The Peninsula Formation is overlain by brownish weathering sandstones of the Goudini Formation, which are less resistant to weathering and which underlie the lower-lying areas to the south of the prominent Peninsula ridges. The youngest rocks in the study area are the relatively hard and resistant quartzitic sandstone of the Skurweberg Formation which form the low hills to the southwest of the Happy Valley farmstead.

The study area lies within the Cape Fold Belt tectonic region which underwent significant compressive and tensile tectonic deformation during and since the breakup of Gondwana. The Eastern Cape region is relatively stable now and there are no significant faults in the immediate vicinity of the study area.

The proposed turbines are positioned along the crest of the hills in the northern and eastern portions of the study area and these hills are underlain by hard, resistant quartzite of the Peninsula Formation. The southern foothills are underlain by softer feldspathic sandstone and siltstone and of the Goudini Formation.

The steep slopes are covered by a thin veneer of talus gravel and boulders with localised organic-rich topsoil development between rock outcrops. The average grain size of the soil cover will tend to decrease downslope but gravelly soils remain dominant. The development of residual clay on Goudini Formation sandstone on the lower slopes is expected. Shallow, hard quartzitic rock or outcrops are expected over 90% of the proposed development footprint area.

Shallow, hard quartzitic rock is expected over 80% of the site and thicker soils are anticipated in the vicinity of farmstead on site and along the foothills north of the railway line.

5.5.3 Ecological Profile

According to the most recent vegetation map of the country ((Mucina & Rutherford 2006) the study area falls primarily within one main vegetation type, Kouga Grassy Sandstone Fynbos, which falls into the Fynbos Biome. The site is on the boundary with another vegetation type, Humansdorp Shale Renosterveld, and it is likely that the site could contain floristic elements derived from either of these vegetation types.

Kouga Grassy Sandstone Fynbos is found along the lower flanks of the Kouga Mountains in the Langkloof north of Joubertina and the northern and lower slopes of Suuranysberge to the low mountains and flats north of Humansdorp. It is a low shrubland with sparse, emergent tall shrubs and dominated by grasses in the undergrowth or grassland with scattered ericoid shrubs. This vegetation type occurs throughout the site under assessment (refer to Figure 5.4).

Humansdorp Shale Renosterveld occurs in three swathes, one of which extends from Jeffreys Bay near the coast inland past Humansdorp to the lower reaches of the Dieprivier near Two Streams. The vegetation type occurs on moderately undulating plains and undulating hills. It is a vegetation composed of low, medium dense graminoid, dense cuppressoid-leaved shrubland, dominated by renosterbos. There are both grassland shrubland and grassland forms of the renosterveld. Thicket patches are common on termitaria and fire-safe enclaves. This vegetation type occurs in the extreme southern part of the site (Figure 5.4).
Kouga Grassy Sandstone Fynbos is classified in Mucina et al. (2006) as Least Threatened, with 19% conserved of a target of 24% and 10% transformed (Mucina et al. 2006). Humansdorp Shale Renosterveld occurs is classified in Mucina et al. (2006) as Endangered, with none conserved of a target of 29% and 61% transformed (Mucina et al. 2006). The Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists this vegetation type as Endangered.

Figure 5.4: Vegetation types as mapped for the study area by Mucina et al. 2006

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 (Appendix F). Of the plant species that are considered to occur within the geographical area under consideration, there were seven species recorded in the quarter degree grid in which the study area is located that are listed on the Red List that could occur in habitats that are available in the study area.

All Red List vertebrates (mammals, reptiles, amphibians, fish) that could occur in the study area are listed in Appendix 2 of the specialist ecology study (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 are a number of mammal species of conservation concern that have a distribution that coincides with the study area. Only two of these are considered to have a possibility of occurring on site, the Brown Hyaena and the Natal Long-fingered Bat, both listed as Near Threatened. There are therefore no threatened species that have a probability of occurring on site.

There are two reptile and no amphibian species of conservation concern that have a distribution that includes the study area and which could occur on site. The two reptile species are the Spotted Rock Snake (Rare) and the Yellow-bellied House Snake (Near Threatened). There are therefore no threatened reptile or amphibian species that occur on site

Tree species protected under the National Forest Act are listed in Appendix 3 of the specialist ecology study (Appendix F). If any of these species occur in the study area, the most likely places would be in the thicket in the drainage lines or in woodland patches. Some of these areas were searched for these species, but no individuals were found on site. The probability of one or more of them occurring on site, is however, still very high.

The study area is located about 60 km south-east of the Kouga-Baviaanskloof Complex, 50 km north-east of the Tsitsikamma National Park, and about 35 km east of the Maitland-Gamtoos Coast – all of which are recognized as national Important Bird Areas, and is likely to support a reasonably diverse avifauna, including some significant populations of rare, threatened and/or endemic species. At least 269 bird species may occur with some regularity within the anticipated impact zone of the wind energy facility, including 60 endemic or near-endemic species, 19 red-listed species, and five species – Knysna Woodpecker Campethera notata, Ludwig's Bustard Neotis ludwigii, Blue Crane Anthropoides

paradiseus, Black Harrier Circus maurus and Knysna Warbler Bradypterus sylvaticus - which are both endemic and red-listed.

Refer to Table 1 in the Avifauna specialist study (refer to Appendix G) for a list of Red-listed bird species considered likely to occur within the impact zone of the proposed wind energy facility.

Avian microhabitats comprise a matrix of quite pristine, rocky Fynbos covered slopes and ridge-tops, bounded by quite degraded, grassy Renosterveld covered flats, with extensive areas of cultivated fields. The deeper valleys or watercourses draining the high ground of the main development area to the north and south contain patches of thicket or forest, in some cases infested by alien trees in their lower reaches. The area does not feature any significant wetlands, although the Seekoei and Leeubos Rivers run around its periphery, and there are a number of small farm dams around the foot of the main ridge.

5.6.3 Critical biodiversity areas features and areas of conservation concern in the vicinity of the proposed development site

The study area occurs within the Cape Floristic Region (CFR), which is recognised as one of the principal centres of diversity and endemism in Africa (refer to figure 5.5).

The characteristic and most widespread vegetation of the Cape Floristic Region is fynbos, consisting of hard-leaved, evergreen, fire-prone shrubs. Other vegetation types occurring in the CFR are Renosterveld, Succulent Karoo, Subtropical Thicket and Afromontane forest, although only Fynbos and Renosterveld are considered to be the main vegetation types in the CFR. Fynbos is associated with the nutrient poor soils of the Cape fold Belt mountains. It is very species rich, with over 75% of the CFR species associated with it, including all the endemic families and most of the endemic genera.

Permanent and complete transformation of habitat has affected 33% of the CFR hotspot. Less than 20% of the total area covered by the CFR hotspot can be considered close to the pristine state in the sense that it is entirely free of alien plants and subjected to appropriate fire and grazing regimes. The study area is within this hotspot area near its eastern end (refer to Figure 5.5) and, although the hotspot contains a wide variety of vegetation types, the study area contains a number of vegetation types that are typical of the areas of concern within the hotspot.

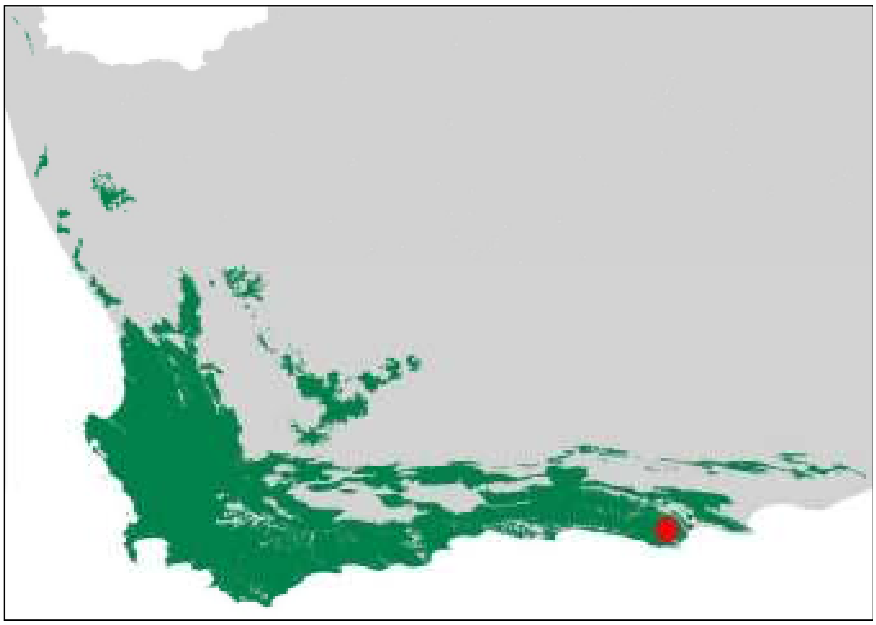

Figure 5.5: Map illustrating the relationship of the Fynbos Biome to the study area (red circle).

There have been a number of regional conservation assessments produced within the Eastern Cape Province, including the following:

» Subtropical Thicket Ecosystem Programme (STEP)
» Succulent Karoo Ecosystems Programme (SKEP)
» National Spatial Biodiversity Assessment (NSBA)
» Eastern Cape Biodiversity Conservation Plan (ECBCP).

These studies identify patterns and processes that are important for maintaining biodiversity in the region. Unfortunately, many of these studies have been done using coarse scale satellite imagery that does not provide spatial or spectral accuracy at the scale of the present study. They are, however, useful for understanding broad issues and patterns within the area. The ECBCP has integrated all previous studies and is a useful reference for identifying conservation issues in the study area and surrounds.

The ECBCP identifies Critical Biodiversity Areas (CBAs), which are terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning. The ECBCP identifies CBAs at different levels with decreasing biodiversity importance, as follows:

1. PA: Protected areas.
2. CBA 1: Critically Endangered vegetation types and irreplaceable biodiversity areas (areas definitely required to meet conservation targets).

3. CBA 2: Endangered vegetation types, ecological corridors, forest patches that do not fall into CBA 1, 1 km coastal buffer, irreplaceable biodiversity areas that do not fall into CBA 1.
4. CBA 3: Vulnerable vegetation types.

Within and around the study area, the ECBCP identifies CBAs at three levels that occur within the study area and surroundings (Figure 5.6). The CBA 2 areas that fall within the study site are corridor areas, which are important for a number of reasons, including the maintenance of ecological processes. The CBA 2 areas that fall within the study site are irreplaceable biodiversity areas.

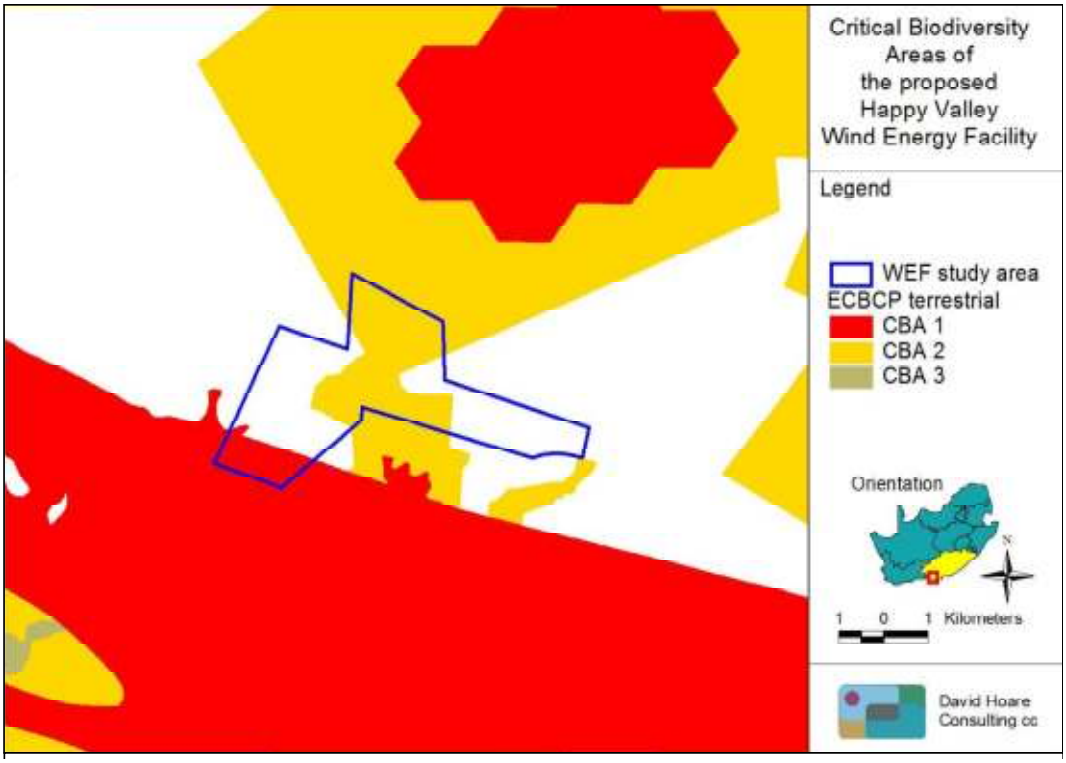

Figure 5.6 Important biodiversity areas in the vicinity of the study area

5.5.4 Agricultural Potential

Much of the study area consists of shallow soils of low potential. The year-round rainfall in the area means that there is potential for arable agriculture in the area although the sandy soils may be prone to drought conditions. The shallower soils are suited for grazing at best. The grazing capacity of the area is moderately low, around 10-14 ha/large stock unit.

5.5.5 Heritage and Palaeontology Profile

» Earlier Stone Age – 1,5 million to 250 000 years ago

The oldest evidence of the early inhabitants in the region are large stone tools, called handaxes and cleavers and belong to the Acheulian Industry dating between approximately 1,5 million and 250 000 years old. These stone tools can be found in the river gravels that caps the hill slopes in the Humansdorp and Kareedouw regions and on the calcrete floors exposed in the dune systems (for example, on the farm Geelhoutboom) along the coast towards Cape St Francis.

» Middle Stone Age – 250 000 to ca 30 000 years ago

The large Acheulian stone tools were replaced by smaller stone tools called the Middle Stone Age (MSA) flake and blade industries. Although MSA stone tools occur throughout the region and may date between 250 000 and 30 000 years old, little is known of the MSA in the study area because no sites with well-preserved deposits have been yet found and systematically researched.

The oldest anatomically modern human remains globally (some 110 000 years old) appear in the Klasies River complex of caves some 20 km east of the proposed. The archaeological deposits at the Klasies River Caves (1-5) date to 120 000 years old and provide an excellent platform to study past human behaviour.

» Later Stone Age – ca 20 000 to historical times

The period between 20 000 and 14 000 years ago experienced extremely cold climatic conditions (Last Glacial Maximum - the last ice age). Archaeological and palaeoenvironmental evidence from the Cape St Francis coast indicate that the cold temperatures created favourable conditions for grassland expansion, which in turn gave rise to large herds of grazing animals. The mammal remains from archaeological sites indicate that there were several large grazing animal species living on the grassland, for example giant buffalo, giant hartebeest and the Cape horse.

Excellent preservation of organic material in some caves and shelters in the nearby Kouga Mountains yielded remarkable botanical artefacts, such as digging sticks (4 500 years old), fire sticks (5 800 years old), decorated wooden sticks (9 200 years old) and almost complete mummified human remains dating to some 2 000 years ago. Other interesting features are 'storage pits' (hollows lined with plant material) which were used to store seeds for later use, and 'postholes' (often with post still in situ). It would appear that shelters were divided, presumably into small family living areas.

» Last 2 000 years

The first real change in the socio-economic landscape came some 2 000 years ago when KhoiKhoi pastoralists settled in the region. Many sites were found along the adjacent Cape St Francis coast, with the oldest dating to 1 500 years old. The preservation of plant remains was excellent and the first archaeo-

botanical study in South Africa was also conducted from this site. A large number of archaeological artefacts and human remains were found near Andrieskraal during the construction of the irrigation canals in the Gamtoos Valley in the 1960s. Not long after their arrival, the first Europeans rounded the Cape and greatly altered the prehistoric socio-economic landscape.

No archaeological remains of any heritage significance were found during site inspection, but it is possible that stone tools may occur and be exposed if the surface soil is disturbed.

The area is underlain by sedimentary rocks of the Cape Supergroup – predominantly of the Table Mountain group and a very small section of the overlying lower Bokkeveld Group. Fossil have in the past been recovered from these sediments throughout the southern Cape but in particular within the Western Cape. However, within the Happy Valley area two geological factors have effectively eliminated fossils from the underlying rocks - firstly the tectonic overprint of the Cape Folding Event that took place around 310 million years ago and secondly, the long period of weathering and erosion that produced the African Land Surface. There is therefore a very low likely hood of finding well preserved fossils within the site.

ASSESSMENT OF IMPACTS: WIND ENERGY FACILITY & ASSOCIATED INFRASTRUCTURE *CHAPTER 6*

The construction activities for a wind energy facility project include land clearing for site preparation and access/haul roads; transportation of supply materials and fuels; construction of foundations involving excavations and cement pouring; compaction of laydown areas and roadways, manoeuvring and operating cranes for unloading and installation of equipment; laying cabling; and commissioning of new equipment. Decommissioning activities may include removal of the temporary project infrastructure and site rehabilitation. Environmental issues associated with these **construction** and **decommissioning** activities may include, among others, threats to biodiversity and ecological processes, including habitat alteration and impacts to wildlife through mortality, injury and disturbance; impacts to sites of heritage value; soil erosion; and nuisance noise from the movement of vehicles transporting equipment and materials during construction.

Environmental issues specific to the **operation** of a wind energy facility include visual impacts; noise produced by the spinning of rotor blades; avian/bat mortality resulting from collisions with blades; and light and illumination issues.

These and other environmental issues were identified through the scoping evaluation. Potentially significant impacts identified have now been assessed within the EIA phase of the study. The EIA process has involved input from specialist consultants, the project proponent, as well as input from key stakeholders (including government authorities) and interested and affected parties engaged through the public consultation process. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts vary significantly from site to site.

This chapter serves to assess the identified potentially significant environmental impacts associated with the proposed **wind turbines and associated infrastructure** (substation, power line, access road to the site, internal access roads between turbines, underground electrical cabling between turbines, turbine foundations), and to make recommendations regarding preferred alternatives for consideration by DEA, as well as for the management of the impacts for inclusion in the draft Environmental Management Plan (refer to Appendix O).

6.1. Assessment of Potential Impacts – overarching methodology

In order to assess the impacts associated with the proposed wind energy facility, it is necessary to understand the extent of the affected area. The affected area

primarily includes the turbines, substation and associated access roads. A wind energy facility is dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. A study area of approximately 12 km^2 is being considered as a larger study area for the construction of the proposed wind energy facility. From the results of the facility layout determination exercise, it is now apparent that the effective utilised area required to accommodate the infrastructure is in fact approximately 0.036 km^2 in extent. This area to be occupied by turbine and associated infrastructure is illustrated in Figure 6.1 below, and would include:

» A cluster of up to **20 wind turbines** to be constructed over an area of ~ **12 km^2** in extent
» Each turbine will be a **steel tower** (of up to 80m in height), a **nacelle** (gear box) and three **rotor blades** with a rotor diameter of up to 100 m (i.e. each blade up to 50 m in length)
» **Concrete foundations** (16m x 16m x 2,5m) to support the turbine towers
» Underground electrical distribution **cabling** between the turbines
» An on-site substation (up to 35m x 22m) with an associated transformer
» A new overhead power line (with a maximum voltage of 132kV) to connect to Eskom's existing Melkhout Substation;
» **Internal access roads** (3m wide) to each wind turbine within the facility
» Main **access / haul road** to the site
» Small office and/or workshop building (20m x 10m) for maintenance purposes

A new overhead power line will be constructed to connect the on-site substation to the electricity distribution grid via Eskom's existing Melkhout Substation, which lies approx 11 km east of the proposed site. Routes for the power line will be assessed, surveyed and pegged prior to construction. Two alternative corridors are proposed for the proposed power line (refer to Figure 6.1).

» Alternative 1 is ~11 km in length. It exits the site in an easterly direction before reaching the N2 national road after ~6 km and heading in a northeast direction for ~3 km. The corridor then heads in a straight line southeast for 2 km towards the Melkhout Substation.
» Alternative 2 is approximately 12 km in length. It follows a similar route but after 6 km it continues straight alongside the N2 for ~2.5 km before heading north where it joins the Alternative 1 route before heading southeast towards Melkhout Substation.

The sensitivity of the proposed routes for the power lines and proposed substation position have been assessed through this EIA report.

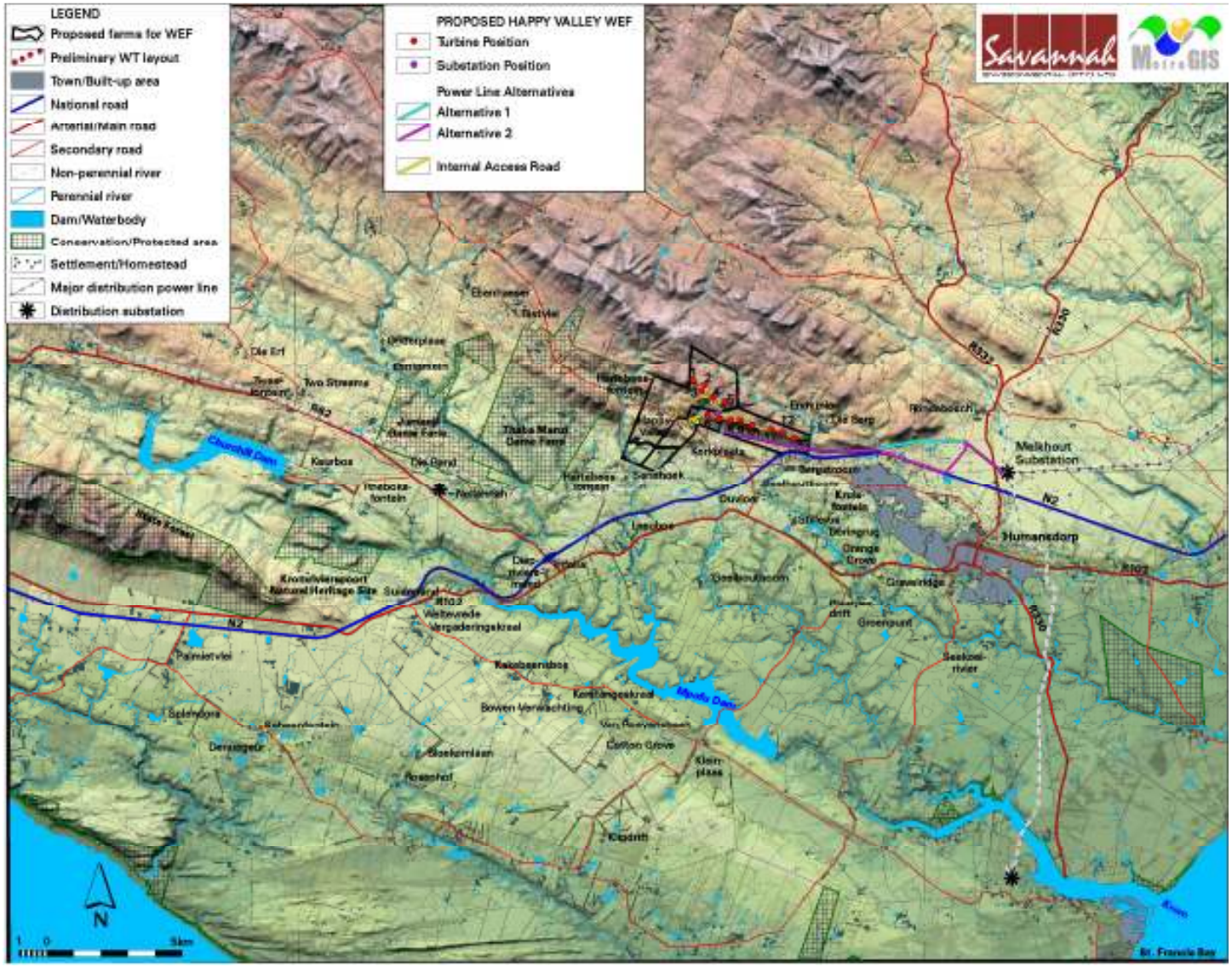

Figure 6.1: Locality map showing provisional wind turbine layout, substation site and power line corridor

6.2. Assessment of Potential Impacts on Ecology

The potential impacts on ecology are described briefly below. There are two major ways that a wind energy development may influence ecosystem structure and functioning: a) through direct impacts on individual organisms and b) through impacts on habitat structure and functioning.

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.

There are two vegetation type that occurs on site, namely Kouga Grassy Sandstone Fynbos (classified as Least Threatened) and Humansdorp Shale Renosterveld (classified as Endangered). The vegetation on site has been classified at a Provincial level, through the Eastern Cape Biodiversity Conservation Plan (ECBCP), as having elevated conservation value. The areas of concern in the ECBCP are remaining areas of lowland fynbos in the southern part of the site that fall within the Endangered vegetation type, known important areas for biodiversity in the northern part of the site (around the upper reaches of the Seekoei River) and a corridor area linking these two. The area is also within the Cape Floristic Region, one of the earth's 25 hotspots. There are, therefore, biodiversity planning constraints to development of the site that affect features identified at a Provincial and National level as being sensitive and of high value.

Most of the study area is still in natural condition or considered to be natural vegetation in relatively good condition. Along the main mountain ridge, the vegetation is in excellent condition and contains a high diversity of habitats and plant species. T he mountain ridge divides the vegetation into dryer north-facing slopes and more moist south-facing slopes, each with its own species composition. In addition, rocky areas contain a different species composition to more open vegetation with no rocks. Drainage lines and moist areas on site contain species more typical of these habitats than terrestrial habitats. There are gradients in species composition between all these different environmental variations and species that are more commonly found only in these interfaces. The mountain ridge therefore contains high species richness and turnover, including a number of species of rare occurrence and/or of conservation concern. In the lower-lying areas, agricultural activities have affected the vegetation to a great extent. Cultivated lands and infrastructure contain no natural vegetation and areas adjacent to these tend to be disturbed. There are, however, small patches of lowland vegetation that are in moderately good condition and

characterized by high richness of species typical of fynbos and/or renosterveld vegetation.

In general, mountains and ridges are characterized by high spatial heterogeneity due to the range of differing aspects, slopes and altitudes all resulting in differing soil, temperature, elevation, light and hydrological conditions. This variation is an especially important predictor of biodiversity. Mountains and ridges are characterized by a particularly high biodiversity and it follows that their protection will contribute significantly to the conservation of biodiversity in the landscape. These areas are vital habitat for many threatened plant and animal species and provide important refugia for species vulnerable to the effects of climate change.

The mountain areas on site also constitute an important mountain catchment area for the streams that emanate from the site or pass through the site. Natural vegetation on site acts as a natural hydrological regulator that contributes towards providing a regular and very clean source of water for downstream areas. The site, in combination with similar surrounding areas therefore acts as an important regional provider of so-called ecosystem goods and services, especially for areas located between the mountains and the coastline.

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. Both functions are potentially critical to conservation of biological diversity as the landscape becomes increasingly fragmented into smaller, more isolated patches. Wetlands are protected under national legislation (National Water Act). Any impacts on these areas would require a permit from the relevant National Department.

The drainage lines on site drain into one main stream that leads to the sea via the Seekoei River. The site constitutes part of the catchment for this river. The mouth of the Seekoei River has an estuary, which is considered to be very sensitive and is shown as having high conservation value and sensitivity in the Eastern Cape Biodiversity Conservation Plan (ECBCP). The value and condition of this estuary is directly affected by activities that occur within the catchment of the waterways that feed the estuary. The potential impacts of activities on site on these river systems may therefore have an effect on an ecosystem downstream of the site. It is especially important that the sensitive Seekoei River estuary is not affected by activities on site.

The site is characterised by the presence of steep mountain slopes (Figure 6.2). Steep slopes can be problematic in constructing infrastructure due to the fact that any impact can have an effect downslope from that point. Depending on the

steepness and the length of the slope, particular areas may be more sensitive to disturbance than others. Any steep slopes are therefore considered to have elevated sensitivity from an ecological perspective. This applies to most of the mountain ridge that constitutes the main topographic feature on site. Potential issues that may arise from development of these areas includes erosion of substrates downslope and the impacts of stormwater runoff.

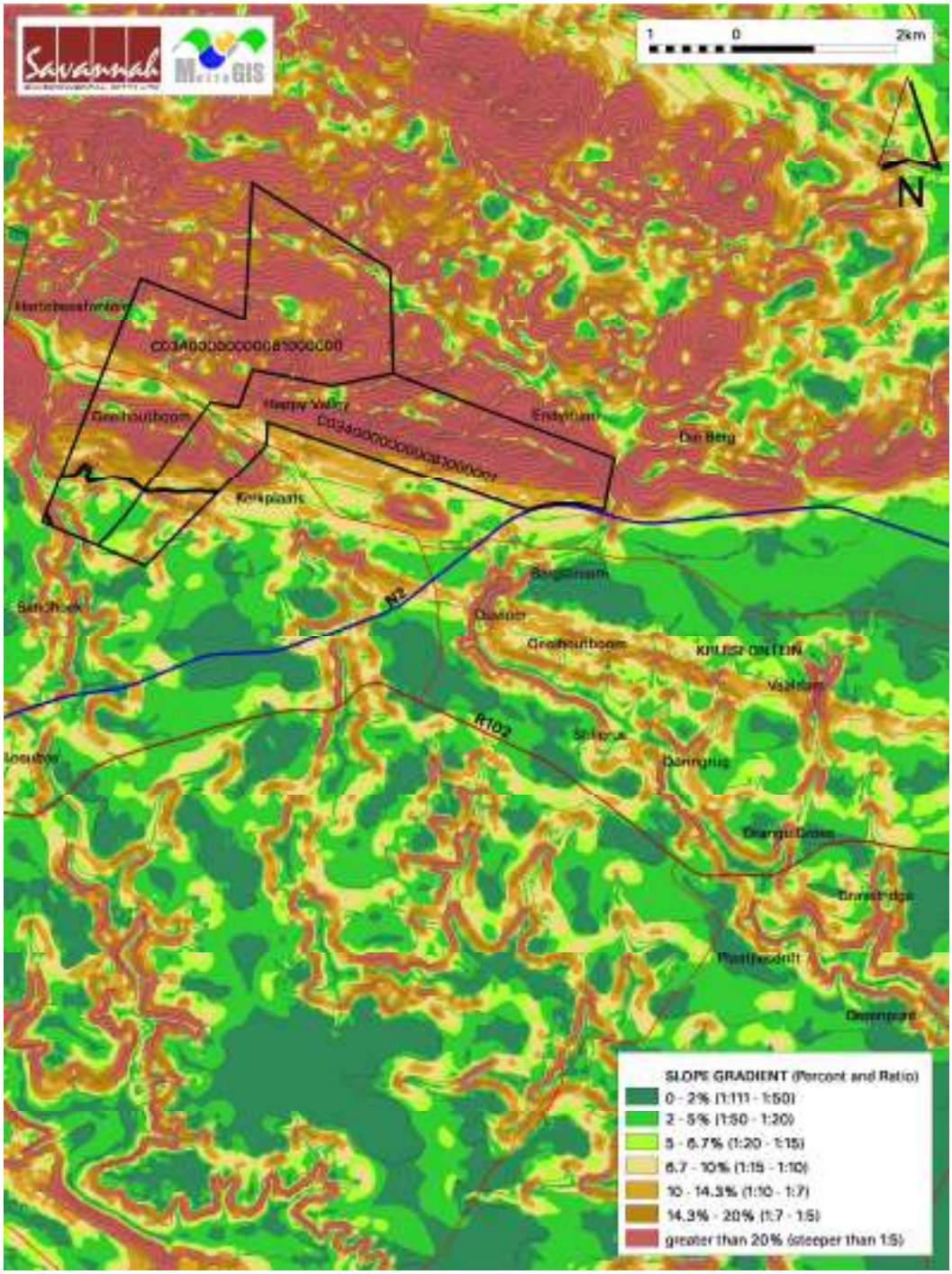

Figure 6.2: Slope Analysis Map

There are eight tree species that are protected under the National Forests Act that have a geographic distribution that includes this area, all of which have a moderate likelihood of occurring on site and one, *Sideroxylon inerme* (white milkwood), has a high likelihood of occurring on site. Any impacts on individuals of any of these species requires a permit from the National Department. None of these species were found on site, but this does not preclude the possibility of them occurring there.

There are two threatened plant species that could occur in available habitats in the study area. This includes one species classified as Critically Endangered (*Erica humansdorpensis*) and one as Endangered (*Disa lugens* var*. lugens*). The Critically Endangered species has been previously recorded in the south-eastern corner of the site adjacent to the N2 National road. The Endangered species has not been previously recorded on site, but based on geographical range, habitat preference and previous collection records in the near vicinity, it is considered highly possible that it occurs on site.

There are three Endangered plant species that were considered to have a moderate probability of occurring on site. In all three cases the habitat on site is not ideal or the closest records of these species, even if close by, is within habitats that are not found on site. The current assessment is therefore that there is a low risk of them occurring on site, but that their occurrence cannot be ruled out completely.

The Near Threatened plant species, *Aloe micracantha*, was recorded on site on the northern side of the main mountain ridge in close proximity to the existing vehicle track. It prefers nutrient-poor, well-drained sandy soils and could occur anywhere along the northern side of the main mountain ridge on site. Although this species occurs on site, it is not legally protected nor considered to be threatened (near threatened is a lesser category than any of the threatened categories). However, the presence of this species on site is an indication of the fact that the site has the potential to support populations of unique and/or rare species. This is supported by the probability of other species of concern possibly occurring on site. Another near threatened plant species, *Protea coronata*, also has a high probability of occurring on site, although it was not observed on site during the field survey. It has been recorded in a number of localities in close proximity to the site and suitable habitat occurs on site. The declining plant species, *Prionium serratum*, is another species of concern that could also occur in any large bottomland wetland systems on site.

There are no threatened mammal, reptile or amphibian species that are likely to occur on site. There are two animal species of lower conservation concern that

may occur in habitats within the study area or that may be affected by the proposed facility. Both species are classified as Near Threatened. They are the Brown Hyaena and the Yellow-bellied House Snake, neither of which are known to occur on site for certain.

There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

» vegetation of conservation importance: this is based primarily on the ECBCP assessment, the Draft Ecosystem List and the fact that the site falls within the Cape Floristic Region;
» perennial and non-perennial rivers and streams: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal;
» potential occurrence of populations of Red List organisms, including flora and fauna that have been evaluated as having a high chance of occurring within remaining natural habitats within the study area.
» estuaries and estuarine habitats that occur off-site, but which may be affected by activities on site.

These factors have been taken into account in evaluating sensitivity within the study area (Figure 6.3). The sensitivity classification for the site is as follows:

VERY HIGH: A small area of lowland fynbos in the south-eastern corner of the site is classified as having very high sensitivity. This patch of vegetation is the site of a previous record of a Critically Endangered plant species, *Erica humansdorpensis*. Also classified as having very high sensitivity are all remaining areas of lowland fynbos that occur within Humansdorp Shale Renosterveld, which is classified in the scientific literature and according to the Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004) as Endangered, and is protected according to this legislation.

HIGH: All of the drainage lines on site are classified as having high sensitivity. They are protected according to the National Water Act (Act 36 of 1998). Ecologically, they are areas that provide high value ecosystem goods and services. Also classified as having high sensitivity are all areas of south-facing mountain fynbos on site. These are potential habitat for the Endangered plant species, *Disa lugens*. They are also considered to have high intrinsic biodiversity value, including high species richness, high habitat variability and high probability of containing species of narrow distribution and/or ecological amplitude. In addition, they are considered to be areas that provide high value ecosystem

goods and services in terms of being within a mountain catchment area for a number of streams and wetlands.

MEDIUM-HIGH: All of the north-facing mountain fynbos on site is classified as having medium-high sensitivity. These are areas of natural vegetation that are considered to have high intrinsic biodiversity value, including high species richness, high habitat variability and high probability of containing species of narrow distribution and/or ecological amplitude. In addition, they are considered to be areas that provide high value ecosystem goods and services in terms of being within a mountain catchment area for a number of streams and wetlands.

MEDIUM: All remaining areas of natural vegetation on site are classified as having medium sensitivity.

LOW: Areas where no natural vegetation occurs is classified as having low sensitivity. This includes cultivated lands, previously cultivated areas with secondary vegetation, areas of buildings, roads and bare ground.

Site-specific factors that may lead to parts of the study area having high ecological sensitivity are the potential presence of wetlands within the drainage lines on site, potential presence of steep slopes, the presence and potential presence of various plant and animal species of conservation concern, and protected trees. Overall the proposed wind energy facility is likely to have a medium - high local and regional negative impact on the ecology on site, prior to mitigation. In most cases this could be reduced to medium negative after mitigation. The primary negative impacts are the result of both direct and indirect factors. Direct impacts include loss of 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.

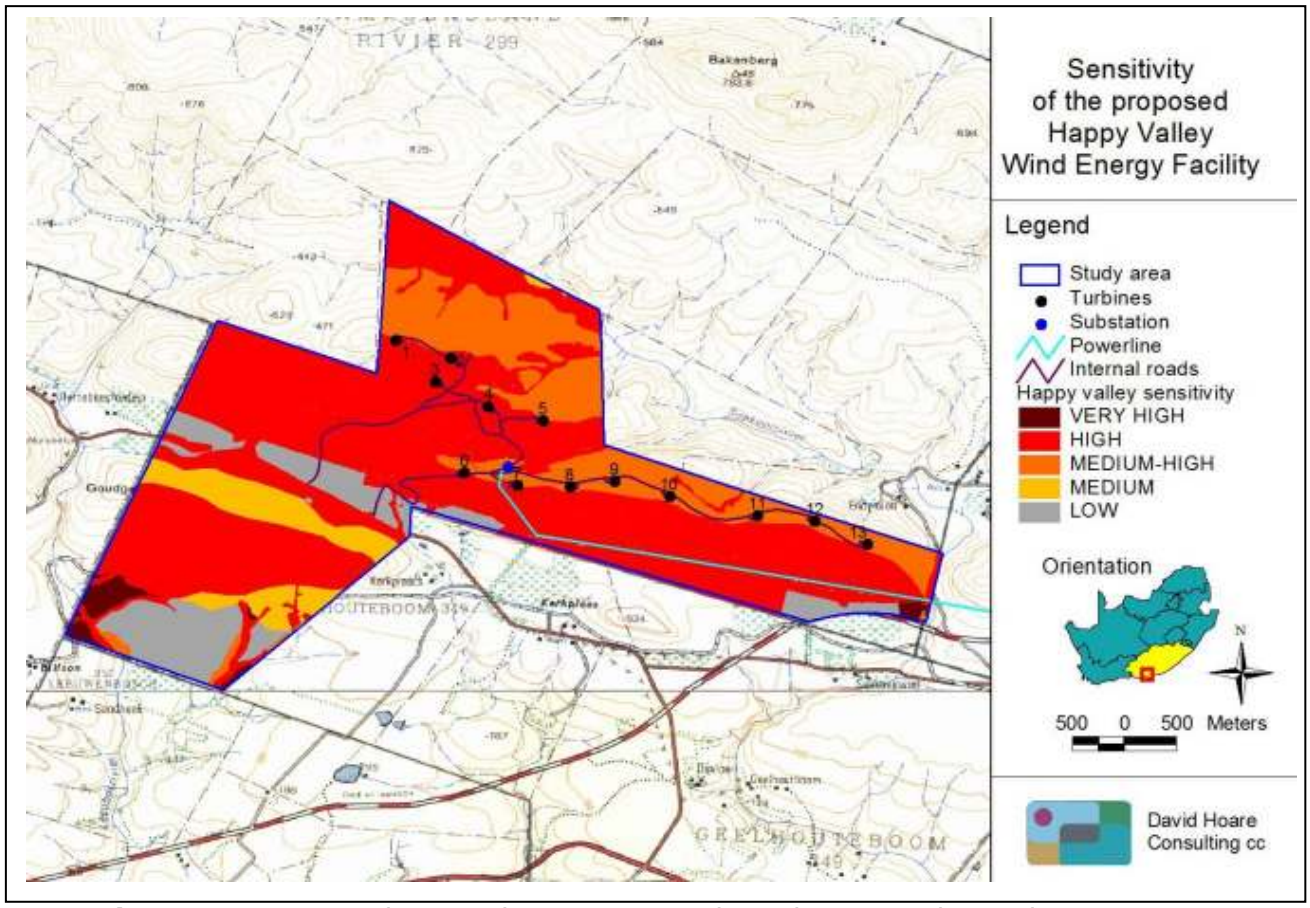

Figure 6.3: Map indicating the sensitive ecological areas in the study area

The major potential impacts are described briefly below.

» **Impacts on bird and bat species**

Bird and bat deaths are one of the most controversial biological issues related to wind turbines. The deaths of birds and bats at wind farm sites have raised concerns by conservation agencies internationally. Potential impacts on birds are discussed in detail in Section 6.4 below. Potential impacts on bats are discussed in detail in Section 6.5. These impacts are therefore not discussed further in this section.

» **Impacts on threatened animals**

Threatened animal species are affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species, a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species,

possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

- fragmentation of populations of affected species;
- reduction in area of occupancy of affected species; and
- loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

There is one mammal species of conservation concern that could potentially be affected by the proposed wind energy facility, that is, the Brown Hyaena, listed as Near Threatened. In addition, there is one near threatened reptile species that has a distribution that includes the study area and which could occur on site, that is, the Yellow-bellied House Snake. The Brown Hyaena is a mobile animal that is likely to avoid the site during construction and re-appear afterwards. If any populations of the Yellow-bellied House Snake occur on site, they are likely to be restricted to the specific parts of the site and unlikely to be able to move away during the construction phase, or are dependent on habitats on site remaining intact. This species, although listed as Near Threatened, occurs throughout a wide part of South Africa and is very unlikely to be significantly affected by, even in the worst-case scenario, the complete loss of the site, which constitutes a very small fraction of its potential overall range. Overall, this species is therefore unlikely to be affected by construction of the proposed infrastructure.

» **Impacts on threatened plants**

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

- fragmentation of populations of affected species;
- reduction in area of occupancy of affected species; and
- loss of genetic variation within affected species.

There are four plant species of conservation concern that have a geographic distribution that includes the site and which have a high chance of occurring in the study area. This includes one species classified as Critically Endangered, one as Endangered and two as Near Threatened. The Critically Endangered species has been recorded adjacent to the N2; the locality description is on the proposed site. The remaining species have all been recorded nearby and the habitat on site is potentially suitable for them. One Near Threatened species was recorded on site during fieldwork undertaken for this project.

» **Impacts on protected tree species**

There are a number of tree species that are protected according to NG1012 under section 12(I)(d) of the National Forests Act (Act No. 84 of 1998). In terms of section1 5(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an applicant and subject to such period and conditions as may be stipulated". Based on habitat preferences there are a number of protected tree species could occur on or near the site.

» **Impacts on indigenous natural vegetation (terrestrial)**

Construction of infrastructure may lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of grassland vegetation. Where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). Consequences of the impact occurring may include:

- negative change in conservation status of habitat;
- increased vulnerability of remaining portions to future disturbance (reduced resilience);
- general loss of habitat for sensitive species;
- loss in variation within sensitive habitats due to loss of portions of it;
- general reduction in biodiversity;
- increased fragmentation (depending on location of impact);
- disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- loss of ecosystem goods and services.

It has been established that the vegetation on site is classified as Least Threatened. However, the site falls within the Cape Floristic Region, which is an area of global biodiversity significance, and also affects areas classified as important corridors or habitats in the ECBCP. The natural vegetation on site

within the mountain area is rich in species and there is a diversity of different habitat types. The vegetation is in very good condition, intact and there is little fragmentation or degradation within the mountain areas.

» **Impacts on wetlands**

Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. This will lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

- increased loss of soil;
- loss of or disturbance to indigenous wetland vegetation;
- loss of sensitive wetland habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
- fragmentation of sensitive habitats;
- impairment of wetland function;
- change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
- reduction in water quality in wetlands downstream of road.

The site contains a number of streams and drainage lines in which wetlands occur. More importantly, one of the major wetland systems on site constitutes part of the catchment for the Seekoei River estuary on the coast downstream of the site. The Seekoei River estuary is classified in the ECBCP as of high conservation significance and sensitivity. The wetlands on site form the upper seepage zones and hillslope seepage wetlands that are the source of the water that is found downstream. They are, therefore, highly sensitive to disturbance and any hard modification to vegetation or soil within these areas is likely to seriously compromise the current functioning of these systems.

» **Change in runoff and drainage patterns**

Infrastructure and roads crossing landscapes cause local hydrological and erosion effects resulting in major peak-flow and sediment impacts (Forman & Alexander 1998). This may occur around construction sites, but also in areas where the infiltration rates of the landscape are changed due to an impermeable surface being constructed. Increased runoff associated with infrastructure may increase the rates and extent of erosion, reduce percolation and aquifer recharge rates, alter channel morphology and increase stream discharge rates. Consequences may include:

- increased loss of soil;
- loss of or disturbance to indigenous vegetation, especially in wetlands;
- loss of sensitive habitats, especially in wetlands;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- impairment of wetland function;
- change in channel morphology in downstream wetlands, potentially leading to loss of wetland vegetation; and
- reduction in water quality in wetlands downstream of disturbance.

There are both steep slopes and wetlands occurring on site and an estuary occurring downstream. The soils within the steeply sloping landscapes are not highly erodible, but the natural vegetation plays an important role in regulating the hydrology of the landscape. A number of turbines and the associated internal access roads and underground cables are on very steep slopes that are vulnerable to downslope damage.

» **Establishment and spread of declared weeds and alien invader plants**

Major factors contributing to invasion by alien invader plants includes high disturbance and negative grazing practices. Exotic species are often more prominent near infrastructural disturbances than further away. Consequences of this may include:

- loss of indigenous vegetation;
- change in vegetation structure leading to change in various habitat characteristics;
- change in plant species composition;
- change in soil chemical properties;
- loss of sensitive habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

There are a number alien plant species that could become established on site. The potential therefore exists for extensive and diverse invasion of the site. The habitats most likely to be affected are watercourses and fynbos, depending on the invasive species.

Impact tables summarising the significance of the impacts on ecology (with and without mitigation) associated with the proposed wind turbines

Impacts are assessed for each component of infrastructure for the proposed wind energy facility. There is therefore a separate assessment for the turbines, substation, overhead power lines and the combination of underground cables between turbines and internal access roads.

Impact Assessment tables for Wind turbines:

Nature: Impacts on individuals of threatened animal species There are two Near Threatened animal species that may be affected by construction activities on site. One, the Brown Hyena is mobile and will not be affected by construction or operation of the facility. The other, the Yellow-bellied House Snake, may occur on site, but it is unknown. It has a wide distribution and the conservation status of the species will not be affected by construction on site.		
	Without mitigation	**With mitigation**
Extent	Local (3)	Local (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (20)**	**Low (20)**
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: » None required		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands and increased frequency of veld fires) may exacerbate this impact.		
Residual Impacts: Unlikely to be residual impacts.		

Nature: Impacts on threatened plants (Erica humansdorpensis) There are two threatened and two near threatened species that could occur on site. One of the Near Threatened species was recorded on site during this study and one threatened species has been previously recorded on site.		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)

Magnitude	Moderate (6)	Moderate (6)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (28)**	**Low (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » None required		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands and increased frequency of veld fires) may exacerbate this impact.		
Residual Impacts: Low		

Nature: Impacts on threatened plants (Disa lugens, EN)
For the Endangered plant species (Disa lugens), it is unknown whether they occur within or near to the footprint of any turbine. It is assessed as improbable that impacts will occur on populations of this species.

	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	High (8)
Probability	Improbable (2)	Highly improbable (1)
Significance	**Medium (32)**	**Low (16)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:
(1) keep disturbance of indigenous vegetation to a minimum
(2) rehabilitate disturbed areas as quickly as possible
(3) Prior to construction, during a suitable season, undertake a targeted survey of the footprint of the turbines to ensure that no populations of *Disa lugens* occur there. If any populations are found, turbines should be repositioned to avoid such populations. If not, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

Cumulative impacts:
Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.

Residual Impacts:
Will probably be very low if control measures are effectively applied.

Nature: Impacts on indigenous natural vegetation

All of the turbines are situated within natural vegetation within the mountain region of the site.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate to low (5)
Probability	Definite (5)	Definite (5)
Significance	**Medium (60)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some extent	

Mitigation:

Avoid unnecessary impacts on natural vegetation surrounding turbine position. Impacts should be contained, as much as possible, within the footprint of the turbines and laydown area.

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 occur.

Nature: Impacts on Wetlands

None of the turbines are currently positioned within mapped wetland areas.

	Without mitigation	**With mitigation**
Extent	Local and surroundings (2)	Local and surroundings (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (2)	Highly probable (2)
Significance	**Low (26)**	**Low (26)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

» Control stormwater and runoff water.

» Obtain a permit from DWA to impact on any wetland or water resource.

Cumulative impacts:
Soil erosion, alien invasions, and increased frequency of veld fires may all lead to additional impacts on wetland habitats that will exacerbate this impact.

Residual Impacts:
None.

Nature: Change in runoff and drainage leading to increased soil erosion and siltation of downslope areas
Hard surfaces created as part of the development, for example, the cement slab at the footprint of each wind turbine, may lead to increased runoff rather than infiltration of water into the ground. Where the ground is relatively flat, this is unlikely to pose too many problems, but on sloping ground, this may lead to increased erosion and siltation of downslope areas. There are both steep slopes and wetlands potentially occurring on site, but turbine positions vary in terms of slope and substrate properties. In a number of cases there is sufficient slope to warrant concern with respects to this potential impact and in other cases the turbine is at the summit of a steep slope. However, the most sensitive parts of the site (in terms of steep slopes), the escarpment zone of the main slope (i.e. the steepest area of the slope / area with the highest gradient), do not have turbines located within them.

The potential impact is likely to be at a local scale, but may affect surrounding (down-slope) areas. It's likely to be long-term and, in a worst-case scenario, may lead to impacts of moderate magnitude. There is currently some evidence of severe erosion in drainage lines in the study area that indicate that this impact could occur and it is therefore assessed as probable that this impact will occur in the absence of control measures.

Turbine numbers 8, 9, 10, 11, 12 and 13 are all in areas where there is a high risk of causing downslope impacts, at the summit of very steep slopes

A comprehensive stormwater management plan must be compiled that details how stormwater off hard surfaces will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces. Any disturbed areas should be immediately rehabilitated in order to stabilise landscapes and prevent exposed surfaces from becoming susceptible to erosion. Water velocity off hard surfaces must be reduced and diffused before water is returned to natural systems in order to minimise the risk of creating erosion channels. If any erosion features develop, they should be stabilised using typical measures, such as gabiens, weirs, rock-packing, etc.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate to low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (24)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

» control stormwater and runoff water and inhibit erosion.
» rehabilitate any disturbed areas immediately to stabilise landscapes
» water velocity must be reduced and diffused before water is returned to natural systems
» erosion features must be immediately stabilised, if they develop.

Cumulative impacts:

Alien invasions, damage and soil erosion may all lead to additional impacts 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

Turbines will create new nodes of disturbance within an otherwise pristine landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be greatly enhanced. Currently there are scattered individuals on site, except for *Acacia mearnsii,* which appears to have invaded some drainage lines quite heavily in places on site and in the surroundings.

	Without mitigation	**With mitigation**
Extent	Regional (3)	Site & surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate to high (7)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (56)**	**Medium (30)**
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 ongoing 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

Impact Assessment tables for Substation:

Nature: Impacts on individuals of threatened animal species There are two Near Threatened animal species that may be affected by construction activities on site. One, the Brown Hyaena is mobile and will not be affected by construction or operation of the facility. The other, the Yellow-bellied House Snake, may occur on site, but it is unknown. It has a wide distribution and the conservation status of the species will not be affected by construction on site. Construction of the substation will cause the loss of a very small area of habitat relative to the overall range of potentially affected species.		
	Without mitigation	**With mitigation**
Extent	Local (3)	Local (3)
Duration	Permanent (5)	Medium-term (3)
Magnitude	Low (2)	Small (1)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (14)**	**Low (14)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	None required	
Mitigation: None required		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands) may exacerbate this impact.		
Residual Impacts: Unlikely.		

Nature: Impacts on threatened plants (Disa lugens) There are two threatened and two near threatened species that could occur on site. One of the Near Threatened species was recorded on site during this study and one threatened species has been previously recorded on site. In terms of legislation, a species listed as Near Threatened is not treated as a threatened species and impacts on these species are not assessed here		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	High (8)
Probability	Improbable (2)	Highly improbable (1)
Significance	**Medium (32)**	**Low (16)**

Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

(1) keep disturbance of indigenous vegetation to a minimum
(2) rehabilitate disturbed areas as quickly as possible
(3) Prior to construction, undertake a targeted survey of the footprint of the substation to ensure that no populations of *Disa lugens* occur there. If any populations are found, the substation should be repositioned to avoid such populations. If not, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

Cumulative impacts:

Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.

Residual Impacts:

Will probably be very low if control measures are effectively applied

Nature: Impacts on indigenous natural vegetation

The substation is situated within natural vegetation within the mountain region of the site.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate to low (5)
Probability	Definite (5)	Definite (5)
Significance	**Medium (60)**	**Medium (55)**
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 unnecessary impacts on natural vegetation surrounding the substation.

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 occur.

Nature: Impacts on wetlands

The substation is positioned within a short distance of a mapped wetland area but is in a flat area at the summit of the slopes.

	Without mitigation	**With mitigation**
Extent	Local and surroundings (2)	Local and surroundings (2)
Duration	Permanent (5)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (39)**	**Medium (30)**
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:

» Control stormwater and runoff water

» Obtain a permit from DWA to impact on any wetland or water resource.

Cumulative impacts:

Soil erosion, alien invasions, damage to wetlands and increased frequency of veld fires may all lead to additional loss of habitat that will exacerbate this impact.

Residual Impacts:

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

Nature: Change in runoff and drainage leading to increased soil erosion and siltation of downslope areas

Hard surfaces created as part of the development may lead to increased runoff rather than infiltration of water into the ground. Where the ground is relatively flat, this is unlikely to pose too many problems, but on sloping ground, this may lead to increased erosion and siltation of downslope areas. The substation position is located on a moderately sloping area and down-slope areas could potentially be affected by uncontrolled impacts on the site.

The potential impact is likely to be at a local scale, but may affect surrounding (down-slope) areas. It is likely to be long-term and, in a worst-case scenario, may lead to impacts of moderate magnitude. There is some severe erosion in drainage lines in the study area that indicate that this impact could occur. Given the current position of turbines it is assessed as improbable that this impact will occur. A comprehensive storm-water management plan must be compiled that details how stormwater off hard surfaces will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces.

	Without mitigation	**With mitigation**
Extent	Local and surroundings (2)	Local and surroundings (2)
Duration	Long-term (4)	Medium-term (3)
Magnitude	Moderate (5)	Moderate to low (4)
Probability	Improbable (2)	Improbable (2)

Significance	**Low (22)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

» Compile a comprehensive stormwater management plan for the substation footprint and workshop areas
» Rehabilitate any disturbed areas immediately to stabilise landscapes
» Water velocity must be reduced and diffused before water is returned to natural systems
» Erosion features must be immediately stabilized, if they develop.

Cumulative impacts:

Alien invasions, damage to wetlands, loss of habitat and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.

Residual Impacts:

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

Nature: Change in runoff and drainage leading to increased soil erosion and damage of downslope areas

The substation is not positioned within a very steep part of the landscape, but erosion could affect surrounding sensitive areas, especially drainage lines and wetlands.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially	

Mitigation:

(1) compile a comprehensive storm-water management plan
(2) rehabilitate any disturbed areas immediately to stabilise landscapes
(3) water velocity must be reduced and diffused before water is returned to natural systems
(4) erosion features must be immediately stabilised, if they develop.

Cumulative impacts:

Alien invasions, damage to wetlands, loss of habitat may all lead to additional impacts 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
The substation will create new node of disturbance within an otherwise pristine landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be enhanced.

	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Permanent (5)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Medium (30)**
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 ongoing monitoring programme to detect and quantify any aliens that may become established

Cumulative impacts:
Soil erosion and damage to wetlands may lead to additional impacts that will exacerbate this impact.

Residual Impacts:
Will probably be very low if control measures are effectively applied

Impact Assessment tables for Overhead power line:

Nature: Impacts on individuals of threatened animal species
There are two Near Threatened animal species that may be affected by construction activities on site. One, the Brown Hyaena is mobile and will not be affected by construction or operation of the facility. The other, the Yellow-bellied House Snake, may occur on site, but it is unknown. It has a wide distribution and the conservation status of the species will not be affected by construction on site. Construction of the powerline will affect a relatively insignificant proportion of the overall habitat of these species.

	Without mitigation	**With mitigation**
Extent	Local (3)	Local (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Small (1)	Small (1)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (14)**	**Low (14)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Not required	
Mitigation: None required		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions) may exacerbate this impact.		
Residual Impacts: Unlikely to be residual impacts.		

Nature: Impacts on threatened plants (Erica humansdorpensis, CR)
The known location of the Critically Endangered species (Erica humansdorpensis) is directly adjacent to a section of the powerline servitude and this species is very likely to be affected. The potential impact could therefore be very high (could result in complete destruction of patterns and permanent cessation of processes) if this population is destroyed.

	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very high (10)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (72)**	**Low (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

(1) keep disturbance of indigenous vegetation to a minimum
(2) rehabilitate disturbed areas as quickly as possible
(3) Prior to construction, undertake a targeted survey of the servitude of the powerline and immediately adjacent areas to ensure that no populations of *Erica humansdorpensis* occur there.
(4) Suitable habitat for *Erica humansdorpensis* in the vicinity where it was previously recorded must be treated as a "no go" area. If not, a permit is required in terms of

Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.
Cumulative impacts: Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.
Residual Impacts: Will probably be low if control measures are effectively applied

Nature: Impacts on threatened plants (Disa lugens, EN)
For the Endangered species (Disa lugens), the impact could potentially be of moderate magnitude and could result in population processes continuing but in a modified way.

	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Improbable (2)	Highly improbable (1)
Significance	**Low (28)**	**Low (12)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:
(1) keep disturbance of indigenous vegetation to a minimum
(2) rehabilitate disturbed areas as quickly as possible
(3) Prior to construction, during a suitable season, undertake a targeted survey of the footprint of the powerline towers to ensure that no populations of *Disa lugens* occur there. If any populations are found, tower structures should be repositioned to avoid such populations. If not, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

Cumulative impacts:
Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.

Residual Impacts:
Will probably be very low if control measures are effectively applied

Nature: Impacts on indigenous natural vegetation
Power line routes are proposed primarily in previously disturbed parts of the landscape. It is not expected that powerline towers will have a major effect on natural vegetation on site, due to the small footprint of each tower structure.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low to small (3)

Probability	Highly probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
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 unnecessary impacts on natural vegetation surrounding pylon position. Impacts should be contained, as much as possible, within the footprint of the pylon position.		
Cumulative impacts: Soil erosion, alien invasions nd 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 occur.		

Nature: Impacts on wetlands Both overhead powerline routes cross three wetlands on site and five off site.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Small (2)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (21)**
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: (1) Place powerline tower structures outside wetland boundaries, OR (2) There is a legal obligation to apply for a Water Use Licence for any wetlands that may be affected, since they are classified in the National Water Act as a water resource		
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: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

Nature: Change in runoff and drainage leading to increased soil erosion and

damage of downslope areas

The powerline will descend along part of the mountain slope and then be situated adjacent to an existing powerline. It is not expected that powerline towers will have a major effect on runoff and drainage patterns on site, due to the small footprint of each tower structure.

	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Low (4)	Small to low (3)
Probability	Probable (3)	Improbable (2)
Significance	**low (24)**	**low (14)**
Status (positive or negative)	negative	negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially	

Mitigation:

(1) rehabilitate any disturbed areas immediately to stabilise landscapes
(2) water velocity must be reduced and diffused before water is returned to natural systems
(3) erosion features must be immediately stabilised, if they develop.

Cumulative impacts:

Alien invasions, damage to wetlands, loss of habitat may all lead to additional impacts 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

The power line is situated primarily in previously disturbed parts of the landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be moderately enhanced.

	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 ongoing 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

Impact Assessment tables for Access roads and underground cables between turbines

Nature: Impacts on individuals of threatened animal species Construction of internal access roads will lead to some loss of habitat for these species		
	Without mitigation	**With mitigation**
Extent	Local (3)	Local (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Low (4)	Small to low (3)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Not required	
Mitigation: (1) Impacts must be contained to within the footprint of the proposed internal access road. Surrounding vegetation must not be affected. (2) The number of internal access roads needs to be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. Soil erosion, alien invasions) may exacerbate this impact.		
Residual Impacts: Unlikely to be residual impacts.		

Nature: Impacts on threatened plants (Erica humansdorpensis, CR)

There are two threatened and two near threatened species that could occur on site.		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (4)	Minor (4)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (12)**	**Low (12)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) None.		
Cumulative impacts: Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be low if control measures are effectively applied		

Nature: Impacts on threatened plants (Disa lugens, EN) There are two threatened and two near threatened species that could occur on site.		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible (3) Prior to construction, during a suitable season, undertake a targeted survey of the footprint of the internal access roads and underground cables to ensure that no populations of *Disa lugens* occur there. If any populations are found, the road alignment should be repositioned to avoid such populations. If not, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.		
Cumulative impacts:		

Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.
Residual Impacts: Will probably be very low if control measures are effectively applied

Nature: Impacts on indigenous natural vegetation

Most of the internal access roads and underground cable alignments are situated within natural vegetation within the mountain region of the site. There are existing tracks up the mountain, but these are inadequate for construction and maintenance of the wind energy facility and will have to be properly constructed as new roads. The impact will occur at the site of the proposed internal access roads. The construction of the turbines potentially directly affects a moderate proportion of natural vegetation on site. However, fragmentation of vegetation on site may affect the integrity of surrounding areas.

	Without mitigation	**With mitigation**
Extent	Local & surroundings (2)	Local & surroundings (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate to high (7)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**High (70)**	**High (65)**
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:

(1) Avoid unnecessary impacts on natural vegetation surrounding the turbines.

(2) Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.

(3) The number of internal access roads needs to be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road.

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 occur.

Nature: Damage to wetland areas resulting in hydrological impacts

Internal access roads and underground cable alignments cross wetlands to the north of the substation site.

	Without mitigation	**With mitigation**
Extent	Local and surroundings (2)	Local and surroundings (2)
Duration	Permanent (5)	Medium-term (3)
Magnitude	High (8)	Low (4)

Probability	Definite (5)	Probable (3)
Significance	**High (75)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

(1) control stormwater and runoff water and inhibit erosion.
(2) Disturbed areas must be rehabilitated as soon as possible.
(3) Re-align internal access roads currently planned to be positioned just south of turbine number 4. If not possible, then the following measures must also be applied:
- » obtain a permit from DWAF to impact on any wetland or water resource.
- » Cross watercourses close to existing disturbances.
- » Cross watercourses perpendicularly, where possible, to minimize the construction footprint.
- » Adequate culvert and/or bridge structures are required at crossings.
- » Construction must not cause the width of the watercourse to be narrowed.

Cumulative impacts:

Soil erosion, alien invasions, may 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: Change in runoff and drainage leading to increased soil erosion and damage of downslope areas

A large proportion of internal access roads and underground cable alignments are in areas where there is a high risk of causing downslope impacts, often at the summit of very steep slopes.

	Without mitigation	**With mitigation**
Extent	Local & Surroundings (2)	Local & Surroundings (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (45)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially	

Mitigation:

(1) Compile a comprehensive storm-water management plan
(2) Rehabilitate any disturbed areas immediately to stabilise landscapes

(3) Water velocity must be reduced and diffused before water is returned to natural systems
(4) Erosion features must be immediately stabilised, if they develop.
(5) The position of those turbines located on very steep slopes must be re-considered and these turbines moved to more appropriate positions (turbine numbers 1, 8, 9, 10, 11, 12 and 13) in order to avoid impacts from roads and underground cabling.

Cumulative impacts:

Alien invasions, damage to wetlands, loss of habitat may all lead to additional impacts 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

Internal access roads will create new areas of disturbance within an otherwise pristine landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be greatly enhanced.

	Without mitigation	**With mitigation**
Extent	Regional (3)	Site & surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate to high (7)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (56)**	**Medium (30)**
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 ongoing 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

Implications for Project Implementation

The following recommendations are proposed to reduce or control potential impacts:

» Impacts associated with turbines 1, 8, 9, 10, 11, 12 and 13 must be very carefully controlled in order to minimize impacts on habitat within the mountain area where there are steep slopes and undisturbed vegetation.

» The number of internal access roads needs to be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road. Also, only a single access road up the mountain should be constructed and not two, as currently indicated.

» A comprehensive search for threatened and near-threatened plant populations must be undertaken within the footprint of the proposed infrastructure prior to construction. This must take place during an appropriate season to maximise the likelihood of detecting these plants. If any plants are found, localised modifications in the position of infrastructure must be made to avoid such populations and a suitable buffer zone around them.

Of greatest concern is the potentially high significance of impacts associated with the construction of internal access roads on site, especially on natural vegetation and wetlands. The primary concerns related to this proposed project are due to impacts caused by the linear infrastructure, specifically the internal access roads, and not to the turbines and/or substation.

6.2.2. Conclusions and Recommendations

A risk assessment was undertaken which identified seven main potential impacts on the ecological receiving environment. This shows that the wind energy facility (including all infrastructure components) could have an impact of medium significance on indigenous vegetation and wetlands and may cause damage due to changes in runoff and drainage patterns that could have a host of consequences. Of greatest concern is the potentially high significance of impacts associated with the construction of internal access roads on site, especially on natural vegetation and wetlands.

The overhead powerlines may have an impact of high significance on a threatened (critically endangered) plant species (Erica humansdorpensis). An evaluation of potentially affected habitat for this species will determine whether

this is of major concern or not and could reduce the significance of this impact to low.

The potential spread of alien plants on site is a concern, primarily because most of the infrastructure is proposed to be situated within an undisturbed part of the landscape. The infrastructure will therefore create new nodes and regions of disturbance that will enhance the potential for invasion of the site. The potential significance of this impact is therefore medium for all infrastructure components.

A number of impacts associated with this project are due to the fact that the infrastructure is proposed to be positioned within a part of the landscape that is currently in a relatively pristine condition, and within vegetation that, although not considered a high conservation priority nationally (Kouga Grassy Sandstone Fynbos is classified as Least Threatened), has a high biodiversity value[5] and contributes valuable ecosystem goods and services to the surrounding landscape, primarily with respect to being a water catchment area. The site contains a number of seepage areas that constitute the water source for all the drainage lines that emanate on site. One of the beneficiaries of this hydrological functioning is the Seekoei River estuary, the conservation of which is considered to be a Provincial priority. This estuary is, however, far off-site.

A significant proportion of the proposed infrastructure is positioned within a steeply sloping part of the landscape at the summit of the highest part of the mountain ridge. This will result in some degree of fragmentation of a currently undisturbed landscape. This will potentially compromise the ecological integrity of this area and lead to long-term negative impacts on the ecology of this site.

Either proposed powerline route is acceptable. The potential impacts are identical for both routes.

6.3. Assessment of Potential Impacts on Avifauna

The identified impacts of the proposed facility on avifauna include:

» *Disturbance*
Construction, and to a lesser extent on-going maintenance, will create disturbance to birds in the proposed site and surrounding area

» *Habitat destruction*
A certain amount of natural vegetation will be destroyed during the construction of the facility. Although the actual final footprint of the facility is

[5] Fynbos as a whole has a high conservation value. The site occurs within the Cape Floristic Region, which is recognised as one of the principal centres of diversity and endemism in Africa. The site must therefore be considered to have a high conservation value.

likely to be relatively small, heavy machinery needed during construction is anticipated to need large turning circles and hence destroy a larger area of vegetation than the final footprint.

» *Collision with turbines*
This is potentially the most significant impact of the proposed development, and could negatively affect a variety of collision prone species.

» *Electrocution on power infrastructure and collision with power lines*
Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components

Impacts of the proposed Wind Energy Facility are most likely to be manifest in the following ways:

(i) Disturbance and displacement of resident/breeding or visiting raptors from foraging areas by construction and/or operation of the facility, and /or mortality of these species in collisions with the turbine blades or the new power lines while flying/foraging in the area, or by electrocution when perched on power infrastructure.

(ii) Disturbance and displacement of resident/breeding or non-breeding large terrestrial birds from nesting and/or foraging areas by construction and/or operation of the facility, and /or mortality of these birds in collisions with the turbine blades while commuting between resource areas (croplands, nest sites, roost sites/wetlands)

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

Impact tables summarising the significance of wind energy facility impacts on avifauna (with and without mitigation)

Nature: Disturbance during construction Noise, movement and temporary occupation of habitat during the building process. 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	Low-Medium (3)	Low-Medium (3)
Duration	Short (1)	Short (1)
Magnitude	Medium-Low (4)	Low-Medium (3)
Probability	Definite (5)	Definite (5)
Significance	**40 (Moderate)**	**35 (Low-Moderate)**
Status (positive or negative)	Negative	Negative

Reversibility	Medium	High
Irreplaceable loss of resources?	Possible	Probably not
Can impacts be mitigated?	Yes	

Mitigation:

» Abbreviating construction time
» Scheduling activities around avian breeding and/or movement schedules
» Lowering levels of associated noise
» Reducing the size of the inclusive development footprint.

More detail is contained in the EMP (Appendix O).

Cumulative Impacts:

Possible, given that there are other wind energy projects proposed for the general area.

Residual Impacts:

Some priority species may move away regardless of mitigation.

Nature: Habitat loss during construction

Destruction of habitat for priority species, either temporary – resulting construction activities peripheral to the built area, or permanent - the area occupied by the completed development.

	Without mitigation	**With mitigation**
Extent	Low (2)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low-Medium (3)	Low (2)
Probability	Definite (5)	Definite (5)
Significance	**50 (Moderate)**	**40 (Moderate -Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Possible	Probably not
Can impacts be mitigated?	Yes	

Mitigation:

» 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.

Cumulative Impacts:

Possible, given that there are other wind energy projects proposed for the general area.

Residual Impacts:

Some species may be permanently lost to the area regardless of mitigation.

Nature: Disturbance during operation

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.

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Lifetime of the facility (4)	Lifetime of the facility (4)
Magnitude	Medium (6)	Medium-Low (5)
Probability	Highly probable (4)	Highly probable (4)
Significance	**48 (Moderate)**	**44 (Moderate)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Possible	Possible
Can impacts be mitigated?	Slightly	

Mitigation:

» Abbreviating maintenance times.
» Scheduling activities in relation to avian breeding and/or movement schedules
» Lowering levels of associated noise.

Cumulative Impacts:

Possible, given that there are other wind energy projects proposed for the general area.

Residual Impacts:

Some priority species may be permanently lost from the area.

Nature: Mortality

Collision of priority species with the wind turbine blades and/or any new power lines, or electrocution of the same on new power infrastructure.

	Without mitigation	**With mitigation**
Extent	Medium (3)	Low-Medium (2)
Duration	Lifetime of the facility (4)	Lifetime of the facility (4)
Magnitude	Medium-High (7)	Medium (6)
Probability	Highly probable (4)	Probable (4)
Significance	**56 (Moderate)**	**48 (Moderate)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Possible
Can impacts be mitigated?	Yes	

Mitigation:

» Careful siting of turbines
» Marking power lines
» Use of bird friendly power hardware
» Monitoring priority bird movements and collisions. Turbine management sensitive to these data – radar assisted if necessary

Cumulative Impacts:
Possible, given that there are other wind energy projects proposed for the general area.
Residual Impacts:
Some priority species may be permanently lost from the area.

Implications for Project Implementation

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

» Minimising the disturbance impacts associated with the construction of the facility, by abbreviating construction time, 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. Possible Denham's Bustard and Blue Crane nest sites particularly relevant here.
» 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.
» Minimising the disturbance impacts associated with the operation of the facility, by abbreviating maintenance times, scheduling activities in relation to avian breeding and/or movement schedules (actual timing to be refined by the results of pre- and post-construction monitoring), and lowering levels of associated noise. Possible Denham's Bustard and Blue Crane nest sites particularly relevant here.
» 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, ensuring that all new lines are marked with bird flight diverters (Jenkins et al. 2010) along their entire length, and that all new power line infrastructure is adequately insulated and bird friendly in configuration (Lehman et al. 2007). Note that current understanding of power line collision risk in birds precludes any guarantee of successfully distinguishing high risk from medium or low risk sections of a new line. 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 both pre- and post-construction (see below), 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 process here is the dearth of knowledge about the actual movements of key species (bustards, cranes, eagles, other raptors, 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.
» 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 other wind energy projects proposed for the same general area. Viewed in isolation, each of these projects may pose only a limited threat to the avifauna of the region. However, in combination they may result in landscape-scale displacement of threatened species from key areas of their distributions, 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 turbines spread across foraging areas and/or flight paths of priority species.
» The broader, coastal plain area around Humansdorp/Jeffrey's Bay/Cape St Francis is clearly of considerable importance to the regional status of Denham's Bustard. Should this species be substantially impacted by either displacement or mortality associated with wind energy development, cumulatively this could have a bearing on the national conservation status of this already threatened bird. Hence, the need for careful monitoring and comprehensive mitigation.
» 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.

6.3.1. Conclusions and Recommendations

The primary concern for the proposed facility in terms of avifauna will be that of collision of birds with the turbines and earth wires of the power lines. This impact on avifauna is potentially of medium - high significance, but could be reduced to a medium significance with the implementation of mitigation measures. A comprehensive programme to fully monitor the actual impacts of the facility on the broader avifauna of the area is recommended and outlined (refer to the EMP

in Appendix O), from pre-construction and into the operational phase of the project.

Either proposed powerline route is acceptable. The potential impacts on avifauna are identical for both routes.

This is a small wind energy project, proposed for a site with some conflicting issues in terms of its avifauna. The proposed development will possibly affect populations of regionally or nationally threatened (and impact susceptible) birds (mainly raptors and large terrestrial species) likely to occur within or close to the proposed turbine arrays. The facility will probably have a detrimental impact on these birds, particularly during its operational phase, unless commitment is made to mitigating these effects. Careful and responsible implementation of the required mitigation measures should reduce construction and operational phase impacts to 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 African avifauna. The impacts of this development must be viewed in the context of the potential cumulative effects generated by at least five other wind energy project proposed for the same general area.

6.4. Assessment of Potential Impacts on Bats

Apart from physical collisions, a major cause of bat mortality at wind turbines is barotrauma. This is a condition where the lungs of a bat collapse in the low air pressure around the moving blades, causing severe and fatal internal hemorrhage. One study done by Baerwald, et al. (2008) showed that 90% of bat fatalities around wind turbines involved internal hemorrhaging consistent with barotrauma.

Some studies propose that bats may be attracted to the large turbine structure as roosting space, or that swarms of insects get trapped in low air pockets around the turbine and subsequently attract bats. Whatever the reason for bat mortalities around wind turbines, the facts indicate this to be a concerning problem. Most bat species only reproduce once a year, bearing one young per female, meaning their numbers are slow to recover.

The correct placement of wind energy facilities in the landscape as well as of individual turbines can significantly lessen the impacts on bat fauna in an area. The proposed preliminary turbine placements provided to the specialist did not indicate any turbines to be an area of High Bat Sensitivity.

Nature of Impact: Bat mortalities due to blade collisions and barotrauma during foraging (operational phase)

Apart from physical collisions, a major cause of bat mortality at wind turbines is barotrauma. This is a condition where the lungs of a bat collapse in the low air pressure around the moving blades, causing severe and fatal internal haemorrhage.

	Without mitigation	**With mitigation**
Extent	Medium (3)	Low (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**39 (Medium)**	**18 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	None	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

» During the operational phase curtailment can be implemented as a mitigation measure to lessen bat mortalities, especially at turbines located in areas of Moderate Bat Sensitivity.
» Use ultrasonic deterrent devices

Cumulative impacts: Bat population numbers are slow to recover from major mortalities. If the activities are allowed to continue without mitigation for a long period of time, and due to a lack of knowledge regarding bat behaviour on high ridges, it must be accepted that there is a possibility that the mortality rate can exceed the reproduction rates of local bat populations, causing a high cumulative impact.

Residual Impacts: If bat populations are under stress, the local insect numbers in the area will elevate. If bat populations need to recover from a small amount of individuals after major mortalities, it will take several years to reach the original population status. Due to a lack of knowledge on bat behaviour and high ridges, this possibility must be considered.

Nature of Impact: Bat mortalities due to blade collisions and barotrauma during migration (operational phase).

The migration paths of South African bats in the Eastern Cape Province are virtually unknown. Cave dwelling species undertake annual migrations, although no caves are known to be in close proximity to the site, and the site is not located in any direct line of path between major caves

	Without mitigation	**With mitigation**
Extent	High (5)	High (5)
Duration	Long term (4)	Long term (4)
Magnitude	High (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**45 (Medium)**	**24 (Low)**

Status (positive or negative)	Negative	Negative
Reversibility	None	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: It will be beneficial to collaborate with academic institutions to promote research on the subject, quantifying the risks more accurately.		
Cumulative impacts: Bat population numbers are slow to recover from major mortalities. If the activities are allowed to continue without mitigation for a long period of time, and due to a lack of knowledge regarding bat behaviour on high ridges, it must be accepted that there is a possibility that the mortality rate can exceed the reproduction rates of local bat populations, causing a high cumulative impact. Migrating bats have been recorded to migrate several hundred kilometres in South Africa, therefore the cumulative impact of numerous wind farms operating without mitigation along migration paths over a long period of time will be catastrophic to the migrating bat population. Mitigation is of uttermost importance.		
Residual Impacts: If bat populations are under stress, the local insect numbers in the area will elevate. If bat populations need to recover from a small amount of individuals after major mortalities, it will take several years to reach the original population status. Due to a lack of knowledge on bat behaviour and high ridges, this possibility must be considered. If migrating bat populations are impacted, the residual impacts will be regional.		

Nature of Impact: Destruction of foraging habitat due to turbine and infrastructure construction (during construction phase, operational phase and decommissioning)		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**18 (Low)**	**12 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, turbine placement	
Mitigation:		

Construction of any associated infrastructure in the areas designated as having a High Bat Sensitivity should be kept to a minimum.
Cumulative impacts: None
Residual Impacts: Small areas of natural vegetation and foraging habitat will be replaced by infrastructure and turbines for the duration of the project and after decommissioning, until sufficiently rehabilitated.

Nature of Impact: Destruction/disturbance of roosts (construction and decommissioning phases)		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Very short duration (1)	Very short duration (1)
Magnitude	Low (3)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**15 (Low)**	**8 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » All diggings and earthworks must be kept to a minimum especially in rocky outcrop areas » Blasting should be avoided.		
Cumulative impacts: None		
Residual Impacts: Once a specific natural roost is destroyed it can't be rehabilitated with high success. Roost disturbances will not have a significant residual impact if the disturbance is of a short duration.		

Implications for Project Implementation

The preliminary localities of the proposed turbines are not in any area of high risk, and any additional turbine localities are not allowed to be placed in the areas of High Bat Sensitivity. Turbines located in areas of Moderate Bat Sensitivity should preferably be considered to be moved to alternative locations, but if not possible they must at least be prioritized in post construction monitoring and implementation of mitigation measures.

6.4.1. Conclusions and Recommendations

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area. The proposed preliminary turbine placements don't indicate any turbines to be an area of High Bat Sensitivity. No turbines should be placed in the area of High Bat Sensitivity.

The potential impacts on bats will be identical for both power line routes.

The proposed mitigation measures and recommendations described in the tables above should be implemented and their practicality and effectiveness researched with high priority at turbines located closest to areas of bat sensitivity. Post construction monitoring of bat fatalities during the operational phase is recommended for at least one study at the proposed wind energy facility on this site.

6.5. Assessment of Potential Impacts on Geology and Soils

The activity will tend to involve minor earthworks on localised, small construction footprints around each turbine or the substation with interlinking gravel access roads.

The most important issues are the direct impacts of soil degradation and erosion of topsoil from the area of activity. This would affect the ecosystems operating in the topsoil and the plant and animal species that depend on it for growth and survival.

The proposed activity may potentially result in all or some of the negative direct impacts. The proposed activity could also result in negative indirect impacts, such as increased siltation in waterways downstream from the site or dust pollution in the area surrounding the site. The severity or significance of the various impacts is related to the nature and extent of the activity.

Soil erosion is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of inter alia chemical processes and/or physical transport on the land surface. Soil erosion induced or increased by human activity is termed "accelerated erosion" and is an integral element of global soil degradation. Accelerated soil erosion is generally considered the most important geological impact in any development due to its potential impact on a local and regional scale (i.e. on and off site) and as a potential threat to global agricultural potential. Soil erodability – the susceptibility of soil to erosion – is a complex variable, not only because it depends on soil chemistry, texture, and characteristics, but because it varies with time and other variables, such as mode of transport (i.e. wind or water).

Erosion of soil due to water run-off is generally considered as more important due to the magnitude of the potential impact over a relatively short period of time which can be very difficult to control. Erosion by water occurs when the force exerted on the soil by flowing water exceeds the internal shear strength of the soil and the soil fails and becomes mobilised into suspension. Erosion potential is typically increased in areas where soil is loosened and vegetation cover is stripped (e.g. construction sites). Erosion sensitivity can be broadly mapped according to the severity of the potential erosion if land disturbing activities occur and this is generally related to the geology, soil types and the topography. Generally speaking, 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 erosion due to water run-off. These areas are typically called "highly sensitive" areas.

Excavations for foundations, underground cabling and access roads in areas where shallow bedrock occurs will have a negative impact on the bedrock. However, the excavations are likely to be restricted and to a depth of less than a few meters which will have minimal effect on the surroundings. Excavations for access roads in areas with steep and rugged terrain may involve significant road cuttings which may result in unsightly scars on the hillside. Road cuttings can also lead to slope instability if not engineered properly, resulting in further degradation of the landscape. Degradation of the natural topography can also lead to changes in the hydrology and groundwater regime of the surroundings.

Impact tables summarising the significance of impacts on geology associated with the wind energy facility

Nature: Soil degradation – Excavation and removal of soil for roads, cabling and structures.		
	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	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to a certain extent.	
Mitigation:	» Use existing roads where possible. » Design platforms, lay-down areas and roads according to	

	contours to minimise cut and fill operations. » Restrict activity outside of authorised construction areas. » Rehabilitate soil after construction.
Cumulative impacts:	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.		
	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. » Restrict activity outside of construction areas. » Rehabilitate soil after construction.	
Cumulative impacts:	The cumulative impact of earthworks in the area is considered low due to the undeveloped nature of the area	
Residual impacts:	Minor negative – slow regeneration of vegetation & soil.	

Nature: Soil degradation – Pollution of soil by contaminants (e.g. fuel, oil, chemicals, 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	Yes	Minor

resources?		
Can impacts be mitigated?	Yes, to a certain extent	
Mitigation:	» Control use and disposal of potential contaminants or hazardous materials. » 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.		
	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Very short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (18)**
Status	Negative	Negative
Reversibility	Irreversible	Practically irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation:	» Minimise construction footprint area. » Restrict activity outside of construction area. » Implement effective erosion control measures. » Carry out earthworks in phases across site to reduce the area of exposed ground at any one time. » Keep to existing roads, where practical, to minimise loosening of natural ground. » Protect and maintain denuded areas 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: Increased siltation of drainage lines and watersources downstream from site (Indirect Impact)		
	Without mitigation	***With mitigation***
Extent	Regional (3)	Local (1)

Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (27)**	**Low (21)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
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 or steep slopes 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 areas surrounding site.		
	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	**Low (28)**	**Low (16)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, low	Yes, minor
Can impacts be mitigated?	Yes	
Mitigation:	» Place 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	

Implications for Project Implementation

» The most important impacts on geology and soils include soil degradation (including erosion).
» The main direct impacts will be localised and limited extent of the proposed activity.
» The underlying geology of the site appears to be generally favourable towards the proposed layout.
» 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 erosion due to water run-off. These areas are typically called "highly sensitive" areas and require control measures to be implemented.
» Excavations for access roads in areas with steep and rugged terrain may involve significant road cuttings which may result in unsightly scars on the hillside. Road cuttings can also lead to slope instability if not engineered properly, resulting in further degradation of the landscape.
» Natural drainage lines should be considered no-go areas.

6.5.1. Conclusions and Recommendations

The findings of the geology and soils study indicate the most important impacts on geology and soils include soil degradation (including erosion). The significance of the main direct impacts that have been identified is considered low to moderate due to the localised and limited extent of the proposed activity and the anticipated geology which appears to be generally favourable towards the proposed layout.

The proposed development will have a low to moderate impact on the geological environment and these impacts can be largely mitigated with a resultant low overall significance. No insurmountable problems or "fatal flaws" which have may have an impact on the design and construction processes however natural drainage lines should be considered no-go options.

Either proposed powerline route is acceptable. The potential impacts are identical for both routes.

6.6. Assessment of Potential Impacts on Heritage Sites and Palaeontology

The results of the investigation of the site proved the site to be of low archaeological sensitivity and no sites/remains of significance were recorded (but material may be covered by soil and grass). The main impacts to archaeological sites/remains (if any) will be the physical disturbance of the material and its context. The construction of the turbine foundations, substation, cabling between the turbines and access roads may expose and/or disturbed/destroy the

sites/remains. However, it is improbable that the exposed windswept rocky outcrops on the summit of the ridge would have been preferred sites for occupation.

Construction of the turbine foundations, substation, cabling between the turbines and access roads may impact on remains which are buried and not visible, but these impacts will be limited and restricted to the local area. Deep excavations for the turbine foundations will also have limited impact on possible buried remains because the top soil is shallow which do not allow for deep archaeological deposits.

The area for the site is underlain by sedimentary rocks of the Cape Supergroup – predominantly of the Table Mountain Group and a very small section of the overlying lower Bokkeveld Group. Fossils have in the past been recovered from these sediments throughout the southern Cape but in particular within the Western Cape. However, within the Happy Valley area two geological factors have effectively eliminated fossils from the underlying rocks

» firstly the tectonic overprint of the Cape Folding Event that took place around 310 million years ago, and
» secondly the long period of weathering and erosion that produced the African Land Surface.

There is therefore a very low likelihood of finding well preserved fossils on the site or within the proposed development footprint

Impact table summarising the significance of impacts on heritage sites and palaeontology (with and without mitigation)

Nature: Disturbance to possible archaeological sites		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (16)**	**Low (16)**
Status (positive or negative)	Negative	Neutral
Reversibility	No	No
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation measures: » No mitigation is proposed for the ridge area as the archaeological remains (if any) are		

of low significance - excluding human remains. » If any human remains (or any other concentrations of archaeological heritage material) are exposed during construction, all work must cease and it must be reported immediately to the nearest museum/archaeologist or to the South African Heritage Resources Agency, so that a systematic and professional investigation can be undertaken. Sufficient time should be allowed to investigate and to remove/collect such material. Recommendations will follow from the investigation.
Cumulative impacts: Low
Residual impacts: Low

Nature: Disturbance or destruction of valuable fossil heritage		
	Without mitigation	**With mitigation**
Extent	International (5)	N/A
Duration	Permanent (5)	N/A
Magnitude	Very high (10)	N/A
Probability	Improbable (1)	N/A
Significance	**Low (20)**	N/A
Status (positive or negative)	Negative	
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No mitigation required	
Mitigation: » Should substantial fossils be exposed during construction, the ECO should safeguard these - in situ. SAHRA and / or a professional palaeontologist (geological staff at either the Albany Museum or Rhodes University in Grahamstown) should then be alerted as soon as possible so that appropriate mitigation measures can be implemented.		
Cumulative impacts: None.		
Residual Impacts: N/A		

Implications for Project Implementation

The area is of a low cultural sensitivity, and has low potential for fossil remains occurring. There are therefore no implications for the implementation of this project on the site. If any human remains (or any other concentrations of archaeological heritage material) are exposed during construction, all work must cease and it must be reported immediately, otherwise no further implications are expected

There is a remote chance that trace or invertebrate body fossils may well be found in the development phase of during excavation, road building or trenching.

Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

6.5.1. Conclusions and Recommendations

The proposed site appears to be of low archaeological sensitivity. No archaeological remains of any heritage significance were found, but it is possible that stone tools may occur and be exposed if the surface soil is disturbed. The impact of the development on archaeological sites/materials (if any) will be limited. However, there is always a possibility that human remains and/or other archaeological and historical material may be uncovered during the development. Should such material be exposed then it must be reported to the nearest museum, archaeologist or to the South African Heritage Resources Agency.

In the unlikely event that any concentrations of archaeological material or human remains are uncovered during further development of the site, all work must immediately cease and be should reported to the Albany Museum and/or the South African Heritage Resources Agency so that systematic and professional investigation/excavations can be undertaken. Sufficient time should be allowed to remove/collect such material.

There is no major palaeontological reason why this development cannot take place. If at any stage during the construction phase of the wind turbines and the associated infrastructure like roads and trenching for cables, any semblance of a fossil were to be observed, it would be vital to recover the fossil and report the occurrence.

Construction managers/foremen should be informed before the start of construction on the possible types of heritage sites and cultural material they may encounter and the correct procedures to follow when they encounter sites.

Either proposed power line route is acceptable. The potential impacts on heritage and palaeontology are identical for both routes.

6.7. Assessment of Potential Visual Impacts

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

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

- » The creation of a detailed digital terrain model of the potentially affected environment.
- » The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- » The identification of sensitive environments upon which the proposed facility could have a potential impact.
- » The creation of viewshed analyses from the proposed development area (for the purposes of this study a separate viewshed indicating the impact of the substation only, as well as a viewshed combining both substation and wind turbines has been included) in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

Viewshed analyses of the proposed wind turbines, substation and overhead power line alternatives were modelled, based on a 20m contour interval digital terrain model of the study area, indicate the potential visual exposure. The visibility analyses were undertaken from each of the proposed wind turbine positions at an offset of 80m (proposed turbine hub height) above average ground level. The viewshed analyses do not include the visual absorption capacity of the vegetation for the study area, as the natural vegetation cover, predominantly mountain grassland and shrubland is not expected to influence the results of the analyses significantly.

The visibility map below (Figure 6.4) clearly illustrates the influence of the topography and the placement of the wind turbines along the ridgeline on the potential frequency of exposure. The proposed facility is placed in an elevated position relative to the surrounding landscape, which means it can be viewed from a large area and that a large number of turbines can be viewed at any one time.

The result of the viewshed analyses for the proposed Happy Valley Wind Energy Facility's provisional layout is shown below in Figures 6.4.

The 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. 10-13 turbines or part thereof may be visible), while the light yellow areas represent a low frequency (i.e. 1-2 turbines or part thereof may be visible).

The highest frequency of potential visual exposure is expected within the drainage valley to the south west, south and south east of the facility. In this area the topography is less mountainous, with fewer visual barriers. The area is also topographically depressed relative to the site.

The visibility analysis map clearly illustrates the influence of the topography and the placement of the wind turbines on the ridge on the potential frequency of exposure. The wind energy facility is placed in an elevated position relative to the surrounding landscape, which means it can be viewed from a large area and that the majority of the turbines (i.e. up to 13) could be visible at any one time.

It is envisaged that the structures would be easily and comfortably visible to observers (i.e. travelling along roads, residing at homesteads or visiting the region), especially within a 5 to 10 km radius (i.e. at short to medium distances) of the wind energy facility and would constitute a high visual prominence, potentially resulting in a high visual impact.

Visibility of the wind energy facility will be high, with a high frequency of exposure for significant stretches of the N2, the R102, the R62, the southern part of the R330 and a number of secondary roads. The northern part of the R330 and the R332 will be mostly shielded from visual impact, with isolated areas having a low to moderate frequency of exposure.

The towns of Kruisfontein and Humansdorp are expected to experience a high frequency of visual exposure, both within the towns and in the surrounding area. St Francis Bay may also experience a high frequency of visual exposure, but is located much further afield (i.e. more than 20km from the proposed wind energy facility). In addition, a large number of settlements and homesteads, especially those within the river valley zone will be visually exposed, with a high frequency of exposure.

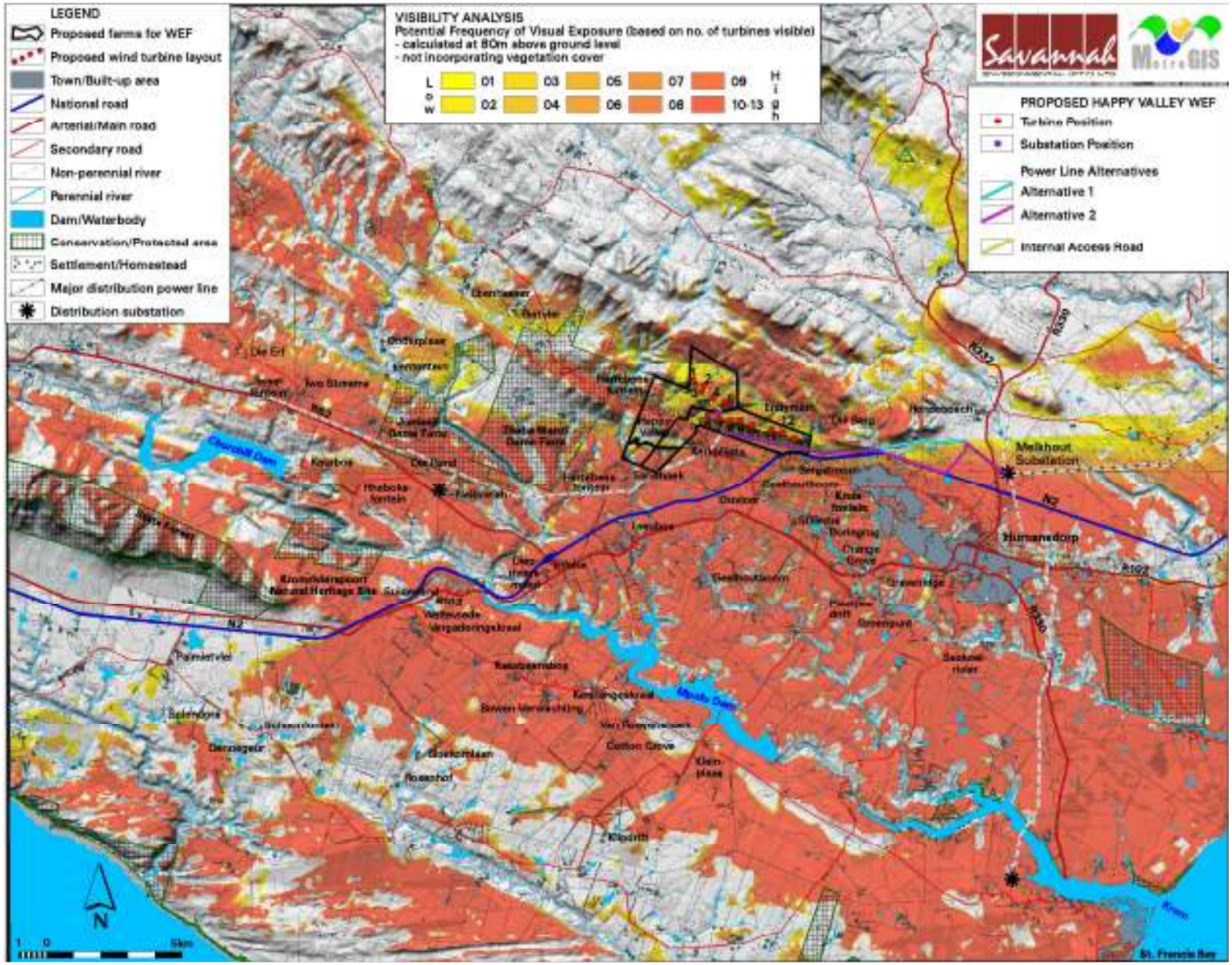

Figure 6.4 Potential visual exposure of the proposed facility.

It is envisaged that the structures would be easily and comfortably visible to observers (i.e. travelling along roads, residing at homesteads or visiting the region), especially within a 5 to 10 km radius (i.e. at short to medium distances) of the wind energy facility and would constitute a high visual prominence, potentially resulting in a high visual impact.

» **Visual Impact Index**

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed wind energy facility are displayed in Figure 6.5. Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, 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 magnitude) 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 following is of relevance:

- The visual impact index map clearly indicates a core area of potentially high visual impact within a 5km radius of the proposed facility. This core area is located partly within the river valley zone (in the south) and partly within the ridges and mountain (to the north).

- Potential areas of very high visual impact within this 5km radius include the entire lengths of the N2, the R102 and all the secondary roads. In addition, the town of Kruisfontein and its surrounds as well as a number of settlements and homesteads are likely to experience very high visual impact. These homesteads and settlements include the following: Hartebeesfontein, Sandhoek, Ouvloer, Stillerus, Doringrug, Orange Grove, Geelhoutboom, Bergstroom, Kerkplaats, Happy valley, Hartebeesfontein, Geelhoutboom, Die Berg and Endymion.

- The extent of potential visual impact is somewhat reduced between the 5km and 10km radius. Areas to the north are largely shielded by the topography, with some patches of potentially low visual impact. Significant areas to the west, south and east of the proposed wind energy facility are, however, exposed to moderate visual impact. Visually protected areas are limited to the incised river valleys.

- The entire N2, R102 and R62 as well as long stretches of the R330, R332 and secondary roads between 5km and 10km are likely to experience a high visual impact due to the high frequency of observers travelling along these roads. These stretches are mostly limited to the southern part of the study area, within the valley zone.

- In addition to Humansdorp and surrounds, a number of homesteads and settlements are likely to experience a high visual impact. These lie within a 10km radius of the proposed development, and include: Gravelridge, Groenpunt, Plaatjiesdrift, Geelhoutboom, Trifolia, Diepriviersmond, Nallannah and Leeubos.

Between 10km and 20km, the magnitude of visual impact is mostly reduced to low. Exceptions are the national, arterial and secondary roads, as well as the homesteads and settlements. Potential visual impact for these receptors is expected to be moderate. Remaining impacts beyond the 20km radius are expected to be very low.

Conservation areas in close proximity to the proposed wind energy facility (i.e. within 10km of the site) include the Thaba Manzi Game Reserve and the eastern parts of the Jumanji Game Farm. Potential visual impact as a result of the proposed facility is anticipated to be high in the mountains immediately to the west of the proposed wind energy facility, and moderate to low further to the west.

The remaining conservation areas within the study area (i.e. the Kromrivierspoort Natural Heritage Site, the portion of State Forest, the Huisklip Local Authority Nature Reserve, the Thyspunt Natural Heritage Site and the Lombardini Game Farm) all lie beyond 10km of the proposed wind energy facility site, and may be expected to experience only low to very low visual impact, if any.

Both the Mpofu and the Churchill Dams lie more than 7 km from the proposed wind energy facility site. Both are likely to experience low visual impact due to the facility. The northern bank as well as the upper reaches of the Mpofu Dam may experience a moderate visual impact.

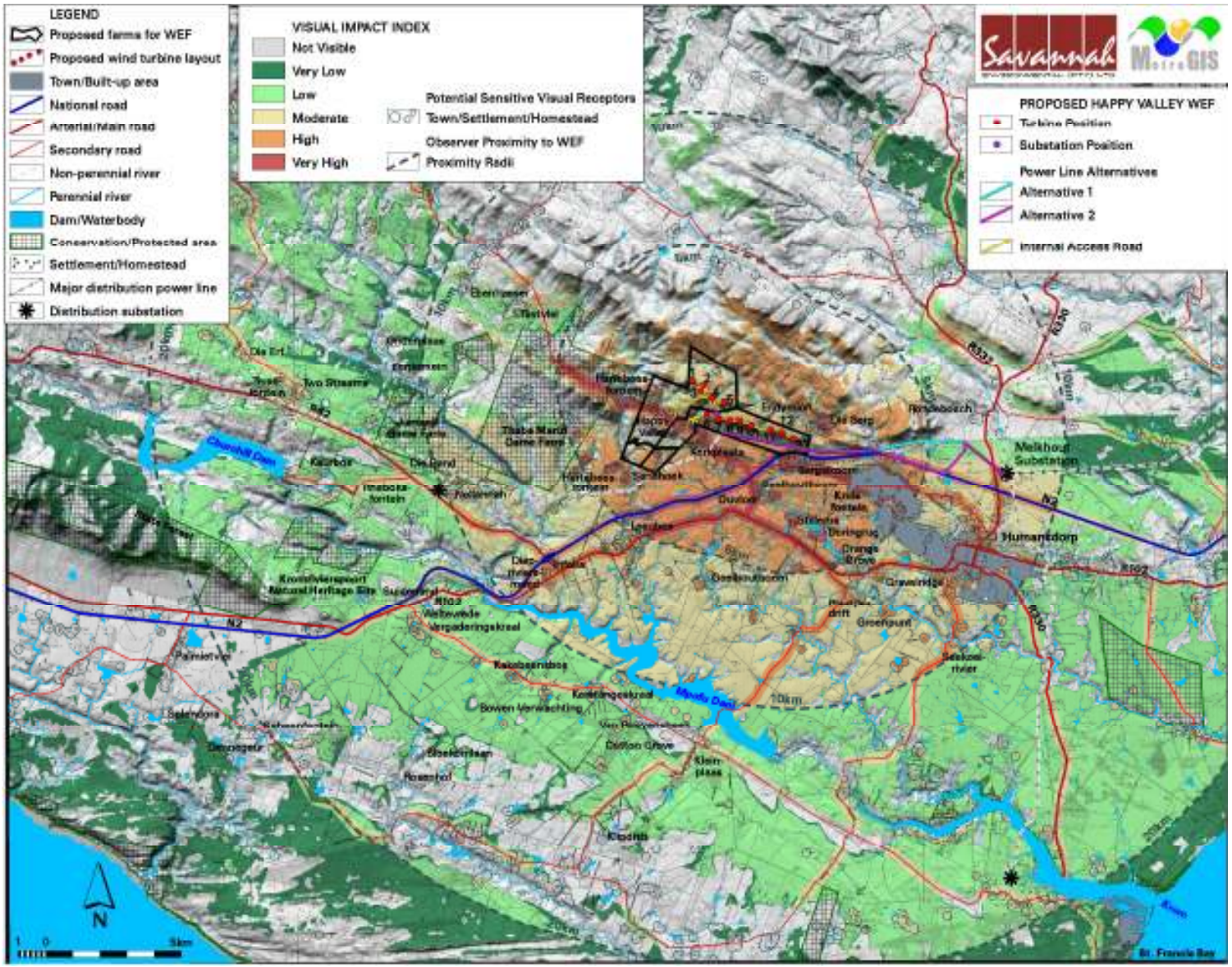

Figure 6.5: Visual impact index of the proposed Happy Valley Wind Energy Facility

» **Distribution power line**

The proposed power line will be highly visible to the south, with less visual exposure to the north due to topography. Visual receptors include users of the N2, R102, R330, R332, Kruisfontein and a number of homesteads / settlements. It is noteworthy that the viewshed for the power line falls largely within that of the proposed turbines. There is a negligible difference between the exposure of Alternative 1 and 2, meaning that either option will result in potential visual impact. However, Alternative 1 follows an existing power line alignment for its entire length, while Alternative 2 does not. In this respect, Alternative 1 is considered preferable to Alternative 2 from a visual perspective as the existing infrastructure may help to 'absorb' the visual impact somewhat. Other than the selection of the preferred alternative, there is no mitigation for this impact.

» **Lighting**

The receiving environment has a relatively small number of populated places (i.e. Kruisfontein, Humansdorp and settlements / farmsteads) and it can be expected that the light trespass and glare from the security and after-hours operational lighting (e.g. flood lights) for the substation and other infrastructure will have some significance. Furthermore, the sense of place and rural ambiance of the local area increases its sensitivity to such lighting intrusions. It is also important that note be taken of the eco-tourist destinations within close proximity to the proposed facility namely Thaba Manzi and Jumanji Game Farms. This potential impact is further aggravated by the fact that the facility is located in such an elevated position. 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. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

» **The potential to mitigate visual impacts**

The primary visual impact, namely the appearance of the wind energy facility (mainly the wind turbines) is not possible to mitigate. The functional design of the structures cannot be changed in order to reduce visual impacts. Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The overall potential for mitigation is generally low or non-existent.

The mitigation of secondary visual impacts, such as security and functional lighting, construction activities, etc. may be possible and should be implemented and maintained on an ongoing basis.

Impact tables summarising the significance of visual impacts associated with the wind energy facility (with and without mitigation)

Nature of Impact: Potential visual impact on users of major and secondary roads in close proximity to the proposed facility		
Potential visual impact on users of national, arterial and secondary roads in close proximity of the proposed facility (i.e. within 5km) are expected to be high. No mitigation is possible.		
	No mitigation	***Mitigation considered***
Extent	Local (4)	N/A
Duration	Long term (4)	N/A
Magnitude	Very high (10)	N/A
Probability	Definite (5)	N/A
Significance	**High (90)**	**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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorized RedCap Kouga Wind Energy Facility located ~ 12 km to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Nature of Impact: Potential visual impact on residents of towns, settlements and homesteads in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local (4)	N/a
Duration	Long term (4)	N/a
Magnitude	Very high (10)	N/a
Probability	Definite (5)	N/a
Significance	**High (90)**	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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorized RedCap Kouga Wind Energy Facility located ~ 12 km to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Nature of Impact: Potential visual impact on sensitive visual receptors within the region.

The visual impact on the settlements and homesteads within the region (beyond the 10km radius) is expected to be of moderate significance. No mitigation is possible.

	No mitigation	***Mitigation considered***
Extent	Regional (3)	N/A
Duration	Long term (4)	N/A
Magnitude	Moderate (6)	N/A
Probability	High (4)	N/A
Significance	**Moderate (52)**	**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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorized RedCap Kouga Wind Energy Facility located ~ 12 km to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Nature of Impact: Potential visual impact on protected areas in close proximity to the proposed Wind Energy Facility.

The potential visual impact on conservation/protected areas within a 10km radius of the proposed Wind Energy Facility (i.e. the Thaba Manzi and Jumanji Game Farms) is expected to be of moderate significance. There is no mitigation for this impact.

	No mitigation	***Mitigation considered***
Extent	Local (4)	N/A
Duration	Long term (4)	N/A
Magnitude	High (8)	N/A
Probability	Probable (3)	N/A
Significance	**Moderate (48)**	**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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorized RedCap Kouga Wind Energy Facility located ~ 12 km to the south of the site.

Residual impacts:
None. The visual impact of the wind turbines will be removed after decommissioning.

Nature of Impact: Potential visual impact on protected areas within the region.
The potential visual impact on conservation/protected areas beyond the 10km radius of the proposed facility is expected to be of low significance. There is no mitigation this impact.

	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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorized RedCap Kouga Wind Energy Facility located ~ 12 km to the south of the site.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

Nature of Impact: Potential visual impact of internal access roads on observers in close proximity to the proposed facility.

Within the facility footprint, existing access roads will be used wherever possible. It may however be necessary to construct additional roads to construct each turbine (construction phase), and to maintain the turbines (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 is required to build access roads to turbines located in high lying areas and on steep slopes. In steep and hilly areas, the graded slopes would be vulnerable to erosion over time. The effects of erosion also represent a potential visual impact to observers.

No dedicated viewshed has been generated for the access roads, but that the area of potential visual exposure will lie within that of the turbines. . They are not likely to be as highly visible as the turbines, however, as some of the roads lie behind the crest of the mountain. This reduces the probability of this impact occurring.

	No mitigation	***Mitigation considered***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Improbable (2)	Improbable (2)
Significance	**Moderate (32)**	**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: ripping and rehabilitation of the road and servitude.
Cumulative impacts:
The construction of the roads will increase the cumulative visual impact within the region.
Residual impacts:
None. The visual impact of the wind turbines will be removed after decommissioning.

Nature of Impact: Potential visual impact of the substation and workshop areas on observers in close proximity to the proposed facility

The substation and workshop could present a visual impact. Areas of vegetation will need to be removed for these structures which are industrial type structures in a natural environment. No dedicated viewshed has been generated for the above infrastructure but the area of potential visual exposure will lie within that of the turbines. This infrastructure is not likely to be as highly visible as the turbines, however, as the substation lies behind the crest of the mountain, and the scale will be much smaller than that of the turbines. This reduces the probability of this impact occurring.

	No mitigation	***Mitigation considered***
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 and ancillary infrastructure after 20 to 30 years		
Cumulative impacts:		
The construction of the substation will increase the cumulative visual impact within the region.		
Residual impacts:		
None. The visual impact of the wind turbines will be removed after decommissioning.		

Nature of Impact: Potential visual impact of the power line on observers in close proximity to the proposed facility.

It is clear that the power line will be highly visible to the south, with less visual exposure to the north due to topography. Visual receptors include users of the N2, R102, R330, R332, Kruisfontein and a number of homesteads / settlements. It is noteworthy that the viewshed for the power line falls largely within that of the proposed turbines.

	No mitigation	***Mitigation considered***
Extent	Local (4)	N/A
Duration	Long term (4)	N/A
Magnitude	Moderate (6)	N/A
Probability	High (4)	N/A
Significance	**Moderate (56)**	**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:
Planning: selection of Alternative 1 for the power line alignment.
Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years

Cumulative impacts:
The construction of the new power lines will increase the cumulative visual impact of power lines within the region, specifically in terms of the two existing Major Distribution Lines, which bypass the site in close proximity.

Residual impacts:
The visual impact will be removed after decommissioning, if the power lines are also removed. If this is not the case, then the visual impact will remain.

Nature of Impact: Potential visual impact on of lighting at night on visual receptors in close proximity of the proposed facility

	No mitigation	***Mitigation considered***
Extent	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	High (4)	Probable (3)
Significance	**High (64)**	**Moderate (42)**
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 lighting design and planning » Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: None.		
Residual impacts: None. The visual impact of the lighting will be removed after decommissioning.		

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

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.

	No mitigation	***Mitigation considered***
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 operational phase?	No	No
Mitigation: Construction: Proper planning, management and rehabilitation of the construction site		
Cumulative impacts: None.		
Residual impacts: None.		

Nature of Impact: Potential visual impact on the visual character and sense of place of the region.

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 pastoral visual quality of the

farmland as well as the scenery beauty of the landscape and the mountains. The anticipated visual impact of the facility on the regional visual character, and by implication, on the sense of place, is expected to be moderate. There is no mitigation for this impact.

	No mitigation	***Mitigation considered***
Extent	Regional (3)	N/A
Duration	Long term (4)	N/A
Magnitude	High (8)	N/A
Probability	Probable (3)	N/A
Significance	**Moderate (45)**	**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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the authorized RedCap Kouga Wind Energy Facility located ~ 12 km to the south of the site.

Residual impacts:
None. The visual impact of the wind turbines will be removed after decommissioning.

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

The region has a rural character and is located within a particularly picturesque part of the country. It is in close proximity to the southern seaboard, and the larger area is thus a known tourist destination. The tourism potential of the region may not yet be optimised, but tourist facilities are sure to exist within the greater region, especially along the coast. There is certainly potential for more to develop. In addition, the N2 is a well known and well used tourist access route, and the arterial and secondary roads make for scenic drives. Visual intrusion through the development of industrial type infrastructure within this environment could impact the area's tourism value and potential in the long term.

	No mitigation	***Mitigation considered***
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	N/A

negative)		
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 13 wind turbines together with the roads and other ancillary infrastructure will increase the cumulative visual impact within the region. This is specifically relevant in light of the proposed Deep River Wind Energy Facility located to the south west of the site, RedCap Kouga Wind Energy Facility located to the south of the site and proposed Jeffrey's Bay Wind Energy Facility to the east of the site.		
Residual impacts: None. The visual impact of the wind turbines 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 facility within the receiving environment. It indicates the visual significance of the alteration of the landscape from various sensitive visual receptors and over varying distances. The simulations are based on the wind turbine dimensions and layout as indicated in Figure 6.1.

The simulated wind turbines, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility. The photograph positions are indicated on the map below and should be referenced with the photo simulation being viewed in order to place the observer in spatial context. The approximate viewing distances indicated were measured from the closest wind turbine(s) to the vantage point.

The simulated views show the placement of the wind turbines during the longer-term operational phase of the facility's lifespan. It is assumed that the necessary post-construction phase rehabilitation and mitigation measures, as proposed by the various specialists in the environmental impact assessment report, have been undertaken. It is imperative that the natural vegetation be restored to its original status for these simulated views to ultimately be realistic. These photographs can therefore be seen as an ideal operational scenario (from a visual impact point of view) that should be aspired to.

Figure 6.6: Photosimulation from viewpoint located on the junction of the R102 and the road that runs past Plaatjiesdrift.

The photo above (Figure 6.6) was taken from a position approximately 5km away from the closest turbine and is indicative of what will be seen from a medium distance by those travelling north on the secondary road. The viewing direction is north-westerly and all 13 turbines may be fully to partially visible in the landscape. This view may be considered similar to that which may be observed from the R102, as well as from Humansdorp.

Refer to Visual Assessment (Appendix I) for the remainder of the photo-simulations.

Implications for Project Implementation

The primary visual impact is associated with the nature and extent of the wind turbines, and is not possible to mitigate. The functional design of the structures cannot be changed in order to reduce visual impacts. Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's Marking of Obstacles expressly states, "Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The overall potential for mitigation is generally low or non-existent. Mitigation of secondary visual impacts associated with the construction of roads includes the use of existing roads wherever possible.

The ridgelines in the greater study area represent scenic and sensitive topographical features with limited existing visual disturbance. The proposed

development is expected to transform the natural character of those ridgelines earmarked for the proposed facility for the entire operational phase of the facility.

Where new roads are required, these should be planned taking 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 properly, with adequate drainage structures in place to forego potential erosion problems. Roads should be positioned behind (i.e. on the north side) of the crest of the ridge wherever possible. Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.

The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility (where this is possible). In this manner, less warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact.

Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site. Construction should be managed according to the following principles:

- Reduce the construction period through careful planning and productive implementation of resources.
- Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
- 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 in order to negate or reduce the visual impacts associated with lighting.
- Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.

There is no mitigation to ameliorate the negative visual impacts on tourist routes and destinations, and on the Thaba Manzi and Jumanji Game Reserves. A land use conflict exists with regard to these private game reserves, as the visual

intrusion will impose some limitation on conservation based development and tourism opportunities in the future

Once the facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

6.6.1. Conclusions and Recommendations

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed Happy Valley Wind Energy Facility, it is acknowledged that the rural, natural and relatively unspoiled wide-open views surrounding the site will be transformed for the entire operational lifespan of the facility.

The facility would thus be highly visible within an area that incorporates various sensitive visual receptors who could consider visual exposure to this type of infrastructure to be intrusive.

The following is a summary of impacts remaining, assuming mitigation as recommended is exercised:

» The potential visual impact of the facility on users of national, arterial and secondary roads in close proximity to the proposed facility will be of high significance.
» The anticipated visual impact on residents of towns, settlements and homesteads in close proximity to the proposed facility will be of high significance.
» Within the greater region, the potential visual impact on sensitive visual receptors (i.e. users of roads and residents of towns, settlements and homesteads) will be of moderate to high significance.
» Conservation / protected areas in close proximity to the proposed facility will experience visual impacts of moderate significance, while those within the grater region will experience visual impacts of low significance.
» In terms of ancillary infrastructure, the anticipated visual impact of the substation and workshop will be of low significance, as will that of the internal access roads. Visual impacts of the proposed power line will be of moderate significance.
» Anticipated visual impacts related to lighting will be of moderate significance.
» Similarly, the visual impact of construction is also expected to be of low significance.
» In terms of secondary visual impacts, the significance of the anticipated impact on the visual character and sense of place of the region will be of moderate significance, as will the anticipated impact on tourist routes, tourist destinations and tourism potential.

Power line **Alternative 1** is considered preferable to Alternative 2 from a visual perspective as the existing infrastructure may help to 'absorb' the visual impact somewhat. Other than the selection of the preferred alternative, there is no mitigation for this impact.

The facility is situated in a visually prominent location in an area with a pastoral character and inherent scenic beauty of the natural features. The location of turbines on the ridge line in this visually exposed environment results in a high visual prominence and an undesirable negative visual impact.

Although undesirable, the anticipated visual impact does not, however, constitute a fatal flaw for the proposed Happy Valley Wind Energy Facility. This is due specifically to the localised area of potential high visual impact (i.e. within 5km), the relatively low incidence of visual receptors and the small scale of the proposed facility. This impact is also not likely to detract from the regional tourism appeal, numbers of tourists or tourism potential of the existing centres such as St Francis Bay.

6.8. Assessment of Potential Noise Impacts

Potential receptors in and around the proposed wind energy facility were identified and the status of the dwellings confirmed by a site visit.

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. From the data obtained, it can be seen that the ambient (background) sound levels are extremely low, ranging between 17 – 23 dBA during times when there is no wind, or very little air movement. As wind speeds increase, noise created by potential wind turbine generators approaches the wind induced noise levels.

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: Construction Phase:**

- *Construction activities include the*
  - construction of access roads,
  - turbine tower foundations and electrical substation,

- the possible establishment, operation and removal of concrete batching plants,
- delivery of turbine, substation and power line components to the site,
- digging of trenches to accommodate underground power cables; and
- erecting of turbine towers and assembly of wind turbine generators.

- *Material supply for the facility*

- *Blasting on site*

- *Traffic movement*

- **Potential Noise Sources: Operational Phase**

Noise emitted by wind turbines can be associated with two types of noise source. These are 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. These sources normally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the substation, traffic movement as well as power line noise.

- *Wind Turbine Noise: Aerodynamic sources*
- *Wind Turbine: Mechanical sources*
- *Transformer noises (Sub-stations)*
- *Power Line Noise (Corona noise)*
- *Low Frequency Noise*

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 0357.

The following was considered in the Noise Impact Assessment:

» The octave band sound pressure emission levels of processes and equipment;
» The distance of the receiver from the noise sources;
» The impact of atmospheric absorption;
» The meteorological conditions in terms Pasquill stability;
» The operational details of the proposed project, such as the location of each wind turbine.
» Topographical layout (-3 dB penalty will be imposed due to the height of the wind turbine generators),

» Acoustical characteristics of the ground. Soft ground conditions were modelled, as the area where the facility is to be constructed is well vegetated and sufficiently uneven to allow the consideration of soft ground conditions.

In addition, the noise emission into the environment from the various traffic options will be calculated using the sound propagation model described in SANS 10210.

» **Construction Phase Impacts**

Construction activities modelled for the purpose of predicting noise levels were selected at the locations of turbines 10 (turbine construction), 11 (pouring of concrete), 12 (digging of foundations) and 13 (surface preparation), with the temporary laydown/workshop/storage area assumed at the area where the sub-station is proposed. This would represent the worst case scenario with five activities taking place simultaneously. For the purpose of the EIA the activities that are most likely to create the most noise are:

- General work at the workshop area.
- Surface preparation prior to civil work.
- Preparation of foundation area.
- Pouring and compaction of foundation concrete (general noise, electric generator/compressor, concrete vibration, mobile concrete plant, TLB).
- Erecting of the wind turbine generator (general noise, electric generator/compressor and a crane).
- Traffic on the site

» **Operational phase impacts**

Day-time period (working day) was not considered for the EIA because noise created during the day by the facility is normally masked by other noises from a variety of sources surrounding potential sensitive receptors.

Typical daytime activities would include:

- The operation of the various wind turbines,
- Maintenance activities (relative insignificant noise source).

However, times when a quiet environment is desired (at night for sleeping, weekends etc.) noise levels are more critical. The time period investigated therefore would be the quiet period, normally associated with the 22:00 – 06:00 slot. Maintenance activities would therefore not be considered, concentrating on the ambient sound levels created due to the operation of the various wind turbines at night.

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). However, there is a

likely probability that the closest residents of "Die Berg" community may experience noise levels exceeding the Zone Sound Levels.

Changes in ambient sound levels are projected to be low excluding the closest residents of the "Die Berg" community. These changes in ambient noise levels are less than 7 dBA, and it is therefore unlikely that the increases in noise levels will represent a "disturbing noise". 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.

Impact tables summarising the significance of noise impacts (with and without mitigation) during Construction

Nature: Noise associated with numerous simultaneous construction activities Acceptable Rating Level: rural district with little road traffic: 45 dBA outside during day.		
	Without mitigation	**With mitigation**
Extent	Regional – Change in ambient sound levels would extend further than 1,000 meters from activity (3)	Local – Impact will extend less than 1,000 meters from activity (2)
Duration	Long term – Noisy activities in the vicinity of the receptor could last up to a month (4)	Long term – Noisy activities in the vicinity of the receptor could last up to a month (4)
Magnitude	High (8)	Low (2)
Probability	Possible (2)	Improbable (1)
Significance	**30 (Medium)** Worse case for 2 of the identified receptors.	**8 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	N/A	N/A
Can impacts be mitigated?	Yes	
Mitigation: Management options to reduce the noise impact during the construction phase include: » Route construction traffic as far as practical possible from potentially sensitive receptors; » Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potential sensitive receptor(s) include: • Proposed working times • how long the activity is anticipated to take place; • what is being done, or why the activity is taking place; • contact details of a responsible person where any complaints can be lodged should there be an issue of concern.		

» When working near (within 500 meters – potential construction of access roads and trenches) to a potential sensitive receptor(s), limit the number of simultaneous activities to the minimum; » When working near to potentially sensitive receptors, coordinate the working time with periods when the receptors are not at home where possible. An example would be to work within the 08h00 to 14h00 time-slot to minimize the significance of the impact because potential receptors are most likely at school or at work, minimizing the probability of an impact happening and normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening. Technical solutions to reduce the noise impact during the construction phase include: » Using the smallest/quietest equipment for the particular purpose. For modelling purposes the noise emission characteristics of large earth-moving equipment (typically of mining operations) were used, that would most likely over-estimate the noise levels. The use of smaller equipment therefore would have a significantly lower noise impact; » Ensuring that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.
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.

Impact tables summarising the significance of noise impacts (with and without mitigation) during Operation

Nature: Noise associated with numerous simultaneous operation activities

Acceptable Rating Level: rural district with little road traffic: 35 dBA outside during nighttime.

	Without mitigation	**With mitigation**
Extent	Local – impact will extend less than 1,000 meters from activity (2)	Local – impact will extend less than 1,000 meters from activity (2)
Duration	Permanent – facility will operate for a number of years (5)	Permanent – facility will operate for a number of years (5)
Magnitude	Medium (6)	Low (2)
Probability	Likely (3)	Improbable (1)
Significance	**Medium (39)** for closest receptors from "Die Berg" community	**Low (9)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable	N/A	N/A

loss of resources?		
Can impacts be mitigated?	Yes	

Mitigation:

Mitigation measures that should be considered before the development of this wind energy facility would include:

» The developer can consider larger wind turbines which would require less wind turbines for the same power generation potential, but increase the buffer zone appropriately (modelling would be required to define the recommended buffer zone);
» The developer can consider the use of smaller and/or quieter wind turbines, especially turbine 13;
» Developing the same number of wind turbines over a larger area;
» Ensuring a larger setback around the potentially sensitive receptors (Die Berg community) taking cognisance of prevailing wind directions;
» A combination of the above options.

Mitigation measures that would reduce a potential noise impact after the implementation of the facility includes (should noise complaints be registered and verified):

» Operating all, or selected wind turbines in a different mode. For the purpose of the Impact Assessment (with mitigation) the Vestas V90 2.0 MW turbine operating in mode 0 was used. The Vestas as well as most other manufacturers allow the turbines to be operated in a different mode. This allows the wind turbine generator to operate more silently, albeit with a slight reduction of electrical power generation capability.
» Problematic wind turbines could also be disabled, or the rotational speeds significantly decreased during periods when a quieter environment is desired (and complaints registered). A combination of the options proposed above.

Cumulative impacts:

This impact is cumulative with existing ambient background noises.

Residual impacts:

This impact will only disappear once the operation of the wind energy facility ceases.

Implications for Project Implementation

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.

It is recommended that the ambient sound environment be defined over a longer period as per the environmental management plan.

In addition quarterly monitoring noise monitoring should be conducted an acoustic consultant for the first year of operation.

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.

In addition:

1. Good public relations are essential. At all stages surrounding receptors should be educated with respect to the sound generated by wind turbines. The information presented to stakeholders should be factual and should not set unrealistic expectations.
2. Community involvement needs to continue throughout the project. A positive community attitude throughout the greater area should be fostered, particularly with those residents near the wind farm, to ensure they do not feel that advantage have been taken of them.
3. The developer must implement a line of communication (i.e. a help line where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. REISA should maintain a commitment to the local community and respond to concerns in an expedient fashion.

6.8.1. Conclusions and Recommendations

Wind turbines produce sound, primarily due to mechanical operations and aerodynamics effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources, and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that does impact areas at some distance away. When potential sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not unduly cause annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should be inaudible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.

The noise impact on surrounding areas (outside of the development footprint) are of low significance. The potential impact on sensitive receptors (e.g. homesteads) within the proposed wind energy facility footprint is potentially of medium significance, but this will be dependent on final turbine placement and mitigation measures applied in order to reduce potential noise impacts on any

receptors to a low significance. Care must be taken to ensure that the operations at the wind farm do not unduly cause annoyance or otherwise interfere with the quality of life of the receptors.

The potential noise impact that the proposed facility could have on the surrounding environment (specifically "Die Berg" community) could be of a medium significance during the important operational phase.

Either of the proposed power line routes are acceptable in terms of potential noise impacts.

6.9. Assessment of Potential Social Impacts

Impacts on the social environment as a result of the wind turbines are expected to occur during both the construction and operation phases.

The key social issues associated with the ***construction phase*** include:

» Potential positive impacts
- Creation of employment and business opportunities

» Potential negative impacts
- Impacts associated with the presence of construction workers employed on the project;
- Increased risk of stock theft, poaching and damage to farm infrastructure associated with presence of construction workers on the site;
- Increased risk of veld fires associated with construction related activities;
- Impact of heavy vehicles, including damage to roads, safety, noise and dust;
- Loss of agricultural land associated with construction related activities.

The key social issues affecting the ***operational phase*** include:

» Potential positive impacts
- Creation of employment and business opportunities. The operational phase will also create opportunities for skills development and training
- The promotion of clean energy as an alternative energy source

» Potential negative impacts
- Impact of the proposed wind energy facility on the current farming activities
- The visual impacts and associated impact on sense of place

- Impact on tourism (impact on tourism may also be positive in some instances).

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 (with and without mitigation) associated with the construction phase of the wind energy facility

Nature: Creation of employment and business opportunities during the construction phase

Based on the information from similar facilities the capital expenditure associate with the construction of 14 wind turbines with a generation potential of 30 MW would be in the region of R 450-500 million. The construction phase is expected to extend over a period of 6-8 months and create approximately 60 temporary employment opportunities. The work associated with the construction phase will be undertaken by contractors and will include the establishment of the access roads and services and the erection of the wind turbines, substations and power lines.

Of this total, approximately 33 % (20) of opportunities will be available to skilled personnel (engineers, technicians, management and supervisory), ~33 % (20) to semi-skilled personnel (drivers, equipment operators), and ~ 33 % (20) to low skilled personnel (construction labourers, security staff). Due to the low education and skills levels in the area, the majority of opportunities for residents in the local towns of Humansdorp, Jeffery's Bay and Cape St Frances are likely to be limited to the low and semi-skilled category, specifically for Historically Disadvantaged Individuals. The majority of the employment opportunities are likely to be associated with the contactors appointed to construct the facility and associated infrastructure. In this regard the majority of contractors use their own staff and this will limit the potential for direct employment opportunities for locals during the construction phase.

The proposed development will create an opportunity to provide on-site training and increase skills levels. However, the majority of these opportunities are likely to benefit the workers employed by the contractors and not necessarily locals from the area. Due to the low education and skills levels in the area the opportunities for skills development and training of locals may be limited. However, due to the relatively recent boom in the construction industry (2000-2008), the required civil engineering contracting and construction skills are likely to be available in the local area The required expertise and skills would also be available in the Nelson Mandela Bay municipality which is located within 100 km of the site.

In terms of business opportunities for local companies, the expenditure of R 450-500 million during the construction phase will create business opportunities for the regional and local economy. However, given the technical nature of the project and the high import content associated with wind turbines the opportunities for the local Humansdorp, Jeffery's Bay and Cape St Frances economy are likely to be limited. Opportunities may however

occur for engineering companies located in the Nelson Mandela Bay Metropolitan Region. The sector of the local economy that is most likely to benefit from the proposed development is therefore the local service industry. The potential opportunities for the local service sector would be linked to accommodation, catering, cleaning, transport and security, etc. The construction workers associated with the construction phase are likely to be accommodated in the local towns of Humansdorp, Jeffery's Bay, St Francis and Cape St Francis. This will create opportunities for local hotels, B&Bs, guest farms and people who want to rent out their houses. In addition, a proportion of the total wage bill earned by construction workers over the 6-8 month construction phase will be spent in the regional and local economy. The total wage bill associated with the construction phase is estimated at R 20-25 million. The injection of income into the area in the form of rental for accommodation and wages will create opportunities for local businesses in Humansdorp, Jefferies Bay, St Francis and Cape St Francis. The benefits to the local economy will however be confined largely to the construction period (6-8 months).

	Without enhancement	**With enhancement**
Extent	Local – Regional (2) (Rated as 2 due to potential opportunities for local communities)	Local – Regional (3) (Rated as 3 due to potential opportunities for local communities and businesses)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (32)**	**Medium (36)**
Status (positive or negative)	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impacts be enhanced?	Yes	

Enhancement Measures:

» Employment

- Where possible REISA should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
- Before the construction phase commences REISA should meet with representatives from the Kouga Municipality to establish the existence of a skills database for the area. If such as database exists it should be made available to the contractors appointed for the construction phase.
- The local authorities, community representatives and organisations on the interested and affected party database should be informed by the Environmental Consultants (Savannah Environmental) of the final decision regarding the project (i.e. the Environmental Authorisation).
- Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.

- The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

» Business

- REISA should develop a database of local companies, specifically companies that qualify as Black Economic Empowerment (BEE) companies, that qualify as potential service providers (e.g. construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction contractors. These companies should be notified of the tender process and invited to bid for project-related work;
- Where possible, REISA should assist local BEE companies to complete and submit the required tender forms and associated information.
- The Kouga Municipality in conjunction with the local Chamber of Commerce and representatives from the local hospitality industry could identify strategies aimed at maximising the potential benefits associated with the project.

Cumulative impacts:

Opportunity to up-grade and improve skills levels in the area. However, due to relatively small number of local employment opportunities this benefit is likely to be limited.

Residual impacts:

Improved pool of skills and experience in the local area. However, due to relatively small number of local employment opportunities this benefit is likely to be limited.

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers

Based on the findings of the social assessment the area can be described as a rural area that is "safe and secure". In terms of affected farmsteads, there are a relatively small number of farmsteads that will be affected by the proposed project. However, there are a number of potentially vulnerable farming activities, specifically sheep and cattle farming. The potential threat to farming activities is discussed below. In addition, the presence of construction workers also poses a potential risk to family structures and social networks in the area (both on farms and in the local towns of Humansdorpand and Kruisfontein. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on the local community. In this regard the most significant negative impact is associated with the disruption of existing family structures and social networks.

	Without mitigation	**With mitigation**
Extent	Local (2) (Rated as 2 due to potential severity of impact on local communities)	Local (1) (Rated as 1 due to potential severity of impact on local communities)
Duration	Very short term for community as a whole (1) Long term-permanent for individuals who may be affected by STD's etc (5)	Very short term for community as a whole (1) Long term-permanent for individuals who may be affected by STD's etc (5)
Magnitude	Minor for community as a whole (2)	Minor for community as a whole (2)

	High-Very High for specific individuals who may be affected by STD's etc (10)	High-Very High for specific individuals who may be affected by STD's etc (10)
Probability	Probable (3)	Probable (3)
Significance	**Low** for the community as a whole **(15)** **Moderate-High** for specific individuals who may be affected by STDs etc **(51)**	**Low** for the community as a whole **(12)** **Moderate-High** for specific individuals who may be affected by STDs etc **(48)**
Status (positive or negative)	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on subsistence farming for their livelihoods	
Can impacts be mitigated?	Yes, to some degree. However, the risk cannot be eliminated.	

Mitigation Measures:

» Where possible, REISA should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories.
» REISA and the contractor should develop a Code of Conduct for the construction phase. The code should identify what types of behaviour and activities by construction workers are not permitted. Construction workers that breach the code of good conduct should be dismissed. All dismissals must comply with the South African labour legislation.
» REISA and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase.
» The movement of construction workers on and off the site should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting workers to and from site on a daily basis.
» Where required, the contractor should make the necessary arrangements to allowing workers from outside the area to return home over weekends and or on a regular basis during the 6-8 month construction phase. This would reduce the risk posed by construction workers to local family structures and social networks.
» It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

Cumulative impacts

Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned/unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.

Residual impacts

See cumulative impacts.

Nature: Potential loss of livestock, poaching and damage to farm infrastructure

associated with the presence of construction workers on site

The presence of construction workers on the site increases the potential risk of stock theft and poaching. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may also be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged. The adjacent land owner, Mr Mayer, indicated that he did not believe that the proposed facility would impact on his current dairy operations. However, the potential issue of stock theft was raised as a concern. These impacts can, however, be effectively managed and mitigated. In addition, it is assumed that REISA has entered into an agreement with the affected landowners whereby the company will compensate farmers for damages to farm property and disruptions to farming activities. It is assumed that this includes losses associated with stock theft and damage to property etc.

	Without mitigation	**With mitigation**
Extent	Local (3) (Rated as 4 due to potential severity of impact on local farmers)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6) (Due to reliance on agriculture and livestock for maintaining livelihoods)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes, compensation paid for stock losses etc	Yes, compensation paid for stock losses etc
Irreplaceable loss of resources?	No.	
Can impacts be mitigated?	Yes however some loss of farmland cannot be avoided.	

Mitigation Measures:

» REISA should, in consultation with the local farmers, develop a Code of Conduct for construction workers. The Code of Conduct should be signed by REISA and the contractors before the contractors move onto site.

» REISA should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between REISA, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities.

» The EMP must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested.

» Contractors appointed by REISA must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.

» Contractors appointed by REISA must ensure that construction workers who are found guilty of stealing livestock, poaching and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation. » The housing of construction workers on the site should be limited to security personnel.
Cumulative impacts No, provided losses are compensated for.
Residual impacts No, provided losses are compensated for.

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires

The presence of construction workers and construction-related activities on the site poses an increased risk of veld fires that in turn pose a threat to the livestock, wildlife and farmsteads in the area. In the process, farm infrastructure may also be damaged or destroyed and human lives threatened.

	Without mitigation	**With mitigation**
Extent	Local (4) (Rated as 4 due to potential severity of impact on local farmers)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate due to reliance on agriculture for maintaining livelihoods (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes, compensation paid for stock losses etc	Yes, compensation paid for stock losses etc
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Mitigation Measures:

» The contractor must ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
» The contractor must ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include clearing working areas and avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months.
» The contractor must provide adequate fire fighting equipment on-site.

» The contractor must provide fire-fighting training to selected construction staff. This must take place before construction activities commence. » As per the conditions of the Code of Good Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire fighting costs borne by farmers and local authorities.
Cumulative impacts: None, provided losses are compensated for.
Residual impacts: None, provided losses are compensated for.

Nature: Potential noise, dust and safety impacts associated with movement of construction related traffic to and from the site and damage to roads.
Road access to the proposed facility will be from the R 102 and a gravel road that crosses the N2 and then later also crosses a railway line. The movement of heavy construction vehicles during the construction phase has the potential to damage roads and create noise, dust and safety impacts for other road users.

Approximately 5 abnormal heavy load trips are associated with the transport of a single turbine onto site. These include loads associated with 40-55 m rigid turbine blades, as well as abnormally heavy loads associated with the 80-ton nacelles. The total number of trips associated with the proposed establishment of 14 turbines would therefore be in the region of 70 trips. In addition assembly cranes will also need to be transported onto and off the site. Other heavy equipment will include normal civil engineering construction equipment such as graders, excavators, cement trucks, etc.

The findings of the SIA indicate that the issues related to the movement of heavy vehicle traffic during the construction phase can be effectively mitigated. These issues are therefore not regarded as significant concerns. In addition, heavy the roads are already used by heavy vehicles that collect milk and beef cattle from the local farms in the area. In addition, it is assumed that REISA has entered into an agreement with the affected landowners whereby the company will compensate farmers for damages to farm property and disruptions to farming activities. It is assumed that this includes damage to local roads.

	Without mitigation	**With mitigation**
Extent	Local (2) (Rated as 2 due to potential severity of impact on local farmers)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (18)**	**Low (15)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation Measures: » The contractor must ensure that damage caused to roads by the construction related activities, including heavy vehicles, is repaired before the completion of the construction phase. The costs associated with the repair must be borne by REISA. » Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. » All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.		
Cumulative impacts: : If damage to roads is not repaired then this will impact on the farming activities in the area and also result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were no responsible for the damage.		
Residual impacts: Refer to cumulative impacts.		

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, substation and power line will damage farmlands and result in a loss of farmlands for future farming activities.

The significance of the impacts is to some extent mitigated by the fact that the farming activities in the area are confined to stock farming as opposed to crops. In addition, in the case of the Happy Valley site the impact is likely to be linked to limited due to the location of the proposed wind turbines on relatively steep slopes and ridges. These areas are not used as key farming areas. However, the loss of potential veld for grazing is still an issue. The impact on farmland associated with the construction phase can therefore be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase.

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long term-permanent if disturbed areas are not rehabilitated (5)	Short term if damaged areas are rehabilitated (1)
Magnitude	Minor (2)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	**Moderate (45)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes, in the long term if facility is dismantled and area is	

	rehabilitated	
Irreplaceable loss of resources?	No, disturbed areas can be rehabilitated	No, disturbed areas can be rehabilitated
Can impacts be mitigated?	Yes, however, loss of farmland cannot be avoided during operational phase	

Mitigation Measures:

» The footprint associated with the construction related activities (access roads, turning circles, construction platforms, workshop etc) should be minimised.
» An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase.
» All areas disturbed by construction related activities should be rehabilitated at the end of the construction phase.
» The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed to establish the facility. The specifications for the rehabilitation programme should be drawn up the Environmental Consultants appointed to undertake the EIA (Savannah Environmental).
» The implementation of the Rehabilitation Programme should be monitored by the ECO;
» Compensation should be paid to farmers that suffer a permanent loss of land due to the establishment of the facility. Compensation should be paid by REISA and based on accepted land values for the area. However farmers affected by the proposed project are being compensated for the loss of land.

Cumulative impacts: :

Overall loss of farmland may impact on the livelihoods of the affected farmers, their families and the workers on the farms and their families. However, due to small scale there will be no significant cumulative impacts and disturbed areas can also be rehabilitated.

Residual impacts:

Refer to cumulative impacts.

Impact table summarising the significance of social impacts (with and without mitigation) associated with the operation phase of the wind energy facility

Nature: Creation of employment and business opportunities associated with the Operation phase

Based on information provided by REISA approximately 10 permanent staff (administrative, management, monitoring, maintenance and security) will be employed during the operational lifespan of the Happy Valley Wind Energy Facility (25-30 years). In addition, approximately 12 security personnel will be employed. The wage bill associated with the operational phase is estimated at R3 million per year (current value).

Due to the need for specialised skills it may be necessary to import the required operational and maintenance skills from other parts of South Africa or even overseas. All of the security positions can however be filled by local residents. However, it will be possible to increase the number of local employment opportunities through the implementation of a skills development and training programme linked to the operational phase. Such a programme would support the strategic goals of promoting local

employment and skills development contained in the Kouga IDP.

Given the location of the proposed facility the majority of permanent staff is likely to reside Humansdorp. Some permanent staff may also elect to live at the coast, in towns such Jeffery's Bay, St Francis and Cape St Francis. In terms of accommodation options, a percentage of the new permanent employees may purchase houses in one of these towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the annual wage bill earned by permanent staff would be spent in the regional and local economy. T his will benefit local businesses in the local towns in the area. The benefits to the local economy will extend over the 25-year operational lifespan of the project. The local hospitality industry is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc) who are involved in the company and the project but who are not linked to the day-to-day operations.

Research undertaken by Warren and Birnie (2009) also highlights the importance of addressing community benefits in the development and implementation of wind energy facilities. The findings of the research found that wind farms in Europe became more socially acceptable when local communities were directly involved in, and benefited from the developments. In Denmark, Germany, the Netherlands and Sweden, where wind farms have typically been funded and controlled by local cooperatives, there has been widespread support for wind power. However, in Britain where the favoured development approach has been the private developer/public subsidy model, many proposals have faced stiff local opposition. This is an issue that should be addressed in the South African context.

	Without enhancement	**With enhancement**
Extent	Local and Regional (2)	Local and Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Medium (39)**
Status (positive or negative)	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impacts be enhanced?	Limited opportunity due to small scale of project	

Enhancement Measures:

» REISA should implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's and locals employed during the operational phase of the project;

Cumulative impacts:

Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities

in the area
Residual impacts:
See cumulative impacts.

Nature: Promotion of clean, renewable energy

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producer of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions.

The establishment of a clean, renewable energy facility will therefore reduce, albeit minimally, South Africa's reliance on coal-generated energy and the generation of carbon emissions into the atmosphere.

The overall contribution to South Africa's total energy requirements of the proposed wind energy facility is limited. However, the 400 MW produced will to some extent off-set the total carbon emissions associated with energy generation in South Africa. In addition the project is an independent power producer (IPP) that generated clean, renewable energy. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as significant.

	Without enhancement	**With enhancement**
Extent	Local, Regional and National (4)	Local, Regional and National (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Very High (10)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**High (64)**	**High (72)**
Status (positive or negative)	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	Yes, impact of climate change on ecosystems	
Can impacts be enhanced?	Yes	

Enhancement Measures:

» N/A

Cumulative impacts:

Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.

Residual impacts:

See cumulative impacts.

Nature: Loss of productive agricultural land due to the establishment of a wind energy facility and the impact on farmers livelihoods

This issue relates to the potential long-term impact of the facility on existing farming activities, specifically the loss of grazing available for cattle and other livestock. However, as indicated above, the significance of the impacts is mitigated by the fact that the farming

activities in the area are confined to stock farming as opposed to crops. The experience with facility is that livestock farming is not affected by operational facility. The final footprint of disturbance associated with facilities also tends to be small and is linked to the foundation of the individual wind turbines, services roads, sub-stations and power lines. The impact on farmland associated with the construction phase can also be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase. The potential impact on farming activities is therefore not regarded as a significant issue. Mr. Mayer, and adjacent farm owner, indicated that he did not feel that the proposed facility would impact on his current dairy farming operations. However, Mrs. Elton raised concerns regarding the impact of wind energy facilities on dairy cattle.

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (21)**
Status (positive or negative)	Negative	Neutral
Reversibility	Yes. Land that is lost to footprint associated with wind energy facility (roads, turbines etc) can be restored to farm land over time if rehabilitated.	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	

Mitigation Measures:

» The footprint associated with the construction related activities (access roads, turning circles, construction platforms, workshop etc) should be minimised.
» An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase.
» All areas disturbed by construction related activities, such as access roads, construction platforms, workshop area etc, should be rehabilitated at the end of the construction phase.
» The implementation of the Rehabilitation Programme should be monitored by the ECO.

Cumulative impacts:

Potential minor loss of agricultural employment opportunities associated with loss of land.

Residual impacts:

See cumulative impacts.

Nature: Visual impact associated with the proposed wind turbines and the potential impact on the areas rural sense of place.

The turbines associated with the proposed facility will have a visual impact and, in so doing, impact on the rural sense of the place of the area and the landscape. While none of the local farmers interviewed identified visual impacts as a significant concern, this does not imply that the proposed facility will not impact on the area's sense of place and the landscape. Experience from elsewhere, such as Australia and Scotland, indicates that

impacts on the landscape represents one of the most significant concerns associated with wind farms. The potential for mitigating the impact on the area's sense of place and the landscape is low. In this regard the Australian National Wind Farm Development Guidelines stress the importance of general location and site selection.

With regard to the Happy Valley Wind Energy Facility, the site is visible from the N2, which is an important tourist route. The R62, which is also an important tourist route and designated scenic route, is located to the south-west of the site. In addition, a number of the local landowners in the area, including Mr. Mayer (dairy farm) and Mr Roesenkraaz (game farm) both raised concerns regarding the potential visual impact that the proposed Happy Valley Wind Energy Facility would have on the areas sense of place and their quality of life.

The key findings of the Visual Impact Assessment (VIA) undertaken by MetroGIS indicate that the region has a rural character, and lies with a number of individual farming homesteads/dwellings occurring within the study area. It is also a particularly picturesque part of the country, in close proximity to the southern seaboard of the country, and is thus a known tourist destination. However, most of the drainage lines within the valley are visually protected, and the anticipated viewshed zone is limited in the north and the south by rolling hills and mountains. The coastal plain is largely free of potential visual exposure. The VIA notes that the visibility of the facility will be high, with a high frequency of exposure for discontinuous significant stretches of the N2, the R102, the R62 and, the southern part of the R330 and a number of secondary roads. The northern part of the R330 and the R332 will be mostly shielded from visual impact, with isolated areas having a low to moderate frequency of exposure.

The VIA notes that in terms of specific settlements, the the towns of Kruisfontein and Humansdorp are expected to experience a high frequency of visual exposure, both within the towns and in the surrounding area.

	Without mitigation	**With mitigation**
Extent	Local (4) (Reflects impact on local residents and travellers along N2 and R 62)	Local (4) (Reflects impact on local residents and travellers along N2 and R 62)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**High (64)**	**High (64)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes. Wind turbines can be removed.	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	
Mitigation Measures: » The recommendations contained in the Visual Impact Assessment should be		

implemented.

Cumulative impacts:

Potential impact on current rural sense of place. However, due to small scale of facility proposed the impact would be limited.

Residual impacts:

See cumulative impacts.

Nature: Potential impact of the wind energy facility on local tourism

The potential impacts on tourism are closely related to potential visual impacts associated with the proposed facility. In this regard the Happy Valley Wind Energy Facility site is visible from the N2, which is an important tourist route. As indicated above, the R62, which is located to the south-west of the site, is also an important tourist route and a designated scenic route. As indicated above the findings of the VIA indicate facility would be visible within an area that is generally seen as having the region has a high quality natural and rural landscape character and is located within a resultant tourism value. It is in close proximity to the southern seaboard, and is thus a known tourist destination. In addition, the N2 is a well-known and well used tourist access route, and the arterial and secondary roads make for scenic drives. The anticipated visual impact of the facility on existing tourist routes is rated as Moderate negative by the VIA.

However, research in Scotland undertaken by Warren and Birnie (2009) found that there appeared to be no clear evidence that tourists would be put off by the presence of wind farms in tourism areas. In this regard far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote an area's reputation as an environmentally friendly area, provided they are sensitively sited. However, the paper notes that this could change as more are built. The key lesson for South Africa is this regard is that wind farms should be located in areas that minimise the potential impact on landscapes and as such also reduce the potential impact on tourism.

	Without mitigation	**With mitigation**
Extent	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	

Mitigation Measures:

» The recommendations contained in the Visual Impact Assessment (Appendix I) should be implemented.

Cumulative impacts:

Impact on sense of place.

Residual impacts:
See cumulative impacts.

Nature: Cumulative impacts on sense of place and the landscape

The proposed establishment of three or possibly more wind energy facilities in the area will have a significant impact on the landscape and the areas rural sense of place and character. This impact will be exacerbated by the sequential visibility of the sites, specifically for motorists travelling along the N2, which is an important tourist route that links Cape Town with the Eastern Cape. As indicated above, it is not possible to effectively mitigate the visual impacts associated with wind turbines. As a result international guidelines stress the importance of general location and site selection.

	Without mitigation	**With mitigation**
Extent	Local and regional (4)	Local and regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**High (70)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	

Mitigation Measures:

» The establishment of more than one wind energy facility in the area is likely to have a negative cumulative impact on the areas sense of place and the landscape. . There is only one authorised facility in the broader area – that is the RedCap Kouga facilty, which lies 11km from the site. In addition, the siting of individual turbines on each of the wind energy sites should be informed by findings of the Visual Impact Assessment (Appendix I), specifically with respect to visual impact on roads frequently used by tourists and farmsteads in the area.

Cumulative impacts:
Impact on other activities whose existence is linked to rural sense of place and character of the area.

Residual impacts:
N/A/

Implications for Project Implementation

The findings of the Social Assessment indicate that the proposed development will create employment and business opportunities for locals during both the construction and operational phase of the project. However, these benefits will be limited. In order to enhance the local employment and business opportunities the mitigation measures listed in the report should be implemented. REISA

should also investigate the opportunities for establishing a Community Trust. The revenue for the trust would be derived from the income generated from the sale of energy from the wind energy facility and used to support local IDP projects and initiatives. The establishment of a Community Trust should be discussed with the Kouga Local Municipality. The mitigation measures listed in the report to address the potential negative impacts during the construction phase should also be implemented.

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 cumulative impacts associated with the three proposed wind energy facilities on the areas sense of place and landscape cannot be ignored. The cumulative impact of wind energy facilities on the rural landscapes is an issue that will need to be addressed by the relevant environmental authorities, specifically given the large number of applications for wind energy projects that have been submitted over the last 12 months.

6.9.1. Conclusions and Recommendations

Most of the potential negative impacts on the social environment as a result of the construction and operation of the wind energy facility are expected to be of moderate to low significance, with implementation of the recommended mitigation measures. A number of positive impacts have been identified, which could be further enhanced if managed effectively. These benefits relate mostly to a temporary change in the employment and economic profile of the local area by means of employment opportunities, which in turn leads to a positive economic impact on local households, as well as the broader social benefits associated with the development of a clean, renewable energy.

The findings of the Social Impact Assessment support the findings of the Visual Impact Assessment and indicate that **Alternative 1** for the transmission lines is the preferred alternative. There are no significant social impacts associated with the on-site substation.

The findings of the SIA confirm the findings of the VIA, that is do not consider the placement of wind turbines and associated infrastructure on scenic and/or elevated topographical units (i.e. hills, mountains, etc.) to be "best practise" from a visual impact point of view. However, the VIA acknowledges that the facility is not considered to be fatally flawed (completely unacceptable).

6.9. Summary of All Impacts

As a summary of the potential impacts identified and assessed through the EIA process, the following tables indicate the significance ratings for the potential ecological, visual and social impacts.

Nature	Without mitigation	With mitigation
Potential impacts on vegetation and ecology (turbines)		
Impact on threatened animals species	Low	Low
Impacts on threatened plant species	Moderate	Low
Loss of indigenous natural vegetation	Moderate	Moderate
Damage to wetlands	Low	Low
Change in run-off patterns	Low	Low
Establishment and spread of declared weeds and alien invader plants	Moderate	Moderate
Potential impacts on vegetation and ecology (substation)		
Impact on threatened animals species	Low	Low
Impacts on threatened plant species	Moderate	Low
Loss of indigenous natural vegetation	Moderate	Moderate
Damage to wetlands	Moderate	Moderate
Change in run-off patterns	Moderate	Low
Establishment and spread of declared weeds and alien invader plants	Moderate	Moderate
Potential impacts on vegetation and ecology (power line)		
Impact on threatened animals species	Low	Low
Impacts on threatened plant species	Low - High	Low
Loss of indigenous natural vegetation	Moderate	Low
Damage to wetlands	Moderate	Low
Change in run-off patterns	Low	Low
Establishment and spread of declared weeds and alien invader plants	Moderate	Low
Potential impacts on vegetation and ecology (access roads and cabling)		
Impact on threatened animals species	Moderate	Low
Impacts on threatened plant species	Low - Moderate	Low
Loss of indigenous natural vegetation	High	Moderate
Damage to wetlands	High	Low
Change in run-off patterns	Moderate	Moderate
Establishment and spread of declared weeds and alien invader plants	Moderate	Moderate
Potential impacts on avifauna		
Disturbance during the construction and operational phases	Moderate	Low - Moderate
Habitat loss - destruction of habitat for priority species, either temporary –	Moderate	Low - Moderate

resulting construction activities peripheral to the built area, or permanent - the area occupied by the completed development		
Mortality - Collision of priority species with the wind turbine blades and/or any new power lines, or electrocution	Moderate - High	Moderate
Potential impacts on bat species		
Bat mortalities due to blade collisions and barotraumas during construction	Moderate	Low
Bat mortalities due to blade collisions and barotraumas during operation	Moderate	Low
Destruction of foraging habitat	Low	Low
Potential impacts on geology, soil, and erosion potential		
Soil degradation - excavation and removal of soil for roads and structures, affecting soil formation processes, hydrology, and ecosystems	Moderate	Moderate
Soil degradation - loosening, mixing, wetting, and compacting of in situ soil during earthworks, affecting soil formation processes, hydrology, and ecosystems	Moderate	Moderate
Soil degradation - soil erosion by wind and water, affecting soil forming processes, agricultural potential, hydrology, and ecosystems	Low	Low
Soil degradation by wind & water	Low	Low
Siltation of waterways and dams downstream from site, affecting ecosystems and hydrology	Low	Low
Dust pollution from construction site affecting areas surrounding site	Low	Low
Potential impacts on heritage sites		
Loss of possible heritage sites during the construction phase	Low	Low
Potential impacts on palaeontology		
Disturbance or destruction of valuable fossil heritage	Low	N/A
Potential visual impacts		
On users of major roads and secondary roads in close proximity to the proposed facility	High	N/A
On residents of settlements and homesteads in close proximity to the proposed facility	High	N/A

On sensitive visual receptors (users of roads and residents of towns, settlements and homesteads) within the region	Moderate	N/A
On protected areas in close proximity to the proposed facility	Moderate	N/A
On protected areas in the region	Low	N/A
Potential visual impact of internal access roads on observers in close proximity to the proposed facility.	Moderate	Low
Potential visual impact on the visual character and sense of place of the region	Moderate	N/A
Potential visual impact of the proposed facility on tourist routes, tourist destinations and tourist potential within the region.	Moderate	N/A
Potential visual impact of the power lines	Moderate	N/A
Potential visual impact of the internal access roads	Moderate	Low
Potential visual impact of lighting on visual receptors in close proximity of the proposed facility	High	Moderate
Potential visual impact of construction on visual receptors in close proximity of the proposed facility	Moderate	Low
Potential noise impacts		
Numerous simultaneous construction activities that could affect potential sensitive receptors.	Moderate	Low
Numerous turbines operating simultaneously during a period when a quiet environment is desirable.	Moderate	Low
Potential social impacts		
Creation of employment and business opportunities associated with the construction phase (Positive Impact)	Moderate	Moderate
Potential impacts on family structures and social networks associated with the presence of construction workers	Low - High	Low - High
Potential loss of livestock, poaching and damage to farm infrastructure	Moderate	Low
Assessment of impact as a result of construction vehicles	Low	Low
Assessment of impact on farmland due to construction related activities	Moderate	Low

Damage farmlands and result in a loss of farmlands for future farming activities	High	Low
Creation of employment and business opportunities associated with the operational phase (Positive Impact)	Moderate	Moderate
Development of infrastructure to generate clean, renewable energy (Positive Impact)	High	High
Visual impact associated with the proposed wind turbines and the potential impact on the areas rural sense of place	High	High
Loss of productive agricultural land due to the establishment of a wind energy facility and the impact on farmers livelihoods	Low	Low
Cumulative impacts on sense of place and the landscape associated with multiple wind energy facilities in the area	High	Moderate

As indicated in Chapter 3, the significance weightings for potential impact 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.

6.10. Comparative Assessment of Layout Options

Two **alternative corridors** are proposed for the proposed power line: Alternative 1 and Alternative 2 (refer to Figure 6.6). No other layout alternatives were assessed as part of the EIA as discussed in Section 2.1 of this EIA report.

There is a negligible difference between the visual exposure of power line Alternative 1 and Alternative 2, meaning that either option will result in potential visual impact. However, Alternative 1 follows an existing power line alignment for its entire length, while Alternative 2 does not. In this respect, Alternative 1 is considered preferable to Alternative 2 from a visual perspective as the existing infrastructure may help to 'absorb' the visual impact somewhat.

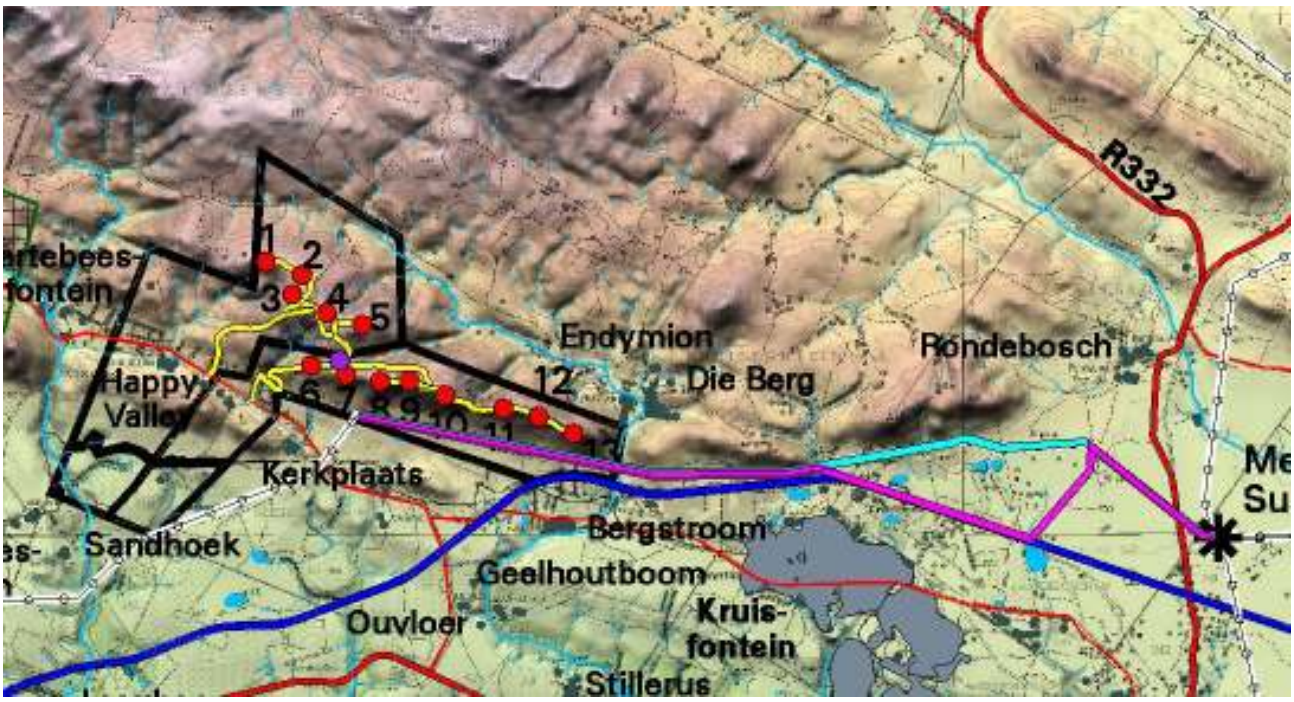

Figure 6.6: Close up view of power line alternative routes assessed in the EIA report (Alternative 1: blue line and Alternative 2: purple line)

The fact that Alternative 1 more closely follows an existing power line alignment will also reduce potential ecological impacts and associated impacts on birds associated with the construction and operation of the proposed power line as this promotes the consolidation of linear infrastructure in a single area as opposed to creating new areas for potential impacts.

The power line **Alternative 1** route is therefore supported.

6.11. Assessment of Potential Cumulative Impacts

Cumulative impacts, in relation to an activity, refer 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 activities or undertakings in the area. The cumulative impacts associated with the proposed wind energy facility can be viewed from two perspectives: 1) cumulative impacts associated with the scale of the project, i.e. that up to 20 turbines will be located on one site; and 2) cumulative impacts associated with other activities/developments in the area.

The potential *direct* cumulative impacts as a result of the proposed project are expected to be associated predominantly with:

» Visual impact on the surrounding area at a local level on the landscape and the areas rural sense of place and character. This impact will be exacerbated by the sequential visibility (e.g. the effect of seeing two or more wind energy facilities along a single journey, e.g. road or walking trail) of the sites, specifically for motorists travelling along the N2, which is an important tourist route that links Cape Town with the Eastern Cape.

  Based on the information available at the time of undertaking the EIA, it would appear that at least five other wind energy facilities are proposed in the region. These include the authorized RedCape Kouga Wind Energy Facility located ~9 km south of the Happy Valley site, the proposed Deep River Wind Energy Facility located ~10 km west of the Happy Valley site, the proposed Tsitsikamma Wind Energy Facility located ~15 km southwest of the Happy Valley sit, the proposed Jeffrey's Bay Wind Energy Facility located ~20 km east of the Happy Valley site and the proposed Oyster Bay Wind Energy Facility located ~15 km south of the proposed Happy Valley site.

The potential *indirect* cumulative impacts as a result of the proposed project are expected to be associated predominantly with:

» *Flora, fauna, avifauna and ecological processes* - (impacts that cause loss of habitat may exacerbate the impact of the proposed facility impact) at a regional level driven mostly by the possibility of other similar facilities being under construction simultaneously. Impacts related to disturbance, habitat loss and collision related mortality of avifauna may become cumulative if other wind energy facilities are developed in the region. 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 wind 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 turbines 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 a low - moderate significance, the cumulative impact of soil removal in the area is considered low due to undeveloped nature of the area. The cumulative impact of soil pollution in the area is considered moderate due to the severely degraded by mining operations to the south of the study area. The cumulative impact of siltation and dust in the area is considered low.

» *Cumulative noise impacts* - the impact of numerous simultaneous construction 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. The potential for cumulative impacts is low.
» Increased pressure on roads and other infrastructure.

Cumulative effects have been considered within the detailed specialist studies, where applicable (refer to Appendices F - N) and are listed in the tables in the sections above.

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 7

The site for the proposed Happy Valley Wind Energy Facility for the lies approximately 9 km north-west of Humansdorp in the Eastern Cape within the Kouga Local Municipality, located within the Cacadu District Municipality. The larger site covers an area of approximately 12 km^2. The facility, which has been positioned on the larger site, includes the following infrastructure:

» A cluster of up to **20 wind turbines**[6] to be constructed over an area of ~ **12 km^2** in extent
» Each turbine will be a **steel tower** (of up to 80m in height), a **nacelle** (housing the gear box) and three **rotor blades** with a rotor diameter of up to 100 m (i.e. each blade up to 50 m in length)
» **Concrete foundations** (16m x 16m x 2,5m) to support the turbine towers
» Underground electrical distribution **cabling** between the turbines
» An on-site substation (up to 35m x 22m) with an associated transformer
» A new overhead power line (of up to 132kV) to connect to Eskom's existing Melkhout Substation located 12km east of the site;
» **Internal access roads** (3m wide) to each wind turbine within the facility
» **Upgrade** to existing **site access** infrastructure
» Small office and/or workshop building (20m x 10m) for maintenance purposes

The facility is proposed on the following farm portions (refer to Figure 7.1):

» Portion 1 of Farm 810
» Remaining extent of Farm 810

The environmental impact assessment (EIA) for the proposed Happy Valley Wind Energy Facility has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006[7], in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

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.

[6] The layout assessed in this EIA report (Figure 7.1) indicates a total of 13 wind turbines proposed for the site, however the application remains for up to twenty wind turbines.

[7] As the application for the project was submitted under the EIA Regulations of 2006 the EIA has been conducted in accordance with these regulations and not the regulations of June 2010

» Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed Happy Valley Wind Energy Facility.

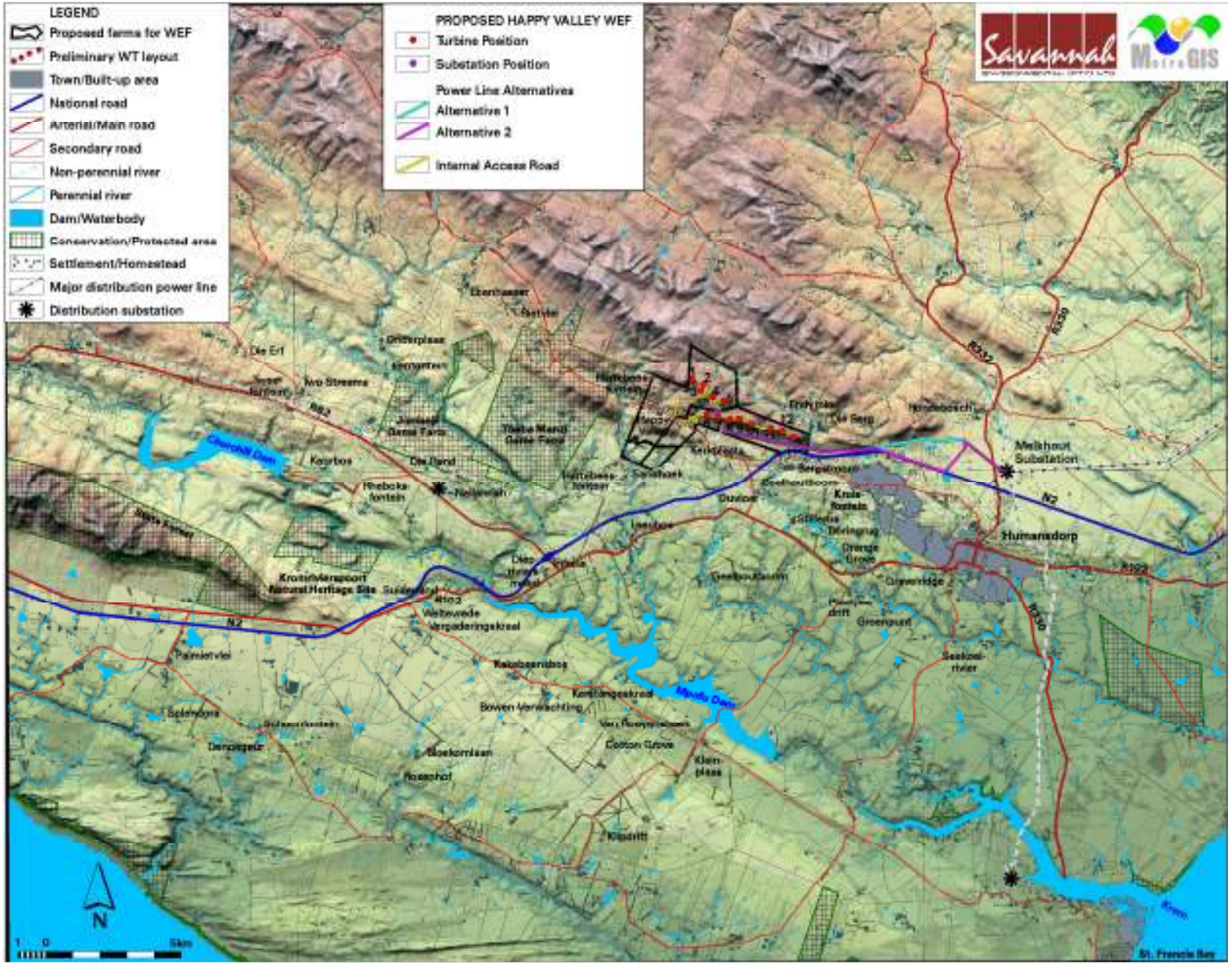

Figure 7.1: Locality map showing the site within the broader area, including the provisional wind turbine layout, proposed substation site, and alternative power line corridors

» Assess the proposed power line corridors and proposed substation site 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 G - N provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This chapter concludes the Final EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the wind energy facility; including the substation and alternative power line corridors. 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.

» Overall the proposed wind energy facility is likely to have a **medium - high** local and regional negative impact on the **ecology** on site, prior to mitigation. This could be reduced to **medium** - **low after mitigation**. The primary negative impacts are the result of both direct and indirect factors. Direct impacts include loss of 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. A number of impacts associated with this project are due to the fact that some of the infrastructure is proposed to be positioned within a part of the landscape that is currently in a relatively pristine condition, and within vegetation that, although not considered a high conservation priority nationally (Kouga Grassy Sandstone Fynbos is classified as Least Threatened), is considered to potentially have high biodiversity value. This portion of the sitecontributes valuable ecosystem goods and services to the surrounding landscape, primarily with respect to being a water catchment area. A portion of the proposed turbines are positioned near the summit of the highest part of the mountain ridgeline which dominates the landscape. This will result in a high degree of fragmentation of a currently undisturbed landscape. The introduction of infrastructure in these areas will compromise the ecological integrity of this area and, potentially, of immediately surrounding areas.
» The primary concern for the proposed facility in terms of **avifauna** will be that of collision of birds with the turbines and earth wires of the power line.

This impact on avifauna is potentially of **medium - high** significance, but could be reduced to a **medium - low significance** with the implementation of mitigation measures. 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.

» The findings of the **geology and soils** study indicate the most important impacts on geology and soils include soil degradation (including erosion). The significance of the main direct impacts that have been identified is considered **low to moderate** due to the localised and limited extent of the proposed activity and the anticipated geology which appears to be generally favourable towards the proposed layout. An assessment of the potential geotechnical constraints on the project indicates no insurmountable problems which have may have an impact on the design and construction processes. Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary degradation of soil. Special attention to be given to roads that cross drainage lines and roads on steep slopes (to prevent unnecessary cutting and filling operations).

» The results of the **heritage** survey suggest that the impacts associated with turbine and other infrastructure footprints would have a **negligible impact** on the archaeological material in the study area. This impact is potentially of **moderate significance** but can be reduced to **low significance** with the implementation of mitigation and monitoring measures. There is a remote chance that trace or invertebrate body fossils may well be found in the development phase during excavation, road building or trenching. Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

» It is envisaged that the structures would be easily and comfortably visible to observers (i.e. travelling along roads, residing at homesteads or visiting the region), especially within a 5 to 10 km radius (i.e. at short to medium distances) of the facility and would constitute a high visual prominence, potentially resulting in a **high** visual impact. In terms of visual exposure, it is not considered "best practise" from a visual impact point of view to place wind turbines (due to their scale) on scenic and/or elevated topographical units (i.e. hills, mountains, etc.). However, it is acknowledged that the facility is not considered to be fatally flawed (completely unacceptable).

» The potential for **noise impact** on surrounding areas (outside of the development footprint) is of **low significance**. The potential impact on sensitive receptors (e.g. homesteads) within the proposed wind energy facility footprint is potentially of **medium significance** on one of the identified sensitive receptors, but this will be dependent on final turbine placement and mitigation measures applied in order to reduce potential noise impacts on any receptors to a **low** significance. Care must be taken to ensure that the

operations at the wind energy facility do not unduly cause annoyance or otherwise interfere with the quality of life of the receptors.

» The majority of the potential **negative impacts on the social environment** as a result of the construction and operation of the wind energy facility are expected to be of **moderate to low significance**, with implementation of the recommended mitigation measures. A number of **positive impacts** have been identified, which could be further enhanced if managed effectively.

No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of high significance requiring mitigation have been highlighted. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Plan (EMP) included within Appendix O. The most significant environmental impacts associated with the proposed project, as identified through the EIA, include:

» Ecological impacts associated with the construction and operation of the facility (most specifically the access roads to the turbine positions), specifically damage to wetlands and drainage lines, impacts due to changes in run-off and drainage patterns, loss of vegetation and the spread of alien plant species.
» Visual impacts on the natural scenic resources of the region imposed by the components of the facility (most specifically the turbines).
» Local site-specific impacts as a result of physical disturbance/modification to the site with the establishment of the facility.
» Impacts associated with the access roads, substation and power line.
» Impacts on the social environment.

These are explored in further detail below:

1. Ecological impacts associated with the construction and operation of the facility.

A number of impacts associated with this project are due to the fact that some of the infrastructure is proposed to be positioned within a part of the landscape that is currently in a relatively pristine condition, and within vegetation that, although not considered a high conservation priority nationally (Kouga Grassy Sandstone Fynbos is classified as Least Threatened), is considered to potentially have high biodiversity value. From a site sensitivity perspective, the south-facing escarpments are considered to be of high sensitivity. The areas of the site contribute valuable ecosystem goods and services to the surrounding landscape, primarily with respect to being a water catchment area. A portion of the proposed turbines are positioned near the crest of the mountain ridgelines which dominate the landscape. This could potentially result in a high degree of

fragmentation of a currently undisturbed landscape. The introduction of infrastructure in these areas could compromise the ecological integrity of this area and, potentially, of immediately surrounding areas.

The site also contains a number of seepage areas that constitute the water source for all the drainage lines that emanate on site. It is considered likely that at least some of these features will be traversed by the construction of internal access roads (although many of access roads already exist on the site and can be used). One of the beneficiaries of this hydrological functioning is the Seekoei River estuary, the conservation of which is considered to be a Provincial priority. This estuary is, however, far off-site.

The overhead powerlines may have an impact of high significance on a threatened (critically endangered) plant species (*Erica humansdorpensis*). A further evaluation of the potentially affected habitat for this species (once the power line route has been defined) will determine whether this is of major concern or not and could reduce the significance of this impact to low. It is considered possible to avoid the area where the species has been identified when determining the final power line alignment.

The potential spread of alien plants on site is of concern, primarily because most of the infrastructure is proposed to be situated within an undisturbed part of the landscape. The infrastructure will therefore create new nodes of disturbance that could enhance the potential for invasion of the site. The potential significance of this impact is therefore medium for all infrastructure components, but can be managed through the strict implementation of rigorous mitigation measures.

A significant proportion of the proposed infrastructure is positioned within a steeply sloping part of the landscape near the summit of the highest part of the mountain ridge. This will result in some degree of fragmentation of a currently undisturbed landscape, and will potentially compromise the ecological integrity of portions of the site.

2. Visual impacts on the natural scenic resources of the region imposed by the components of the facility

The most significant impact associated with the proposed wind energy facility and associated infrastructure is the visual impact on the natural scenic resources and rural character of this region imposed by the components of the facility. The rural vistas surrounding the site will be transformed for the entire operational lifespan of the plant.

It is envisaged that the turbine structures would be easily and comfortably visible to observers (i.e. travelling along roads, residing at homesteads or visiting the region), especially within a 5 to 10 km radius (i.e. at short to medium distances) of the wind energy facility and would constitute a high visual prominence, potentially resulting in a high visual impact.

The primary visual impact, namely the appearance and dimensions of the wind energy facility (mainly the wind turbines) is not possible to mitigate to any significant extent within this landscape. The potential for mitigation is, therefore, low or non-existent.

In terms of visual exposure, it is not considered "best practise" from a visual impact point of view to place wind turbines (due to their scale) on scenic and/or elevated topographical units (i.e. hills, mountains, etc.). However, it is acknowledged that the facility is not considered to be fatally flawed (completely unacceptable) due to the following:

- the relative obscurity of the hill (i.e. it is not considered to be a topographical feature of national importance (e.g. Table Mountain) or provincial important (e.g. Magaliesberg in Gauteng)).
- the proposed facility is (compared to other authorised and proposed facilities in the region) a small facility, further reducing the potential visual impact. From a technical perspective, its location makes it highly desirable in terms of the overall efficiency of the plant.
- the visual exposure of the facility, and ultimately the potential visual impact, is (based on the viewshed and proximity analyses) fairly localised (i.e. restricted to a 5-10 km radius of the facility).
- the wind energy facility is still considered to be (generally) more acceptable than other non-renewable forms of electricity generation (i.e. the placement of conventional power generation infrastructure (e.g. gas turbines) on the hilltop would have constituted a fatal flaw).

In terms of the potential for visual impact, the proposed facility has been viewed in terms of a number of criteria, including the abovementioned factors. Potential visual impacts for tourists (e.g. impacts from the N2 national road) are assessed, however it cannot be stated that the construction of the facility will definaetly deter tourists from visiting the area or even the Garden Route.

Photo simulations were undertaken in order to illustrate the potential visual impact of the facility within the receiving environment (refer Appendix I for the remainder of the photo simulations).

Figure 7.2 View from on a secondary road which intersects the N2 about 5km west of Kruisfontein.

The view in Figure 7.2 may be considered similar to that observed from the N2, which lies immediately to the south of the viewpoint. The wind turbines are positioned behind the north-facing crest of the ridgeline and the lowest portions of the towers will be obscured.

3. Local site-specific impacts as a result of physical disturbance/modification to the site with the establishment of the facility

A wind energy facility is dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. A site of ~12 km^2 was considered for the facility. The bulk of this effective area required for the facility footprint would not suffer any level of disturbance as a result of the required activities on site.

A number of impacts associated with this project are due to the fact that the a portion of the proposed infrastructure is proposed to be positioned within a part of the landscape that is currently in a relatively pristine condition, and within vegetation that has a high biodiversity value. This infrastructure includes turbines as well as access roads.

Permanently affected areas (excluding the power line footprints, which will mostly be situated off-site) comprise up to 20[8] proposed turbine footprints (20 foundation areas of 16 m x 16 m in extent), access roads (to be rehabilitated to 3 m in width), substation footprint (up to 35 m x 22 m in extent) and a workshop area (200m^2). The area of permanent disturbance is calculated as follows:

Facility component - permanent	**Approximate area/extent (in m^2)**
20 turbine footprints (each 16 m x 16 m)	5 120
~ 10 km of permanent access roads (3 m in width)	30 000
Substation footprint (35 x 22 m)	770
Workshop area	200
TOTAL	**36 090** (of a total area of ~12 000 000) **= 0.30 % of site**

Temporarily affected areas comprise the temporary laydown areas as well as a track of up to 11 m in width for the crane to move across the site (i.e. an additional 8 m width to the permanent road of 3 m in width). The area of temporary disturbance is as follows:

Facility component - temporary	**Approximate area/extent (in m^2)**
Temporary storage area	500
Temporary crane travel track adjacent to access road ~10 km PLUS trench for cabling	80 000
20 laydown areas (each 25 m x 50 m)	25 000
TOTAL	**105 500** (of a total area of 12 000 000) **= 0.88 % of site**

Therefore, a total area of 141 590 m^2 can be anticipated to be disturbed to some extent during the construction of the wind energy facility. This amounts to **1.2%** of the total area which will form part of the total wind energy facility site.

[8] [8] The layout assessed in this EIA report (Figure 2.1) indicates a total of 13 wind turbines proposed for the site, however the application remains for up to twenty wind turbines. A worst-case scenario is assumed for the purposes of these are calculations.

Figure 7.3 shows the combined sensitivity map for the project study area. Indicated on the map are:

» High sensitivity ecological areas
» Homesteads (potentially sensitive noise receptors)
» High sensitivity bat areas

From the specialist investigations undertaken for the proposed wind energy facility site, several environmentally sensitive areas were identified with regard to potential ecological impacts. The only effective way to reduce impacts on natural vegetation and/or steep slopes is to modify the position of infrastructure to avoid the pristine mountain areas. Impacts associated with turbines 1, 8, 9, 10, 11, 12 and 13 must be very carefully controlled in order to minimise impacts on habitat within the mountain area where there are steep slopes and undisturbed vegetation.

The access roads, rather than the turbine footprints potentially have the most significant impact (owing to approximately 10km of access road being required). The use of existing tracks on the site must be prioritised. This would reduce the need of new road to ~8 km. The number of internal access roads needs to be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road.

Figure 7.3 indicates an area of high ecological sensitivity. Several wind turbines are currently proposed within this area. Should mitigation measures be adhered to, impacts can be adequately managed.

Disturbance to the site during the establishment of the facility will alter habitats on the site, which could disturb resident birds during the construction phase. During operation of the facility, the threat of collision of avifauna with the turbine blades is the most significant impact. However, the real extent of this potential risk is not currently well understood within the South African context.

The proposed development will possibly affect populations of regionally or nationally threatened (and impact susceptible) birds (mainly raptors and large terrestrial species) likely to occur within or close to the proposed turbines. The facility will probably have a detrimental impact on these birds, particularly during its operational phase, unless commitment is made to mitigating these effects. Careful and responsible implementation of the required mitigation measures should reduce construction and operational phase impacts to 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 African avifauna. The impacts of this development must be viewed in the context of the potential cumulative effects generated by at least five other wind energy project proposed for the same general area.

It is also considered essential that the bird interactions which do take place with the establishment of the facility are fully documented. To this end, the initiation of a comprehensive pre-and-post commissioning monitoring programme, and a longer-term scheme for surveying bird movements in relation to the wind energy facility and fully documenting all collision (or electrocution with power line infrastructure/substation) casualties, is considered critical. Such a monitoring programme will also inform and refine any post-construction mitigation of impacts which might ultimately be required.

In order to reduce/avoid impacts on sensitive areas, it is recommended that:

» Impacts associated with turbines 1, 8, 9, 10, 11, 12 and 13 must be very carefully controlled in order to minimise impacts on habitat within the mountain area where there are steep slopes and undisturbed vegetation.
» As far as possible, wind turbines and associated laydown areas and access roads which could potentially impact on sensitive areas should be shifted in order to avoid these areas of high sensitivity (i.e. best practice is impact avoidance). Where this is not technically feasible or viable, alternative mitigation measures as detailed in this report must be implemented.
» 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 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 much as possible.
» Any steep slopes are therefore considered to have elevated sensitivity from an ecological perspective. This applies to most of the mountain ridge that constitutes the main topographic feature on site.
» The number of internal access roads must be rationalised to reduce the overall impact. The current layout proposes a network of roads, which should be reduced to single connections between turbines. For example, between turbines 3, 4 and 5, the internal access roads are doubled up and should be reduced to a single road.
» A comprehensive search for threatened and near-threatened plant populations must be undertaken within the footprint of the proposed infrastructure prior to

construction. This walk-through survey should take place during an appropriate season to maximise the likelihood of detecting these plants. If any plants are found, localised modifications in the position of infrastructure must be made to avoid such populations and a suitable buffer zone around them.

» Natural drainage lines should be considered no-go areas to reduce potential erosion impacts.

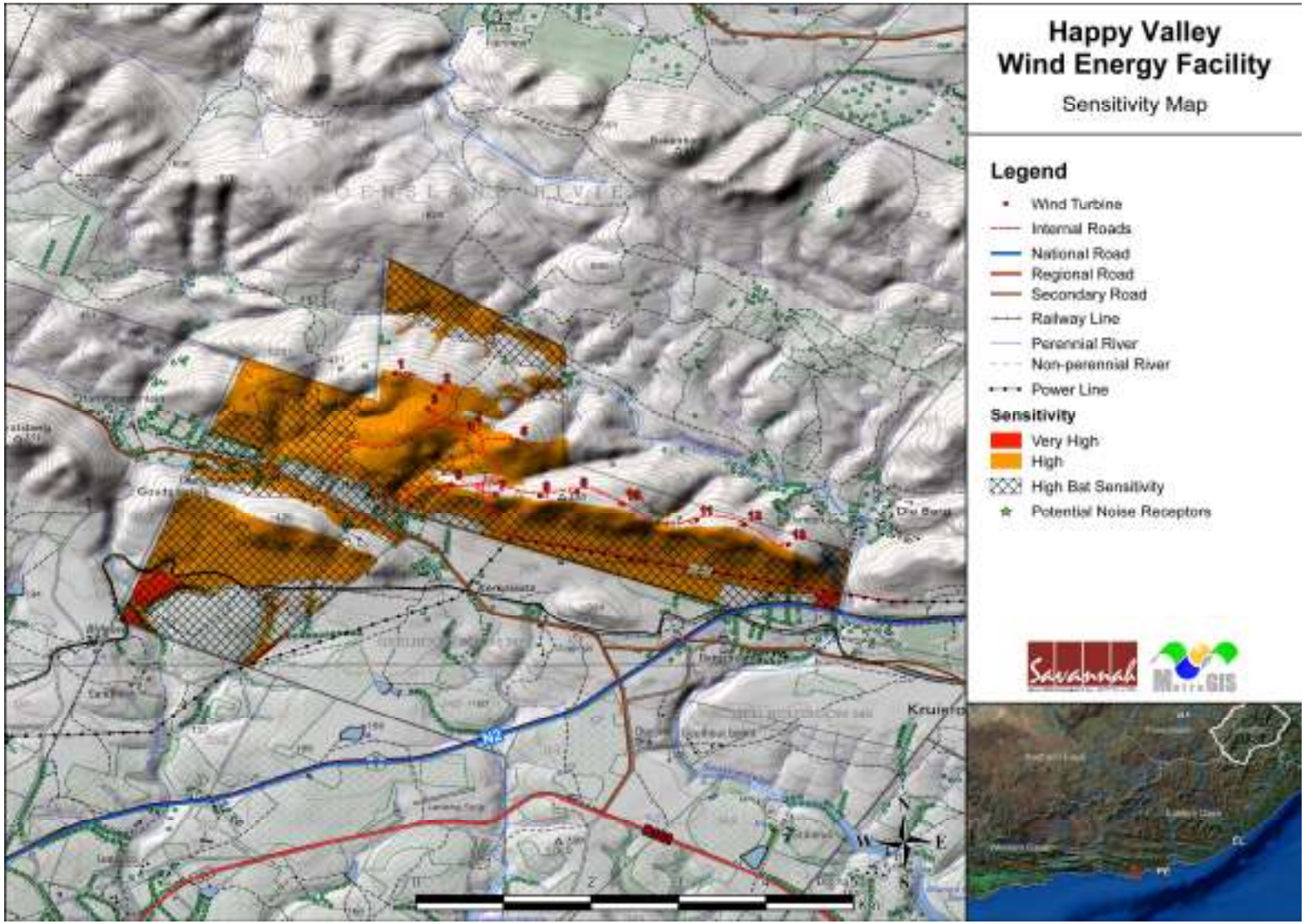

Figure 7.3: Combined sensitivity map for the project study area illustrating identified potentially sensitive areas in relation to the wind energy facility layout: areas of high and very high ecological sensitivity, areas of high bat sensitivity and potential noise receptors (refer to Appendix P for an A3-size version of this map)

» A comprehensive programme to fully monitor the actual impacts of the facility on the broader avifauna of the area be implemented to cover the pre-construction environment as well as the operational phase of the project (Appendix H and Appendix O).
» The workshop area, any interim construction facilities and temporary laydown areas should located away from any identified sensitive areas.
» The developer must consider the various mitigation options as suggested in the noise EIA assessment (Appendix M) to reduce the significance of the potential noise impact on any sensitive receptors to an impact of lower significance.

Internal access roads are required for construction and operation (maintenance) of wind turbines). Where possible, they will run along any existing roads or vehicle tracks. There are up to ~ 10 km of internal access roads proposed across the development footprint, however much of these (~5 km) will make use of existing access roads, so the length of new access roads would in reality be considerably less of this (approximately 5 km of new roads). The major impacts associated with the access roads will be the ecological impacts (potential impacts on wetlands, loss of habitat within indigenous natural vegetation types and spread of alien species), avifaunal impacts (habitat destruction and disturbance) and direct impacts on soil (soil erosion and degradation). These impacts can be successfully mitigated against if the mitigation measures proposed in the EIA specialist reports are implemented.

A *single substation* will be constructed within the site footprint. Each wind turbine will be connected to the proposed substation by underground electrical cables (33 kV cables). A new distribution power line is proposed to connect the substation in the facility to the Melkhout Substation approximately 12 km east of the site. The power line and substation infrastructure within the facility is not expected to be highly noticeable amidst the much taller wind turbines and are therefore not expected to pose a significant visual impacts. Some localised visual impacts may occur during the construction phase as trenching and backfilling will occur, but these activities and their related impacts are not expected to be significant in comparison the construction of the wind turbines.

4. *Impacts associated with the power line*

There are two alternatives for the power line which will link with the Melkhout Substation. The first alternative follows the alignment of the existing Eskom distribution power lines for the whole length of the alignment.

The second alternative follows the alignment the Eskom distribution lines for most of its alignment. For a short section, however, this alternative alignment branches

away from the existing Eskom line to follow the N2 for some distance, where after it rejoins the alignment of the Eskom line.

The construction of the power line will generally have medium to low impacts on the ecology of the study area.

Habitat destruction and disturbance with regard to avifauna associated with construction of the power lines and substation should be mitigated against. Electrocution on power line infrastructure has a potential impact on birds, which should be monitored through the proposed bird monitoring programme and mitigated through the use of bird diverters in areas where required.

It is clear from this map that the power line will be highly visible to the south, with less visual exposure to the north due to topography. Visual receptors include users of the N2, R102, R330, R332, Kruisfontein and a number of homesteads / settlements. It is noteworthy that the viewshed for the power line falls largely within that of the proposed turbines.

5. *Impacts on the social environment*

Based on the findings of the Social Impact Assessment, the landowners who stand to be directly affected by the proposed wind energy facility are not opposed to the development.

Impacts on the social environment are expected during both the construction phase and the operational phase of the wind energy facility. Impacts are expected at both a local and regional scale. Impacts on the social environment as a result of the construction of the wind energy facility can be mitigated to impacts of low significance or can be enhanced to be of positive significance to the region.

No construction crew camp will be established on the site, and construction workers will be housed in neighbouring formal towns. Construction activities on the site will be restricted to daylight hours.

The findings of the social impact study also indicate that the development will create employment and business opportunities for locals during both the construction and operational phase of the project. In order to enhance the local employment and business opportunities the mitigation measures listed in the report should be implemented. The mitigation measures listed in the report to address the potential negative impacts during the construction phase should also be implemented.

7.2. Cumulative Impacts

Based on the information available at the time of undertaking the EIA, it would appear that at least five other wind energy facilities are proposed in the immediate region. These include:

» the authorised RedCap Kouga Wind Energy Facility located ~9 km south of the site,
» the proposed Deep River Wind Energy Facility located ~10 km west of the site,
» the proposed Tsitsikamma Wind Energy Facility located ~15 km southwest of the site,
» the authorised Jeffrey's Bay Wind Energy Facility located ~20 km east of the site, and
» the proposed Oyster Bay Wind Energy Facility located ~15 km south of the proposed Happy Valley site.

The cumulative impacts associated with the proposed wind energy facilities from a social perspective relate largely to the impact on sense of place and visual impacts. The area designated for the proposed facility projects is rural and agricultural in nature. This impact will be exacerbated by the sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail) of the sites, specifically for motorists travelling along the N2. The dominant current land use activity in the area is livestock farming. The proposed wind energy facilities will alter the sense of place and the existing landscape which will be dominated by turbines. In this regard a number of residents in the immediate/local area to this site raised concerns regarding the cumulative impacts associated with the establishment of multiple wind energy facilities in the Humansdorp, Jeffreys Bay, St Francis Bay and Cape St Francis area. They were not opposed to wind energy *per se*, however, concerns were raised regarding the number of proposed facilities being mooted in the area.

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 ~4% (1667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

Through pre-feasibility assessments and research, the viability of establishing a wind energy facility on a site north-west of Humansdorp has been established by Renewable Energy Investments South Africa (REISA). The positive implications

of establishing a wind energy facility on the demarcated site within the Eastern Cape include:

» The project would assist the South African government in reaching their set targets for renewable energy.
» The potential to harness and utilise good wind energy resources at an inland site would be realised.
» The National electricity grid in the Eastern Cape 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 there are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation and management measures are implemented, and given due consideration during the process of finalising the wind energy facility layout.

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**.

The proposed substation position and power line corridors are considered to be acceptable from an environmental perspective. The proposed power line should follow the alignment **Alternative 1** in order to minimise potential visual and ecological impacts.

The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

7.3. Overall Recommendation

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 facility and associated substation and distribution power line, 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 Happy Valley Wind Energy Facility on a site near Humansdorp is not fatally flawed.

1. The visual impact associated with the facility is the primary impact which cannot be significantly mitigated. However the impact of high significance is restricted to within a distance of 5 - 10 km of the site. In terms of visual exposure, the facility a small facility, further reducing the potential visual impact. From a technical perspective, its location makes it highly desirable in terms of the overall efficiency of the plant.
2. The primary concerns related to this proposed project are due to impacts caused by the linear infrastructure, specifically the internal access roads, and not to the turbines and/or substation. However correct placement of infrastructure and the application of mitigation measures listed in this EIA report will reduce any associated potential ecological impacts to acceptable levels.

The following infrastructure would be included within an authorisation issued for the project:

» Construction of the Wind Energy Facility with up to **20 wind turbine units**, and all **associated infrastructure** (access roads to site, internal access roads, workshop building)
» Construction of a single **substation** on the site at the position proposed in Figure 7.1.
» **Overhead power line** (of up to 132kV) linking the wind energy facility to the Eskom electricity distribution network via the existing Melkhout Substation as proposed in Figure 7.1 to follow the proposed **Alternative 1** route.

The following conditions would be required to be included within an authorisation issued for the project:

» Mitigation measures detailed within this report and the specialist reports contained within Appendices F to N be implemented.
» The draft Environmental Management Plan (EMP) as contained within Appendix O of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed wind 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 to be key in achieving the appropriate environmental management standards as detailed for this project.
» Natural drainage lines should be considered no-go areas to reduce potential erosion impacts.
» Disturbed areas should be rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.

- During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum. The wind turbines and access road infrastructure should be positioned on the northern slope of the ridgeline to reduce impacts on sensitive ecological areas on the southern slope.
- A comprehensive stormwater management plan should be compiled for the substation footprints prior to construction.
- Mitigate secondary visual impacts associated with the construction of roads through the use of existing roads wherever possible. Where new roads are required, these should be planned taking 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 properly, with adequate drainage structures in place to forego potential erosion problems. Roads should be positioned behind (i.e. on the north side) of the crest of the ridge wherever possible. Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.
- A monitoring program should be initiated in order to collect data on the numbers of birds affected by the wind energy facility.
- The developer should consider the various mitigation options as proposed in the noise assessment to reduce the significance of the potential noise impact on any sensitive receptors.
- Applications for all other relevant and required permits required to be obtained by REISA and 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.

REFERENCES CHAPTER 8

Acha, A. 1997. Negative impact of wind generators on the Eurasian Griffon Gyps fulvus in Tarifa, Spain. Vulture News 38:10-18

Acocks, J.P.H. 1988. Veld types of South Africa (3rd edn.). Mem. Bot. Surv. S. Afr. No 28. Government printer, Pretoria.

Alexander, G. & MARAIS, J. 2007. A guide to the reptiles of southern Africa. Struik, Cape Town.

Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

ARC-ISCW, 2004. Overview of the status of the agricultural natural resources of South Africa (First Edition). ARC-Institute for Soil, Climate and Water, Pretoria

Avian Powerline Interation Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electric Institute. Washington DC.

Barclay, R.M.R, Baerwald, E.F. & Gruver, J.C. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology 85: 381-387.

Barnes, K.N. (ed.) (2000) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

Barnes, K.N. (ed.) 1998. The Important Bird Areas of southern Africa. BirdLife South Africa, Johannesburg.

Barnes, K.N. (ed.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Barrios, L. & Rodríguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81.

Berliner, D. & Desmet, P. 2007. Eastern Cape Biodiversity Conservation Plan Technical Report. Department of Water Affairs and Forestry Project No. 2005 - 012, Pretoria.

Bevanger, K. 1994. Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. Ibis 136: 412-425.

Bevanger, K. 1995. Estimates and population consequences of Tetraonid mortality caused by collisions with high tension power lines in Norway. Journal of Applied Ecology 32: 745-753.

Bevanger, K. 1998. Biological and conservation aspects of bird mortality caused by electric power lines. Biological Conservation 86: 67-76.

Binneman, J.N.F. & Hall, S.L. 1993. The context of four painted stones from the Eastern Cape. Southern African Field Archaeology 2:89-95.

Binneman, J.N.F. 2001. An introduction to a Later Stone Age coastal research project along the south-eastern Cape coast. Southern African Field Archaeology 10:75-87.

Binneman, J.N.F. 2005.Archaeological research along the south-eastern Cape coast part1: open-air shell middens Southern African Field Archaeology 13 & 14:49-77. 2004/2005.

Binneman, J.N.F. 1996. The symbolic construction of communities during the Holocene Later Stone Age in the south-eastern Cape. Unpublished D.Phil. thesis: University of the Witwatersrand.

Binneman, J.N.F. 1997. Results from a test excavation at The Havens Cave, Cambria, south- eastern Cape. Southern African Field Archaeology 6:93-105.

Binneman, J.N.F. 1998. Results from a test excavation at Kleinpoort Shelter in the Baviaanskloof, Eastern Cape Province. Southern African Field Archaeology 7:90-97.

Binneman, J.N.F. 1999a. Results from a test excavation at Groot Kommandokloof Shelter in the Baviaanskloof/Kouga region, Eastern Cape Province. Southern African Field Archaeology 8:100-107.

Binneman, J.N.F. 1999b. Mummified human remains from the Kouga Mountains, Eastern Cape. The Digging Stick 16:1-2.
Binneman, J.N.F. 2000. Results from two test excavations in the Baviaanskloof Mountains, Eastern Cape Province. Southern African Field Archaeology 9:81-92.

Boshoff, A., Barkhuysen, A., Brown, G. & Michael, M. 2009. Evidence of partial migratory behavior by the Cape Griffon. Ostrich 80: 129-133.

Branch, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.

Brink, A.B.A. (1979) Engineering Geology of South Africa (Series 1-4). Building Publications, Pretoria.

Butzer , K.W. 1978. Sediment stratigraphy of the Middle Stone Age sequence at Klasies River Mouth, Tsitsikama Coast, South Africa. South African Archaeological Bulletin 33:141-151.

Carrion, J.S., Brink, J.S., Scott, L. & Binneman, J.N.F. 2000. Palynology and palaeoenvironment of Pleistocene coprolites from an open-air site at Oyster Bay, Eastern Cape coast. South African Journal of Science 96:449-453.

Carrion, J.S., Brink, J.S., Scott, L. & Binneman, J.N.F. 2000. Palynology and palaeoenvironment of Pleistocene coprolites from an open-air site at Oyster Bay, Eastern Cape coast. South African Journal of Science 96:449-453.

Crockford, N.J. 1992. A review of the possible impacts of wind farms on birds and other wildlife. Joint Nature Conservation Committee. JNCC Report number 27. Peterborough, United Kingdom.

Curry, R.C., & Kerlinger, P. 2000. Avian mitigation plan: Kenetech model wind turbines, Altamont Pass WRA, California. In: Proceedings of the National Avian-Wind Power Planning Meeting III, San Diego California, May 1998.

Curtis, O., Simmons, R.E. & Jenkins, A.R. 2004. Black Harrier Circus maurus of the Fynbos biome, South Africa: a threatened specialist or an adaptable survivor? Bird Conservation International 14: 233-245.

De Lucas, M., Janss, G.F.E., Whitfield, D.P. & Ferrer, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. Journal of Applied Ecology 45: 1695-1703.

De Villiers, H. 1965. Skeletal remains from the Gamtoos Valley. South African Archaeological Bulletin 20:201-213.

Deacon, H. J & Shuurman,R. 1992. The origins of modern people: the evidence from Klasies River. In:Bräuer, G. & Smith, F. H., eds, Continuity or replacement: controversies in Homo sapiensevolution. Rotterdam: Balkema, pp. 121–9.

Deacon, H. J. & Wurz, S. 1996. Klasies River Main Site, Cave 2: a Howiesons Poort occurrence. In: Pwiti, G. & Soper, R., eds, Aspects of African Archaeology. Harare: University of Zimbabwe Publications, pp. 213–8.

Deacon, H.J. & Geleijnse, V. 1988. The stratigraphy and sedementtology of the Main Site sequence at Klasies River, South Africa. South African Archaeological Bulletin 43:5-14.

Deacon, H.J. & Deacon, J. 1999.Human beginings in South Africa: uncovering the secrets of the Stone Age. Cape Town: David Phillips Publishers.

Deacon, H.J. 1967. Two radiocarbon dates from Scott's Cave, Gamtoos Valley. South African Archaeological Bulletin 22:51-52.

Deacon, H.J. 1992. Southern Africa and modern human origins. Philosophical Transactions of the Royal Society, London 337: 177–83.

Deacon, H.J. 1993. Southern Africa and modern human origins. In: Aitken, M. J., Stringer, C. B. & Mellars, P. A., eds, The origin of modern humans and impact of chronometric dating. Princeton: Princeton University Press, pp. 104–17.

Deacon, H.J. 2001. Modern human emergence: an African archaeological perspective. In: Tobias, P. V., Raath, M. A., Moggi-Cecchi, J. & Doyle, G. A., eds, Humanity from African Renais-sance to coming Millennia. Johannesburg: University of the Witwatersrand Press, pp. 213–22.

Deacon, J. 1965. Cultural material from the Gamtoos River Valley shelters (Andrieskraal). South African Archaeological Bulletin 20:139-200.

Devereaux, C/L., Denny, M.J.H. & Whittingham, M.J. 2008. Minimal effects of wind turbines on the distribution of wintering farmland birds. Journal of Applied Ecology 45: 1689-1694.

Drewitt, A.L. & Langston, R.H.W. 2006. Assessing the impacts of wind farms on birds. Ibis 148: 29-42.

Drewitt, A.L. & Langston, R.H.W. 2008. Collision effects of wind-power generators and other obstacles on birds. Annals of the New York Academy of Science 1134: 233-266.

Driver, A., Maze, K., Rouget, M., Lombard, A.T., Nel, J., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K and Strauss, T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia 17. South African National Biodiversity Institute, Pretoria.

Du Preez, L. & Carruthers, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik (Pty) Ltd, Cape Town.

Eastern Cape State of the Environment Report, 2004.

Erickson, W.P., Johnson, G.D., Strickland, M.D., Young, D.P., Sernka, K.J., Good, R.E. 2001. Avian collisions with wind turbines: a summary of existing studies and comparison to other sources of avian collision mortality in the United States. National Wind Co-ordinating Committee Resource Document.

Everaert, J. 2003. Wind turbines and birds in Flanders: Preliminary study results and recommendations. Natuur. Oriolus 69: 145-155.

Fairbanks, D.H.K., Thompson, M.W., Vink, D.E., Newby, T.S., Van Den Berg, H.M & Everard, D.A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. S.Afr.J.Science 96: 69-82.

Farfán, M.A., Vargas, J.M. & Duarte, J. 2009. What is the impact of wind farms on birds. A case study in southern Spain. Biodiversity Conservation 18: 3743-3758.

FRIEDMANN, Y. & DALY, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

Geological Survey, 1995. 1:250 000 scale geological map 3226 Grahamstown. Department of Mineral and Energy Affairs, Pretoria.

Germishuizen, G., Meyer, N.L., Steenkamp, Y And Keith, M. (eds.) (2006). A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41, SABONET, Pretoria.

Gill, J.P., Townsley, M. & Mudge, G.P. 1996. Review of the impact of wind farms and other aerial structures upon birds. Scottish Natural Heritage Review 21.

GROOMBRIDGE, B. (ed.) 1994. 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland.

Hanowski, J.M., & Hawrot, R.Y. 2000. Avian issues in development of wind energy in western Minnesota. In Proceedings of the National Avian-Wind Power Planning Meeting III, San Diego California, May 1998.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa, Johannesburg.

Henderson, Z. & Binneman, J.N.F. 1997. Changes in the significance of a site: Klasies River complex in the Middle and Later Stone Ages. In: Bosal, C. & Smith, C. (eds) The human use of caves. Edinburgh: Edinburgh University Press.

Henderson, Z. 1992. The context of some Middle Stone Age hearths at Klasies River Shelter 1B: implications for understanding Human behaviour. Southern African Field Archaeology 1:14-26.

Henning, S.F. & Henning, G.A. 1989. South African Red Data Book - Butterflies. South African National Scientific Programmes No. 158, Foundation for Research Development, CSIR, Pretoria.

Hoare, D.B., Mucina, L., Rutherford, M.C., Vlok, J., Euston-Brown, D., Palmer, A.R., Powrie, L.W., Lechmere-Oertel, R.G., Proches, S.M., Dold, T. And Ward, R.A. Albany Thickets. in Mucina, L. and Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19, South African National Biodiversity Institute, Pretoria.

Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (Eds) 2005. Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Hodos, W. 2002. Minimization of motion smear: Reducing avian collisions with turbines. Unpublished subcontractor report to the National Renewable Energy Laboratory. NREL/SR 500-33249.

Howell, J.A. 1995. Avian mortality at rotor sweep areas equivalents Altamont Pass and Montezuma Hills, California. Prepared for Kenetech Wind Power, San Francisco, California.
Identification of Problematic Soils in Southern Africa (2007). Technical notes for civil and structural engineers. Published by the Department of Public Works.

IUCN (2001). IUCN Red Data List categories and criteria: Version 3.1. IUCN Species Survival Commission: Gland, Switzerland.

Janss, G. 2000a. Bird behaviour in and near a wind farm at Tarifa, Spain: Management considerations. In: Proceedings of National Avian-Wind Power Planning Meeting III, San Diego California, May 1998.

Janss, G.F.E. 2000b. Avian mortality from power lines: a morphologic approach of a species-specific mortality. Biological Conservation 95: 353-359.

Jaroslow, B. 1979. A review of factors involved in bird-tower kills, and mitigation procedures. In: G.A. Swanson (Tech co-ord). The Mitigation symposium. A

national workshop on mitigation losses of Fish and Wildlife Habitats. US Forest Service General Technical Report. RM-65.

Jenkins, A.R. 1994. The influence of habitat on the distribution and abundance of Peregrine and Lanner Falcons in South Africa. Ostrich 65:281-290.

Jenkins, A.R. 2001. The potential impact of a demonstration wind farm facility on the birds of the Darling / Yzerfontein area, Western Cape Province, South Africa. Unpublished report to the Environmental Evaluation Unit, University of Cape Town, Cape Town.

Jenkins, A.R. 2003. Populations and movements of priority bird species in the vicinity of the proposed Darling Demonstration Wind Farm facility. Unpublished report to the Environmental Evaluation Unit, University of Cape Town, Cape Town.

Jenkins, A.R. 2008a. Eskom generation wind energy facility – Western Cape: Avifaunal impact assessment. Report to Savannah Environmental Pty (Ltd).

Jenkins, A.R. 2008b. Environmental impacts on birds of Eskom's proposed 66 kV overhead power line between the Skoongesig substation and St Helena Bay, with comments on the preferred line route. Report to EnviroAfrica.

Jenkins, A.R. 2009. Hopefield wind energy facility: avifaunal impact assessment. Report to Savannah Environmental Pty (Ltd).
Jenkins, A.R., Smallie, J.J. & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International.

Kareedouw, in the southern Cape. Transactions of the Royal Society of South Africa 31:283-313.

Kemper, C.A. 1964. A tower for TV: 30 000 dead birds. Audubon Magazine 66: 86-90.

Kerlinger, P. & Dowdell, J. 2003. Breeding bird survey for the Flat Rock wind power project, Lewis County, New York. Prepared for Atlantic Renewable Energy Corporation.

King, D.I. & Byers, B.E. 2002. An evaluation of powerline rights-of-way as habitat for early-successional shrubland birds. Wildlife Society Bulletin 30: 868-874.

Kingsley, A. & Whittam, B. 2005. Wind turbines and birds – A background review for environmental assessment. Unpublished report for Environment Canada/Canada Wildlife Service.

Klein, R.G. 1976. The mammalian fauna from the Klasies River Mouth sites, southern Cape Province, South Africa. South African Archaeological Bulletin 3:75-98.

Klein, R.G. & Scott, K. 1974. The fauna of Scott's Cave, Gamtoos Valley, Southeastern Cape Province. South African Journal of Science 70:186-187.

Koch, F.G.L., 2003. Land types of the maps 3224 Graaf-Reinet and 3324 port Elizabeth (Climate). Mem. Nat. Agric. Res. S. Afr. No. 33. ARC-Institute for Soil, Climate and Water, Pretoria.

Kopke, D. 1988. The climate of the Eastern Cape. In: M.N. Bruton & F.W. Gess. (ed.) Towards an environmental plan for the Eastern Cape. Rhodes University, Grahamstown.

Kouga Local Municipality Integrated Development Plan (IDP) (2007-2012)

Krijgsveld, K.L., Akershoek, K., Schenk, F., Dijk, F. & Dirksen, S. 2009. Collision risk of birds with modern large wind turbines. Ardea 97: 357-366.
Küyler, E.J. 2004. The impact of the Eskom Wind Energy Demonstration Facility on local avifauna – Results from the monitoring programme for the time period June 2003 to Jan 2004. Unpublished report to Eskom Peaking Generation.

Kuvlevsky, W.P. Jnr, Brennan, L.A., Morrison, M.L., Boydston, K.K., Ballard, B.M. & Bryant, F.C. 2007. Wind energy development and wildlife conservation: challenges and opportunities. Journal of Wildlife Management 71: 2487-2498.

Larsen, J.K. & Guillemette, M. 2007. Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk. Journal of Applied Ecology 44: 516-522.

Lehman, R.N., Kennedy, P.L. & Savidge, J.A. 2007. The state of the art in raptor electrocution research: a global review. Biological Conservation 136: 159-174.

Low, A.B. & Rebelo, A.G. (1998) Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

Macvicar, C. N., Scotney, D. M. Skinner, T. E. Niehaus, H. S. & Loubser, J. H., 1974. A classification of land (climate, terrain form, soil) primarily for rainfed agriculture. S. Afr. J. Agric. Extension, 3(3): 1-4.

MacVicar, C.N., de Villiers, J.M., Loxton, R.F, Verster, E., Lambrechts, J.J.N., Merryweather, F.R., le Roux, J., van Rooyen, T.H. & Harmse, H.J. von M., 1977.

Soil classification. A binomial system for South Africa. ARC-Institute for Soil, Climate & Water, Pretoria.

Madders, M. & Whitfield, D.P. 2006. Upland raptors and the assessment of wind farms impacts. Ibis 148: 43-56.

McIsaac, H.P. 2001. Raptor acuity and wind turbine blade conspicuity. Pp. 59-87. National Avian-Wind Power Planning Meeting IV, Proceedings. Prepared by Resolve, Inc., Washington DC.

Mills, G. & Hes, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. And Kloepfer, D. (eds.) 2004. Atlas and Red Data Bookof the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, DC.
Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. DA (eds.) Hotspots revisited. CEMEX, pp.218–229. ISBN 968-6397-77-9.

Mucina, L, Bredenkamp, G.J., Hoare, D.B & Mcdonald, D.J. 2000. A National Vegetation Database for South Africa South African Journal of Science 96: 1–2.

MUCINA, L. AND RUTHERFORD, M.C. (editors) (2006). Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. Strelitzia 19, National Botanical Institute, Pretoria.

Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria.

Mucina, L., Rutherford, M.C. And Powrie, I.W. (editors) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 SCALE SHEET MAPS South African National Biodiversity Institute, Pretoria.

Mucina, L., Rutherford, M.C., Hoare, D.B. & Powrie, L.W. 2003. VegMap: The new vegetation map of South Africa, Lesotho and Swaziland. In: Pedrotti, F. (ed.) Abstracts: Water Resources and Vegetation, 46th Symposium of the International Association for Vegetation Science, June 8 to 14 – Napoli, Italy.

Mucina. L. & Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Mueller-Dombois, D. And Ellenberg, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

National Wind Co-ordinating Committee. 2004. Wind turbine interactions with birds and bats: A summary of research results and remaining questions. Fact Sheet, Second Edition.

Newton, I. & Little, B. 2009. Assessment of wind-farm and other bird casualties from carcasses found on a Northumbrian beach over an 11-year period. Bird Study 56: 158-167.

Norton, M.P. and Karczub, D.G.: Fundamentals of Noise and Vibration Analysis for Engineers, Second Edition, 2003.

Oosthuizen, A.B., De Corte, A.W.M., Schloms, B.H.A., Rudman, R.B., Robertson, T.A., and Fullstone, M.J., 2001. Land types of the map 3324 Port Elizabeth. Field information. Mem. Nat. Agric. Res. S. Afr. No. 26. ARC-Institute for Soil, Climate and water, Pretoria.

Passmore, N.I. & Carruthers, V.C. (1995) South African Frogs; a complete guide. Southern Book Publishers and Witwatersrand University Press. Johannesburg.

Pierce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. 2009. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology, Published Online, September 24, 2009.

Rebelo, A.G., Boucher, C., Helme, N., Mucina, L. & Rutherford, M.C. 2006. Fynbos Biome. in Mucina, L. and Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19, South African National Biodiversity Institute, Pretoria.

Richardson, W.J. 2000. Bird migration and wind turbines: Migration timing, flight behaviour and collision risk. In Proceedings of the National Avian-wind Power Planning Meeting III, San Diego, California, May 1998.

Rightmire, G.P. & Deacon, H.J. 1991. Comparative studies of Late Pleistocene human remains from Klasies River Mouth, South Africa. Journal of Human Evolution 20:131-156.

RUTHERFORD, M.C. & WESTFALL, R.H. (1994). Biomes of southern Africa: an objective categorization. Memoirs of the Botanical Survey of South Africa No. 63.

SACS (1980). Stratigraphy of South Africa. Handbook 8, Geological Survey, Department of Mineral and Energy Affairs, Government Printer, 690pp.

SANS 0103:2004. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.

SANS 0210:2004. 'Calculating and predicting road traffic noise'.

SANS 0357:2004 The calculation of sound propagation by the Concave method'.

SANS 10328:2003. 'Methods for environmental noise impact assessments'.

SCHULZE, B.R. 1984. Climate of South Africa, Part 8, General Survey, WB 28. South African Weather Bureau 60. Government Printer, Pretoria.

Shaw, J., Jenkins, A.R. & Ryan, P.G. In prep. The end of the line for South Africa's national bird? Modelling collision risk for the Blue Crane.

Singer, R. & Wymer, J. 1982. The Middle Stone Age at Klasies River Mouth in South Africa. Chicago: University of Chicago Press.

Skeleton, P. 2001. A complete guide to the freshwater fishes of southern Africa. Struik Publishers, Cape Town.

Smallwood, K.S. & Thelander, C. 2008. Bird mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72: 215-223.

Smallwood, K.S., Rugge, L. & Morrison, M.L. 2009. Influence of behavior on bird mortality in wind energy developments. Journal of Wildlife Management 73: 1082-1098.

South African Weather Service.

Sovacool, B.K. 2009. Contextualizing avian mortality: a preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity. Energy Policy 37: 2241-2248.

Steenkamp, Y., Van Wyk, A.E., Victor, J.E., Hoare, D.B., Dold, A.P., Smith, G.F. & Cowling, R.M. 2005. Maputaland-Pondoland-Albany Hotspot. In: Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux,

J. & Fonseca, G.A.B. da (eds.) Hotspots revisited. CEMEX, pp.218–229. ISBN 968-6397-77-9

Steenkamp, Y., Van Wyk, A.E., Victor, J.E., Hoare, D.B., Dold, A.P., Smith, G.F. & Cowling, R.M. 2004. Maputaland-Pondoland-Albany Hotspot. In: Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. da (eds.) Hotspots revisited. CEMEX, pp.218–229. ISBN 968-6397-77-9

Stewart, G.B., Pullin, A.S. & Coles, C.F. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation 34: 1-11.

Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape. Towards a Regional Methodology for Wind Energy Site Selection (May 2006).

The Assessment and Rating of Noise from Wind Farms: Working Group on Noise from Wind Turbines, September 1996.

The White Paper on the Energy Policy of the Republic of South Africa, December 1998.

Van Rooyen, C. 2001. Bird Impact Assessment Study – Eskom Wind Energy Demonstration Facility, Western Cape South Africa. Prepared for Eskom Enterprises, TSI Division.

Van Rooyen, C.S. 2004a. The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

Van Rooyen, C.S. 2004b. Investigations into vulture electrocutions on the Edwardsdam-Mareetsane 88kV feeder, Unpublished report, Endangered Wildlife Trust, Johannesburg.

Van Wyk, A.E. & Smith, G.F. 2001. Regions of floristic endemism in southern Africa. Umdaus press, Hatfield.

Weather Bureau 1996. Climate data for stations from the Eastern Cape.

Weir, R. D. 1976. Annotated bibliography of bird kills at manmade obstacles: a review of the state of the art and solutions. Canadian Wildlife Services, Ontario Region, Ottawa.

Wells, M.J. 1965. An analysis of plant remains from Scott's Cave in the Gamtoos Valley. South African Archaeological Bulletin 20:79-84.

Westhoff, V. And Van Der Maarel, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.
WHITE, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNISO vegetation map of Africa. Natural Resources Research 20. Unesco, Paris.

Wienert, H. H. (1980). The Natural Road Construction Materials of Southern Africa. H&R Academia Publ., Pretoria, 298pp.

Winkelman, J.E. 1995. Bird/wind turbine investigations in Europe. In Proceedings of the National Avian- wind Power Planning Meeting 1994.

Wurz, S. 1999. The Howiesons Poort backed artefacts from Klasies River: an argument for symbolic behaviour. South African Archaeological Bulletin 54: 38–50.

Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D. & Colahan, B.D. (eds). 2003. Big birds on farms: Mazda CAR report 1993-2001. Avian Demography Unit, Cape Town.

Internet Sources

Dent, M.C., Lynch, S.D. & Schulze, R.E. 1989. Mapping mean annual and other rainfall statistics in southern Africa. Department of Agricultural Engineering, University of Natal. ACRU Report No. 27. Massachusetts: Clark University.
Department of Water Affairs website (www.dwaf.gov.za).

Steenkamp, Y., van Wyk, A.E., Victor, J.E., Hoare, D.B., Dold, A.P., Smith, G.F. & Cowling, R.M. 2005. Maputaland-Pondoland-Albany Hotspot. http://www.biodiversityhotspots.org/xp/hotspots/maputaland/.

www.demarcation.org.za (Census 2001 data).

http://www.ecprov.gov.za (accessed in May 2010)

South African National Biodiversity website (www.sanbi.org).